2022 Annual Performance Report

Aberthaw Ash Disposal Site

Permit Number: DP3432SW

March 2023

RWE
The energy to lead

Summary

This document gives details on the performance of RWE Generation UK plc's Aberthaw Ash Disposal Site throughout 2022, as required by condition 4.2.1 of the site's Environmental Permit (EP), DP3432SW.

CONTENTS

1. Operational Update

Aberthaw Ash Disposal Site historically reached its maximum allowable height and has been restored as per plans approved by the Local Authorities.

There were no changes to the operational activities and no Environmental Permit variations associated with the Ash Mound during 2022. The Ash Mound, as part of the wider Aberthaw Power Station Site, is in the process of being sold to a new landowner. It is expected that the associated permit transfer application will be determined during early 2023.

2. Review of Results for Emission Monitoring

Four groundwater monitoring visits were undertaken by a specialist contractor during 2022:

- 23rd February 2022 (Q1 Visit)
- 28th April 2022 (Q2 Visit)
- 21st July 2022 (Q3 Visit)
- 13th October 2022 (Q4 Visit)

Please note that BH11A could not be sampled in Q3 and Q4 as it was dry. BH9B and BH11B also have no parameter data for Q4 due to respective labelling errors and time constraints (as reported significantly after the fact by the sampling contactor). A complaint was raised directly with the sampling contractor when the Q4 issue became known by RWE in late January 2023.

2.1. Hydrogeological Risk Assessment Review

In accordance with Environmental Permit DP3432SW there is a requirement to undertake a 6-yearly review of the HRA. This was last completed in early 2018 by an external specialist consultant.

2.2. Groundwater Quality Review

Monitoring Objective

To carry out routine monitoring of groundwater to monitor the performance of the ash disposal site by measurement of absolute levels and concentrations and trends relative to relevant criteria including background levels and concentrations, control levels and compliance limits.

Number and Location of Monitoring Points

A summary of the monitoring boreholes is provided in Table 1 below and the locations are shown in Appendix A. There are 7 boreholes in natural ground, of which 5 are completed in the Porthkerry Member limestone and 2 in the Alluvium (clay). There are 2 shallow boreholes in fill material, BH7A with a response zone partly in clay fill and BH11A with a response zone partly in fill containing coal ash.

Groundwater flow beneath the ash disposal site is directed towards the River Thaw to the west and the sea to the south. Due to the ash disposal site's contact with the sea, the southern boundary of the site is a downgradient boundary. There are 4 boreholes on this boundary, BH10B, BH11B, BH7B and BH9B, with an average spacing of approximately 250m. The two shallow boreholes, BH7A and BH11A are situated close to boreholes BH7B and BH11B respectively. There is also 1 borehole, BH3B on the western downgradient boundary. Borehole BH8B was found damaged in Q2 2017 and a representative sample was unable to be obtained for the remainder of 2017. Following the outcome of the HRA review in 2018, sampling of BH8B was suspended. Please note that a replacement for BH8A & BH8B was installed in February 2021.

BH6 and BH5 are located on the eastern boundary with an average spacing of approximately 750m and as both response zones are overlain by PFA they cannot be considered truly upgradient. Upgradient monitoring boreholes at the nearby Aberthaw Quarry Ash Disposal Site (Environmental Permit BP3339BH) could be used as an indication of upgradient groundwater quality data for the limestone aquifer.

Table 1: Summary of Monitoring Boreholes

Monitoring Borehole	Formation Sampled	Lithology Type – Natural (N) Imported Fill (F)	Response Zone Depth (m b GL)	Geological Barrier Thickness above Response Zone (m)	Other Lithology above Response Zone
BH3B	Limestone	N	13.5-23.0	6	PFA: 6m
BH5	Limestone	N	2.5-11.5	0	PFA: 1.5m
BH6	Limestone	N	13.0-20.5	0	PFA: 12.2m
BH7A	Clay fill and Gravelly clay	F/N	2.0-9.5	8	PFA: 1.5m
BH7B	Limestone	N	17.0-26.0	3.9	Fill: 7.4m Sand & gravel: 5.7
BH8A	Limestone	N	5.3-7.0m	0	PFA: 5.3m
BH8B	Limestone	N	30.0-38.0m	0	PFA: 5.3m
BH9B	Limestone	N	6.0-13.0	0	PFA: 3m
BH10B	Clay	N	23.0-30.0	6.6	Fill: 2.8m Sand: 13m
BH11A	Fill – ash and clay	F	1.5-5.0	0	N/A
BH11B	Clay	N	9.5–19.0	4.5	Fill: 4.9m

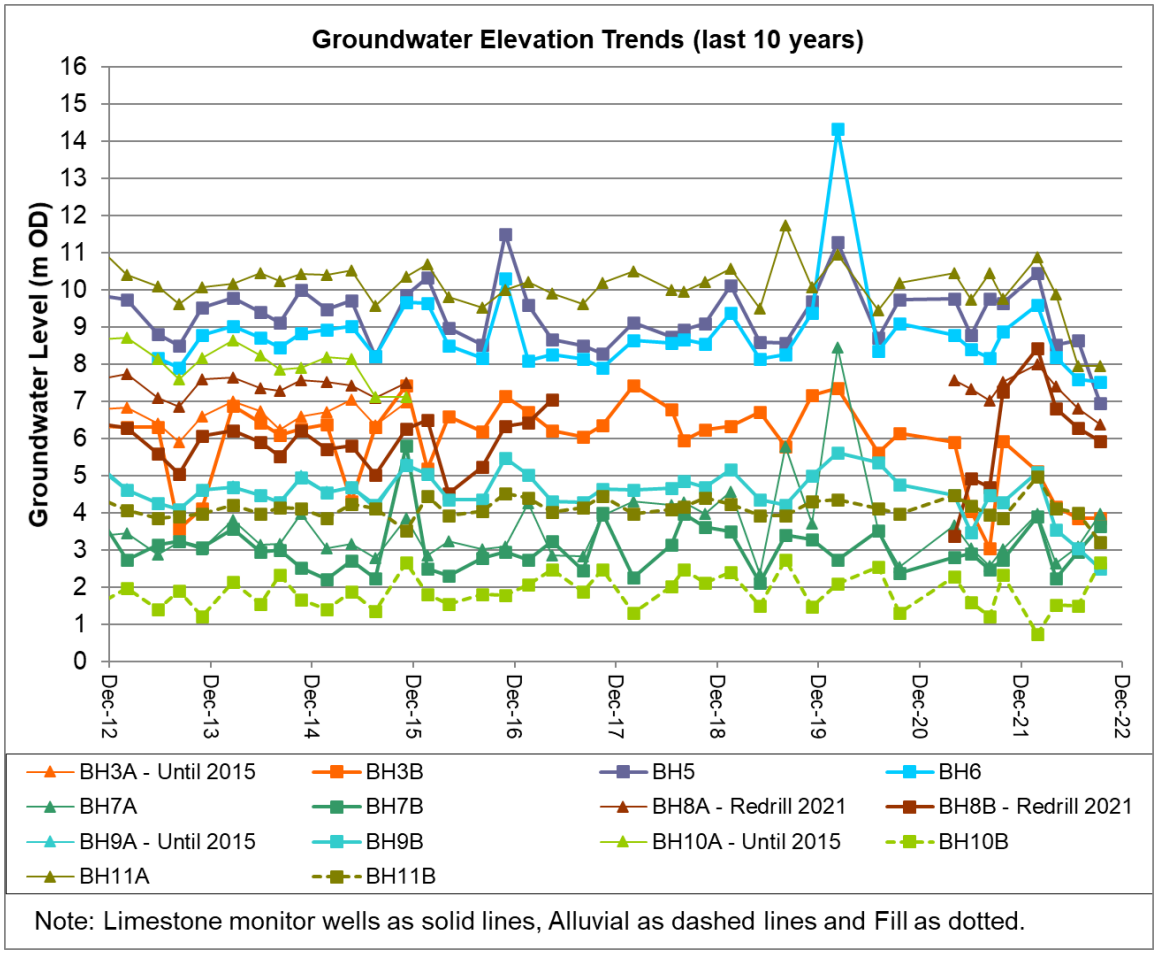
Note: mb GL – metres below ground level

Monitoring Measurements

The groundwater monitoring analytical suite contains a range of parameters which are monitored on a quarterly basis along with groundwater level and standard field measurements in accordance with the Environmental Permit. RWE employ the services of an independent external contractor for the sampling of groundwater boreholes and an independent external laboratory is used for the analysis of those samples.

Figure 1 shows recorded groundwater elevations for the previous 10 years. These vary between +0.75 (BH10B) to +14m OD (BH6) with groundwater elevations in limestone boreholes being characterised by seasonal cyclic water level fluctuations associated with annual winter influxes of rainfall recharge.

Figure 1: Groundwater Hydrograph



Note: Limestone monitor wells as solid lines, Alluvial as dashed lines and Fill as dotted.

Figure 2 shows the groundwater control charts with concentrations of boreholes plotted. It should be noted that the compliance limits and control levels (where defined) apply to boreholes BH3B and BH7B. An exceedance is defined as a result above the compliance limit or control level for 3 consecutive sampling events.

In 2022, there were no exceedances of the compliance limit or control level for any critical parameters for either of the compliance boreholes. In line with historical trends, elevated concentrations in BH3B of arsenic, boron, molybdenum, sulphate and vanadium were observed. In BH7B elevated concentrations of boron, molybdenum, sulphate and ammoniacal-nitrogen were observed.

The control charts show there are no increasing trends in critical parameter concentrations. Other key points to note are:

- Low and generally stable trends for cadmium, mercury, aluminium and chromium.
- Highly variable ammoniacal nitrogen concentrations in BH10B.
- Elevated sulphate, boron and molybdenum in most boreholes.

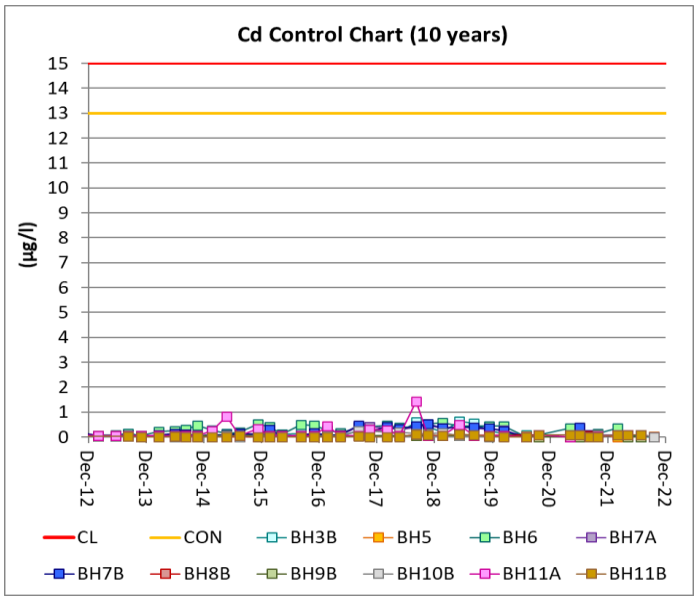
For information, trends for the other monitored parameters (i.e. those without an applied Control Level or Compliance Limit) have been attached within Appendix B. A general summary of Groundwater & Surface Water Quality over the last 10 years has also been included within Appendix C.

Please note that the historic datasets for all the borehole, and surface water, locations have been adapted for the purpose of assessment and trend plotting. For many of the parameters a significant proportion of the results are routinely reported by the external accredited laboratory as being below the limit of detection (LOD), the value of which generally decreases as individual methods are developed/improved over time. Historically the <LOD results have been automatically plotted by Excel as 'zeros' which has resulted in a significant skewing of the trends. In line with other RWE sites, and in accordance with available guidance[1], consideration has been given to how these <LOD results should be handled. The main options considered were:

- Remove <LOD results from the dataset or replace with a zero value – discounted as this heavily skews the dataset.
- Replace <LOD results with the LOD value – As early LOD values can be significantly higher than current analysis trends direct substitution with the LOD value does result in unrealistic skewing of the dataset.
- Replace <LOD results with half of the LOD value – this generally accepted approach ultimately provides better representation as it reduces the unavoidable skewing effect of the substitution.

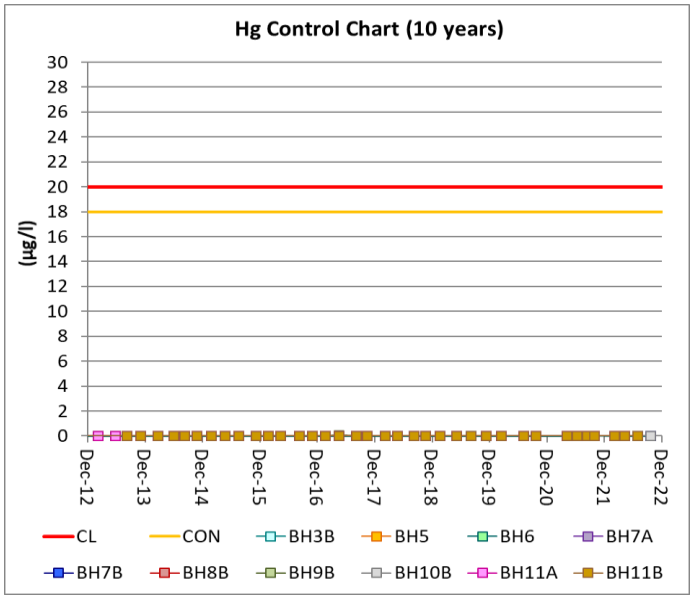
For the purposes of this this report all <LOD values have therefore been substituted with values of half the LOD applicable at the time of analysis.

Figure 2: Control charts for groundwater boreholes
(CL – Compliance Limit, CON – Control Level)

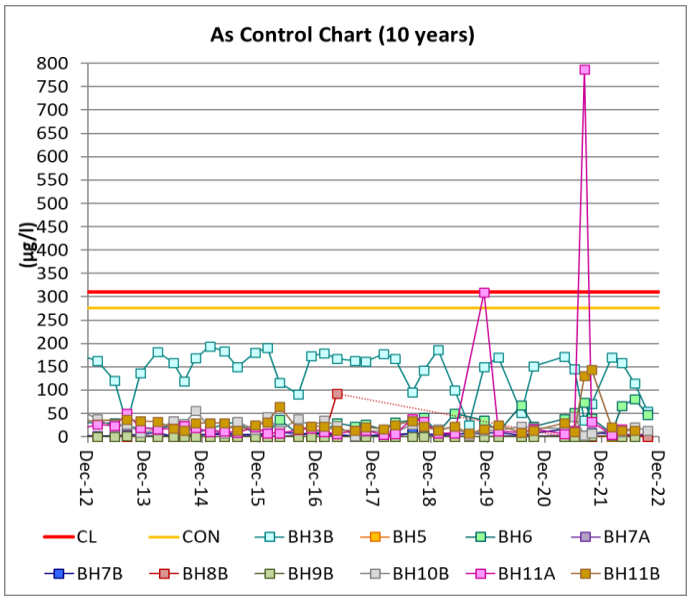


In line with previous years all results have been within both the Control Level & Compliance Limit during 2022.

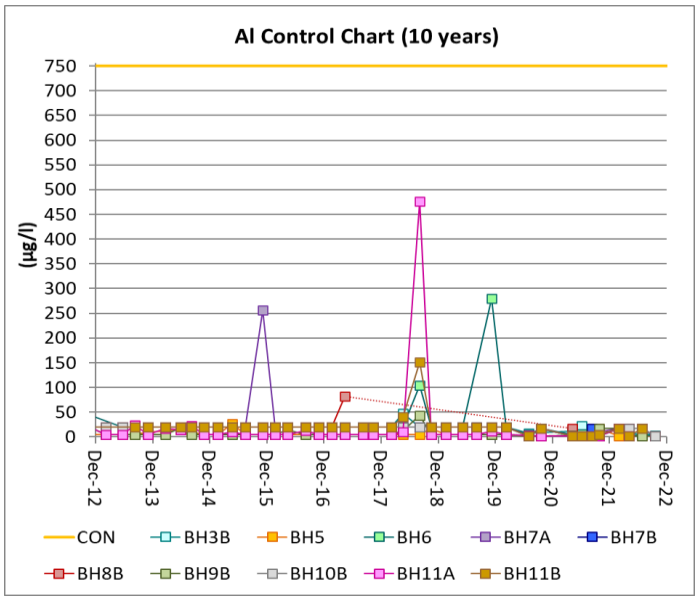
[1] UK Technical Advisory Group on the Water Framework Directive Groundwater Trend Assessment, Section 4.2, UKTAG, 2012.



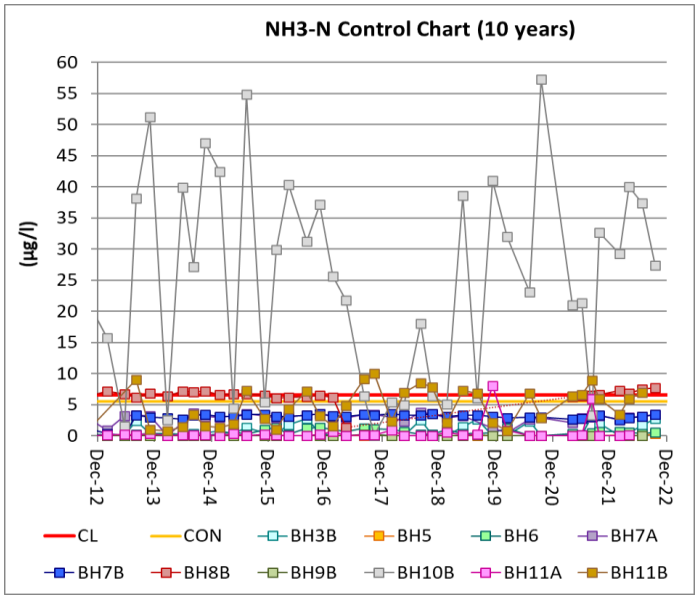
In line with previous years all results have been within both the Control Level & Compliance Limit during 2022.



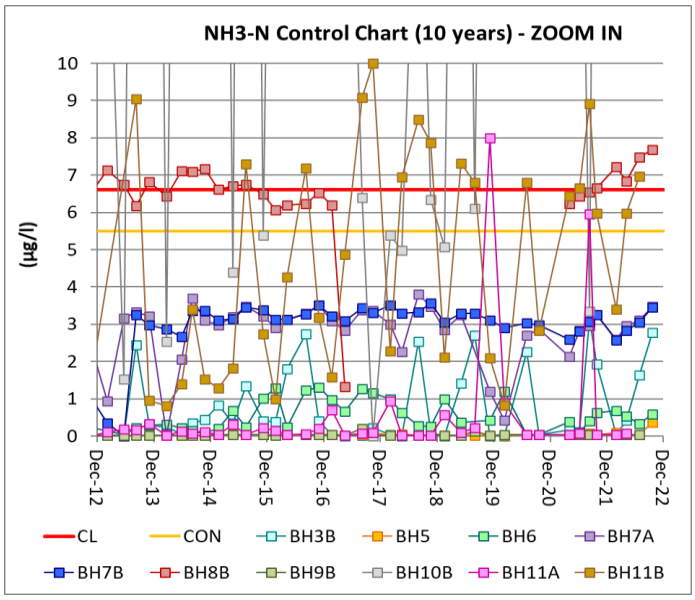
All results have been within both the Control Level & Compliance Limit during 2022.



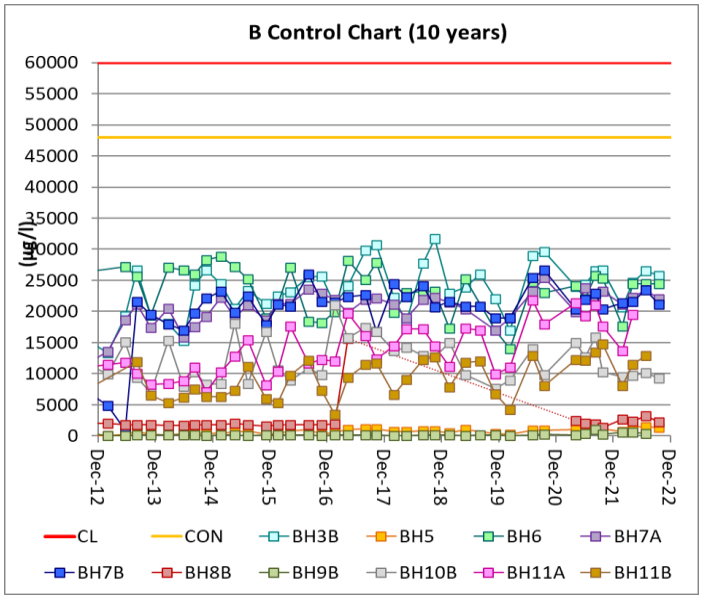
In line with previous years all results have been within the Control Level during 2022.



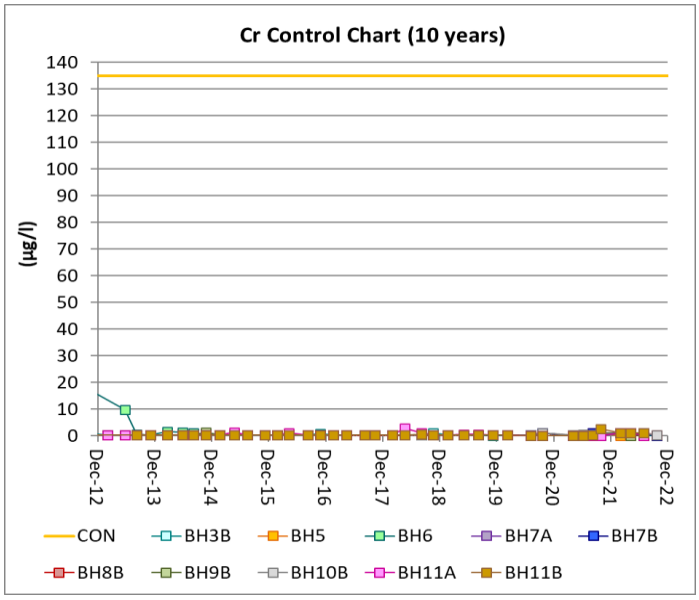
All results have been within both the Control Level & Compliance Limit over the last year except for BH8B, BH10B, and BH11B (please see re-ranged graph below). n/b Both the compliance locations remain well below limit.



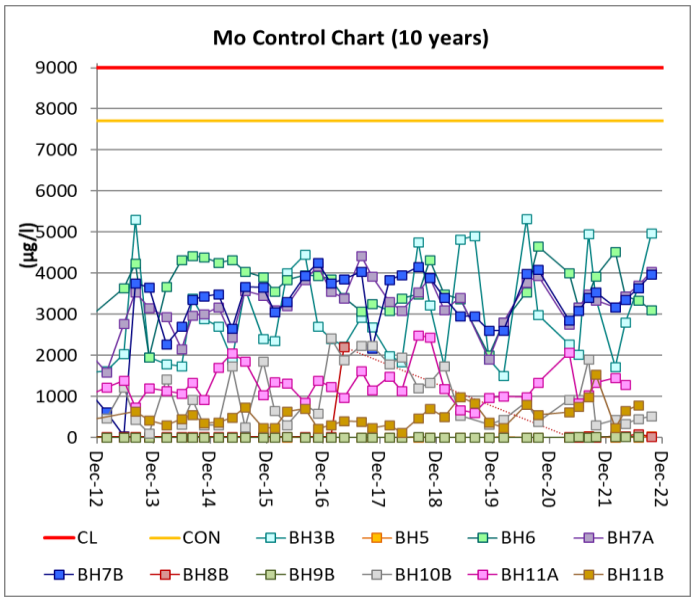
Ammonia continues to fluctuate for some locations. Notably in 2022:
BH8B: 4 above CL
BH10B: 4 above CL
BH11B: 1 above CON and 1 above CL.



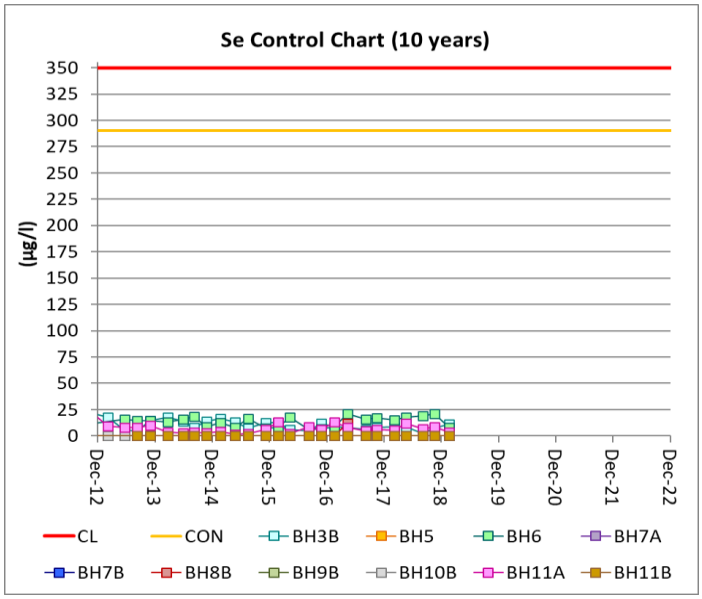
In line with previous years all results have been within both the Control Level & Compliance Limit during 2022. It is noted that boron levels are generally elevated across several locations.



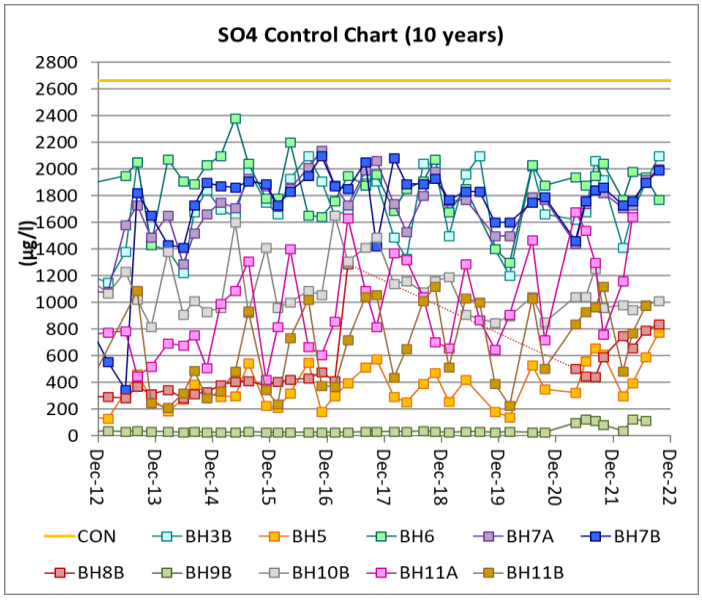
In line with previous years all results have been within the Control Level during 2022.



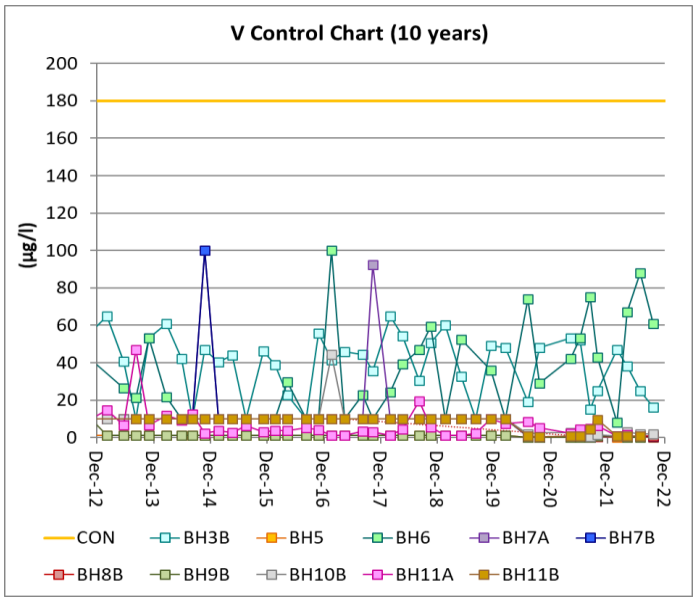
In line with previous years all results have been within both the Control Level & Compliance Limit during 2022. It is noted that molybdenum levels are generally elevated across several locations.



In line with local NRW agreement, this parameter has not been monitored in GW since 2018.



In line with previous years all results have been within the Control Level during 2022. It is noted that sulphate levels are generally elevated across several locations.



In line with previous years all results have been within the Control Level during 2022.

2.3. Surface Water Quality Review

Monitoring Objective

To carry out routine monitoring of surface water to:

- Monitor the performance of the ash disposal site by measurement of absolute levels and concentrations and trends relative to relevant criteria including background concentrations and control levels.
- Identify and quantify effects on surface water receptors.

Number and Location of Monitoring Points

A summary of the surface water monitoring points is provided in Table 3 below and the locations are shown in Appendix A.

Table 3: Summary of Surface water monitoring points

Monitoring Point	Description	Direction from site	Remarks
Eastern Perimeter Drain (EPD)	Western bank of drainage ditch	East	
Brackish Lagoon (BL)	Saline lagoon	South-east	Surface water Receptor
River Thaw (S3)	Eastern bank, tidal mudflats below rail bridge	North upgradient	Surface water Receptor
Group 5 Spring (S1)	Wetland area adjacent to spring within ash disposal site	West	
Mouth of River Thaw	At the mouth of the river as it meets the sea	South-west	Surface water receptor (added after suggestion by HRA review 2018)

Monitoring Measurements

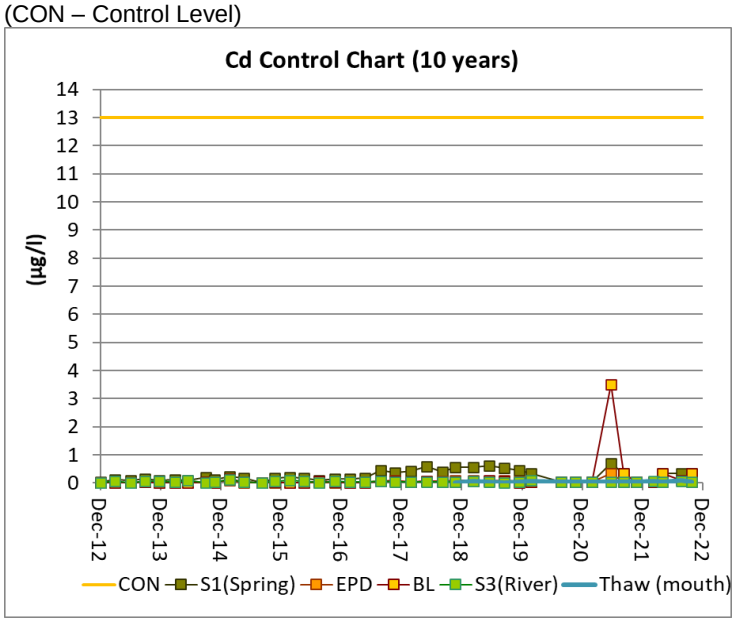
The surface water monitoring analytical suite contains a range of parameters which are monitored on a quarterly basis in accordance with the Environmental Permit. A trained RWE operative is responsible for the sampling of the surface water locations and an independent external laboratory is used for the analysis of the samples.

Figure 3 shows the surface water control charts for the associated monitoring points. It should be noted that the control levels apply to all surface water monitoring points and are identical to the respective groundwater control levels. An exceedance is defined as a result above the control level for 3 consecutive sampling events.

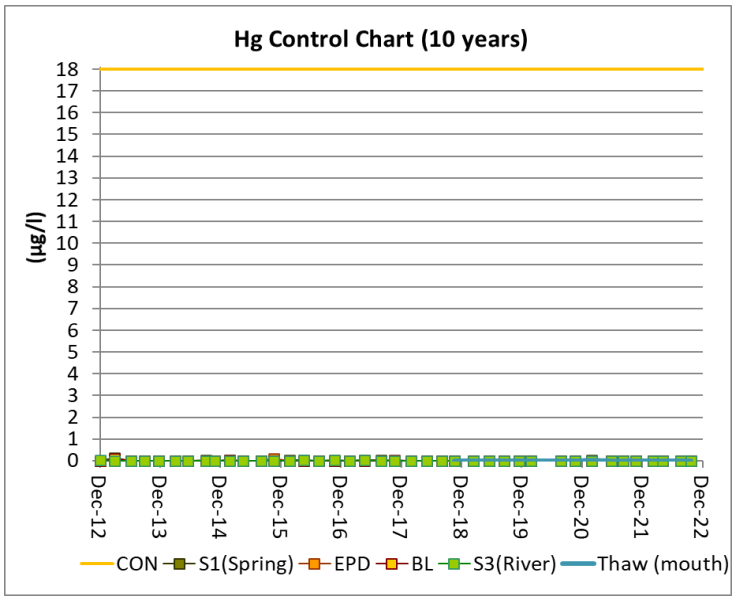
In 2022 there were no exceedances of the control level for any critical parameter. The control charts also show there are no increasing trends in critical parameter concentrations.

- Ammoniacal-nitrogen levels remain highly variable in Group 5 Spring (S1).
- Group 5 Spring (S1) also displays the highest concentrations of other critical parameters, in particular arsenic, boron, molybdenum, sulphate and vanadium, which does suggest that it is affected by water being in contact with PFA. However, it should be noted the spring discharges into a stagnant pond surrounded by wetland with water only lost by evapotranspiration or seepage. Therefore, the samples taken from the pond may not be representative of the spring discharge from the ash mound nor considered as a discharge from the ash disposal site.

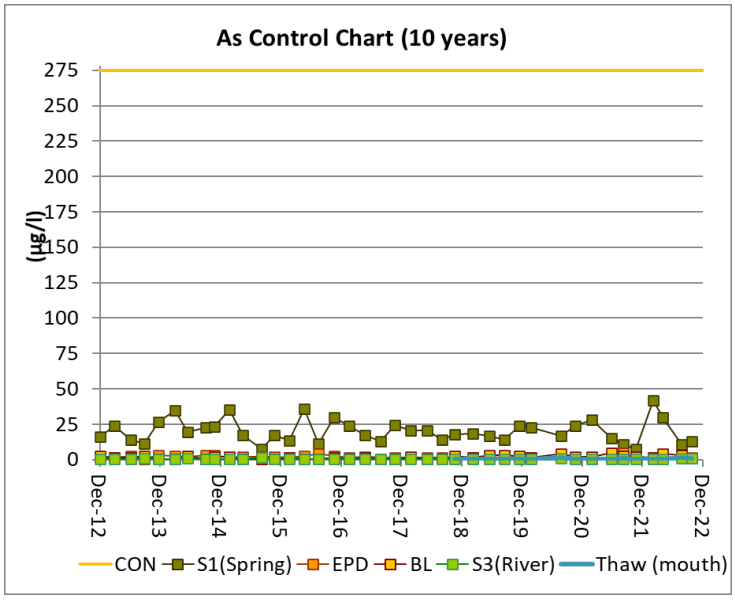
Figure 3: Control charts for surface water monitoring points
(CON – Control Level)



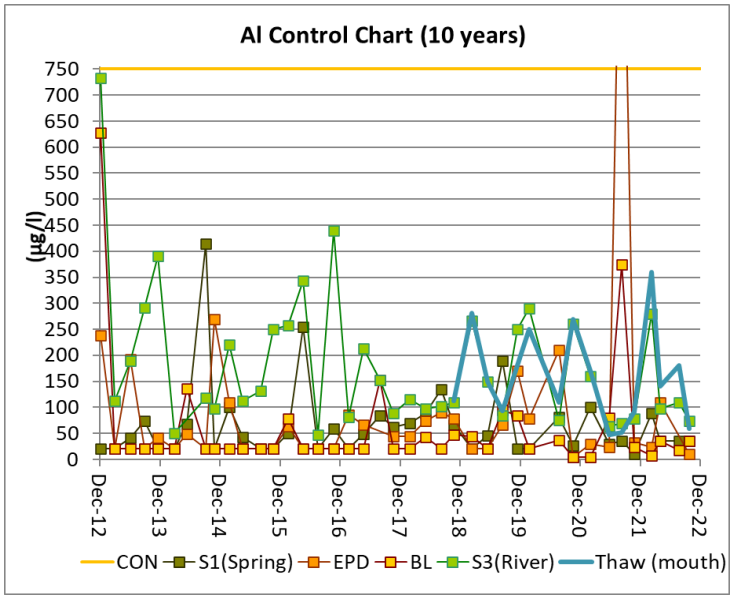
In line with previous years all results have been below the Control Level during 2022.



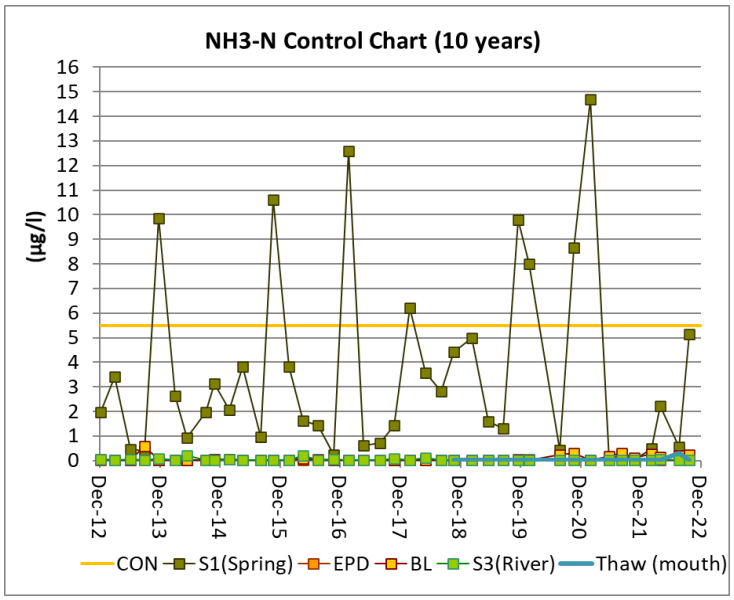
In line with previous years all results have been below the Control Level during 2022.



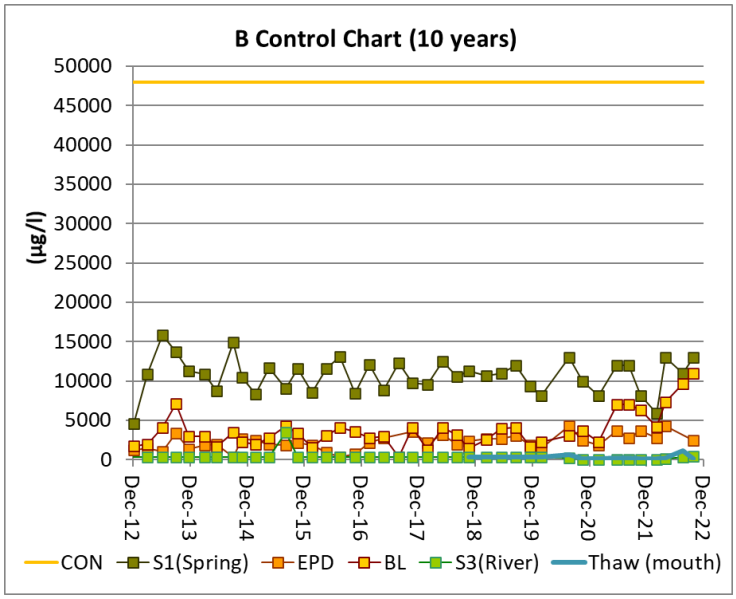
In line with previous years all results have been below the Control Level during 2022. It is noted that arsenic is slightly elevated for the S1 Spring when compared against the other surface water locations.



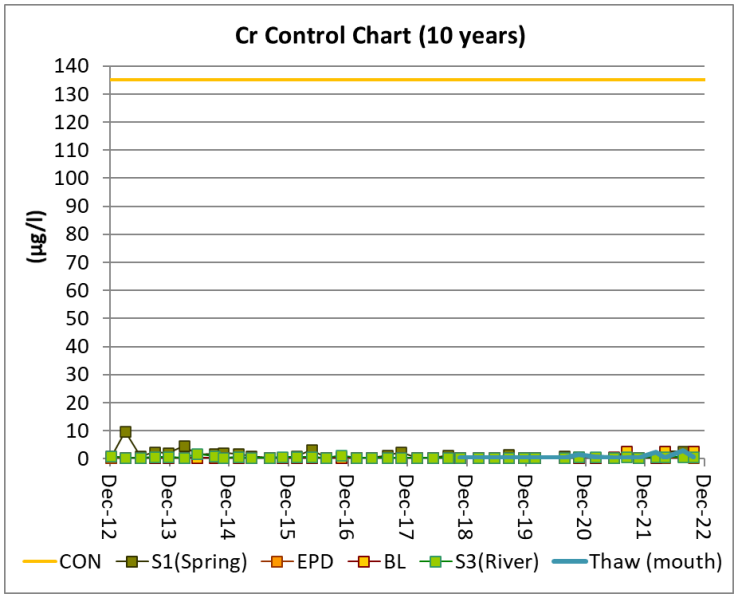
All results have been below the Control Level during 2022.



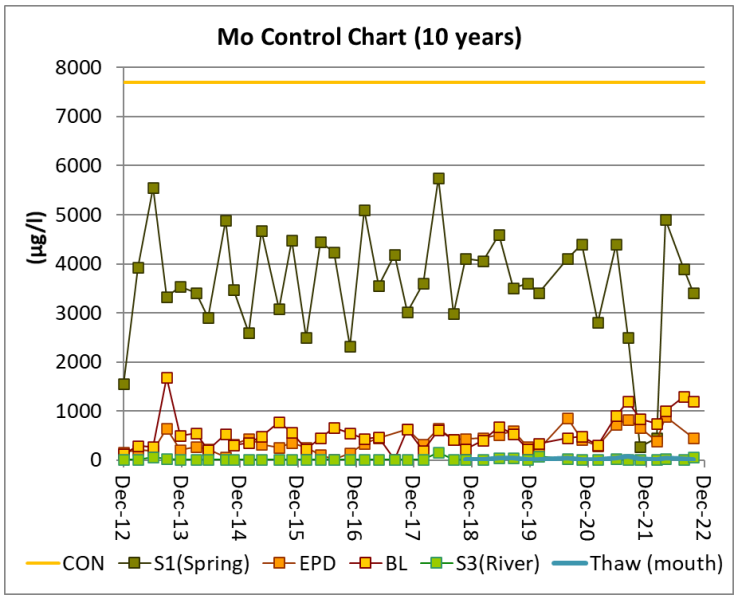
All results have been below the Control Level during 2022. It is noted that ammonia is generally more changeable for the S1 Spring when compared against the other surface water locations.



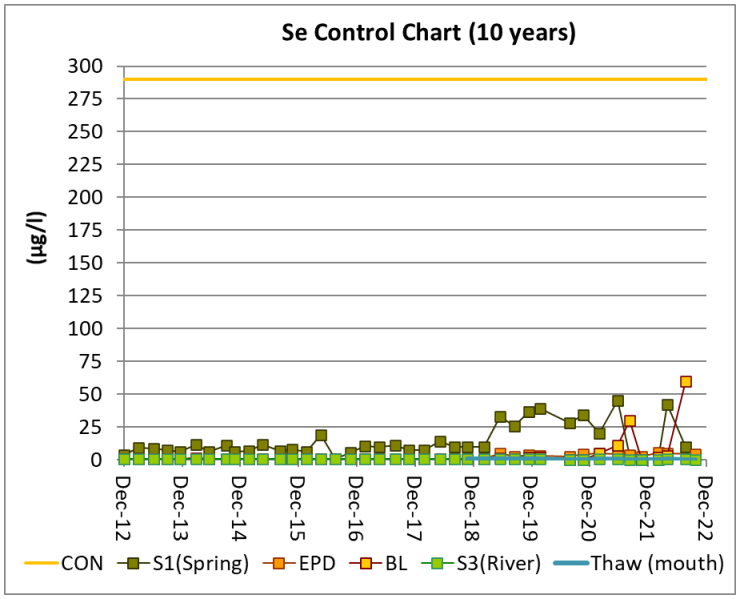
In line with previous years all results have been below the Control Level during 2022. It is noted that boron is slightly elevated for the S1 Spring when compared against the other surface water locations.



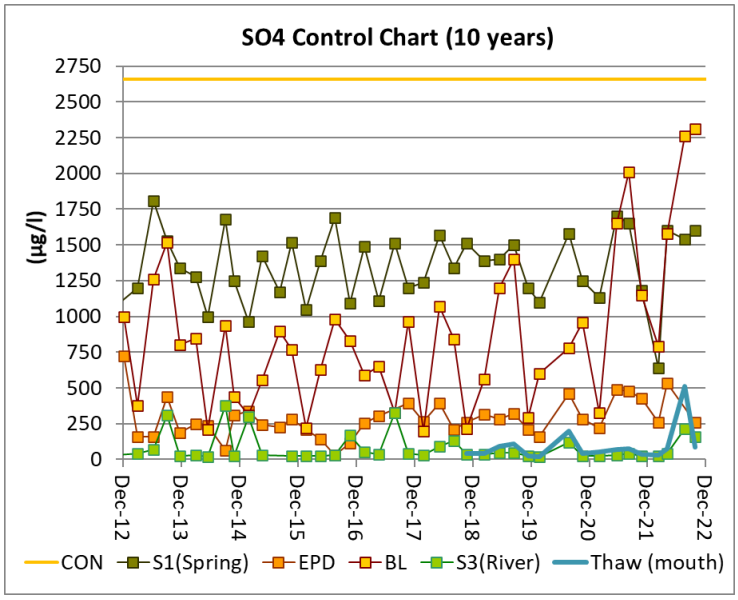
In line with previous years all results have been below the Control Level during 2022



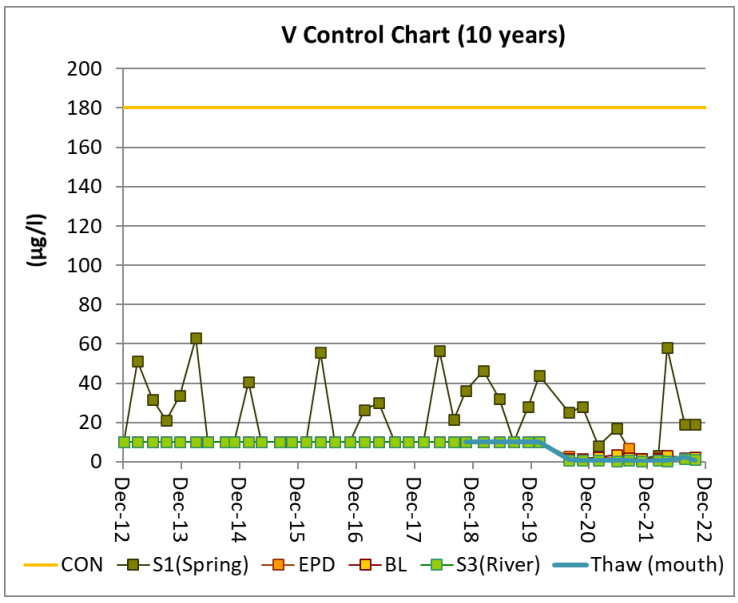
All results have been below the Control Level during 2022. It is noted that molybdenum boron is generally elevated for the S1 Spring when compared against the other surface water locations.



In line with previous years all results have been below the Control Level during 2022.



All results below the Control Level over the last year although it is noted that sulphate levels are generally elevated for the Brackish Lagoon and S1 Spring.



In line with previous years all results have been below the Control Level during 2022. It is noted that vanadium is generally more changeable for the S1 Spring when compared against the other surface water locations.

3. Annual Production/Treatment Data 2022

Table 5: Annual Production/Treatment Data(Table S5.2 EP)

Parameter	Value	Unit
Surface water disposed off site	0	m^3/yr
Groundwater disposed off site	0	m^3/yr

4. Contamination/Decontamination of Site

There have been no incidents or emissions which may have caused any site contamination during 2022, and, therefore, no requirement to decontaminate the site during 2022.

5. Topographical Surveys

The last topographical survey to ordnance datum was carried out in March 2021 as part of the wider Aberthaw Power Station sale preparatory survey works. The drawings from this were attached as part of the 2021 Annual Report.

6. Landfill Capacity

Aberthaw Ash Disposal Site historically reached its maximum permissible height and the only area used for depositing Pulverised Fuel Ash (PFA) over the last few operational years was the temporary 'short tip' storage area on the western side (utilised for ash sales). This was reprofiled as part of the main Aberthaw Power Station closure and decommissioning process during 2020.

Table 6 below, represents the total reported to Natural Resource Wales via the Waste Return form route

Table 6: PFA Deposited

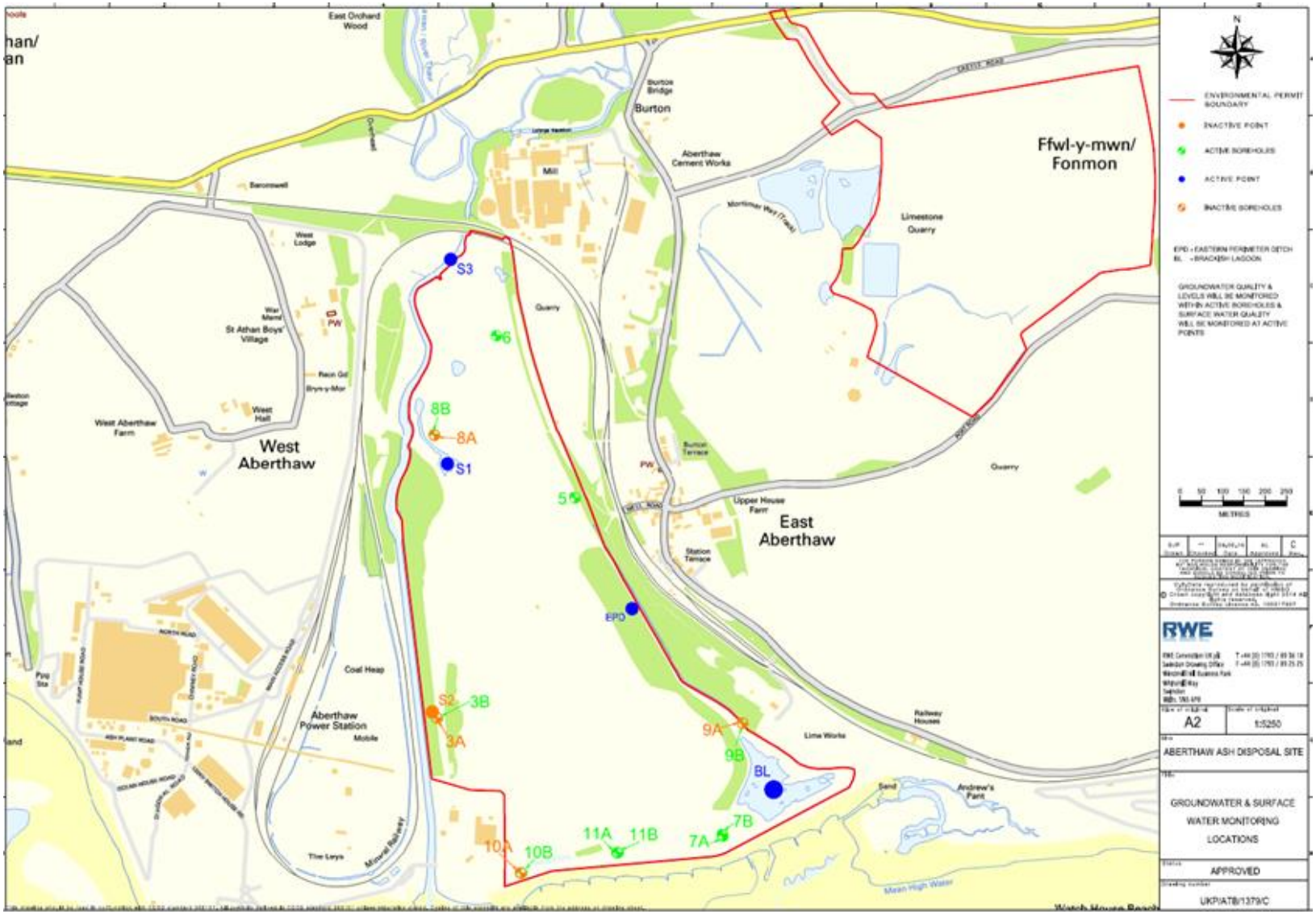
Reporting Period	PFA Deposited (tonnes)
1st January – 31st December 2022	Nil

7. Waste Acceptance Compliance Testing

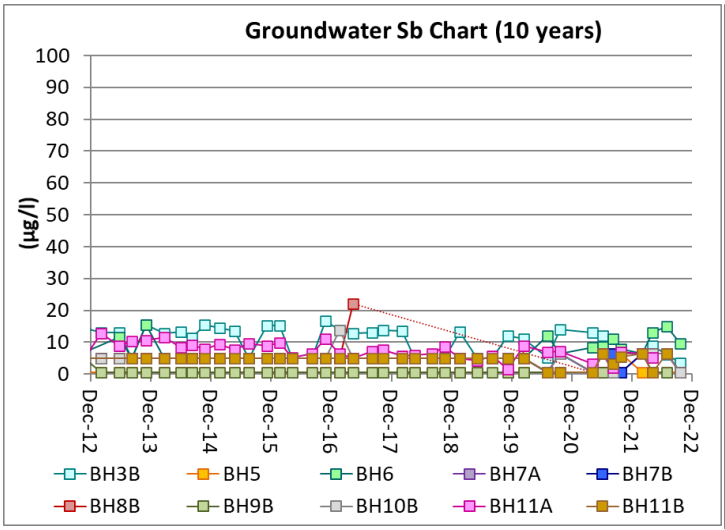
Aberthaw Ash Disposal Site is a mono-landfill site under the direct operational control of Aberthaw Power Station. All ash was transported directly from the Power Station to the Ash Disposal Site.

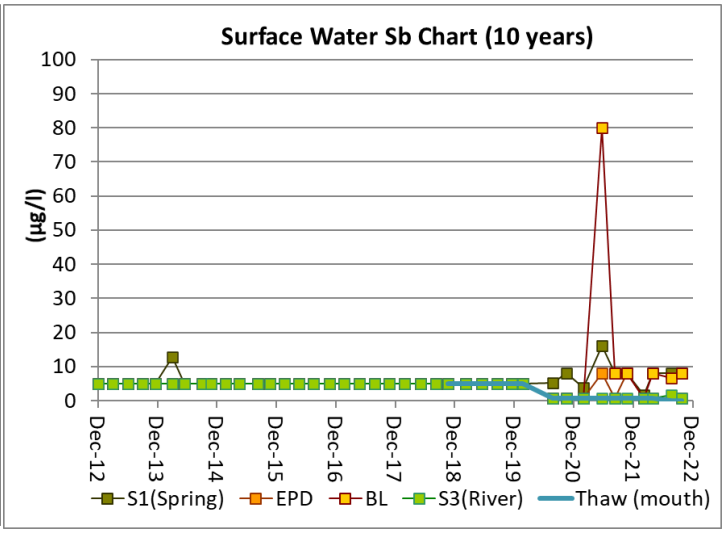
The exact composition of PFA was dependent upon the composition of the fuel utilised by the Power Station. RWE has well established procedures which control the quality of fuel supplied to its stations. Analytical data was obtained from leachate tests performed on composite samples of conditioned PFA from Aberthaw Power Station between 2012 and 2017. The CEN two-stage method for leachate analysis was used (BS EN 12457-3:2002 Characterisation of waste – Leaching – Compliance test for leaching of granular waste materials and sludges of which Part 3). A summary of this data can be seen in the historical annual performance reports for the site.

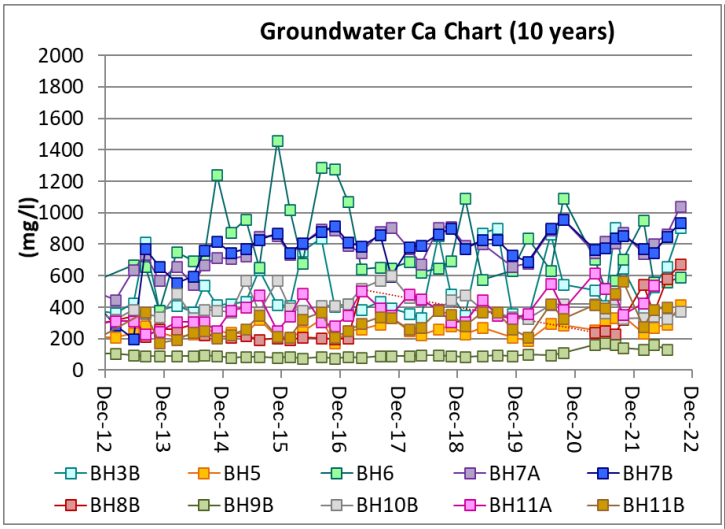
Appendix A. Groundwater and Surface Water Monitoring Locations

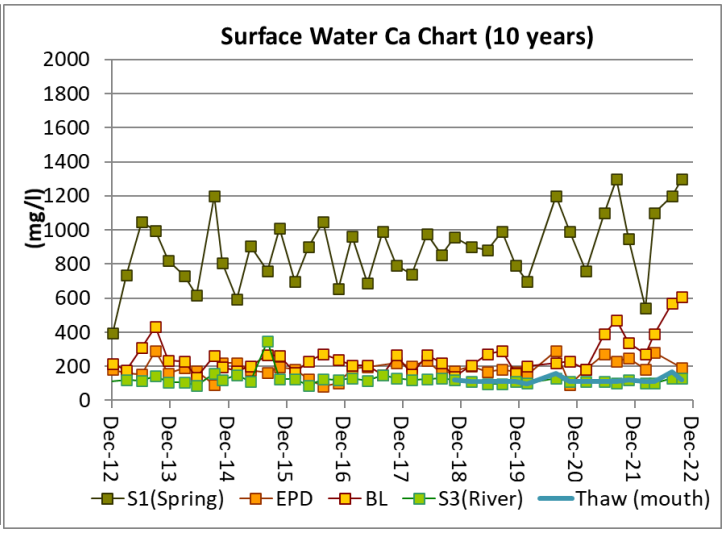


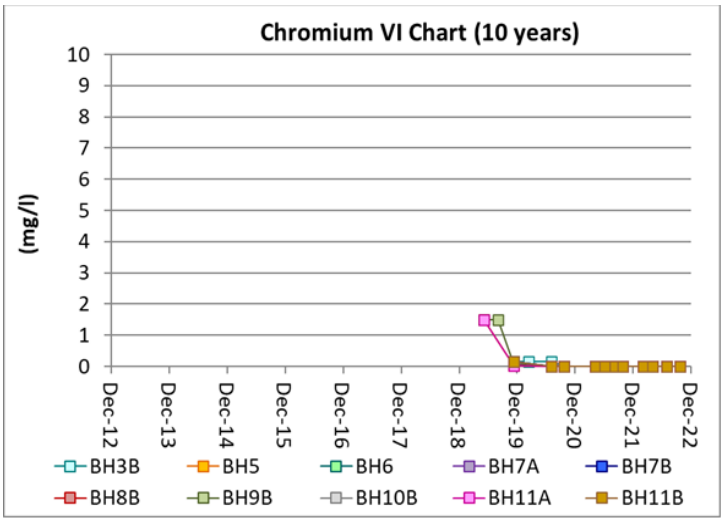
Appendix B. Other monitored parameters (trends over the last 10 years)



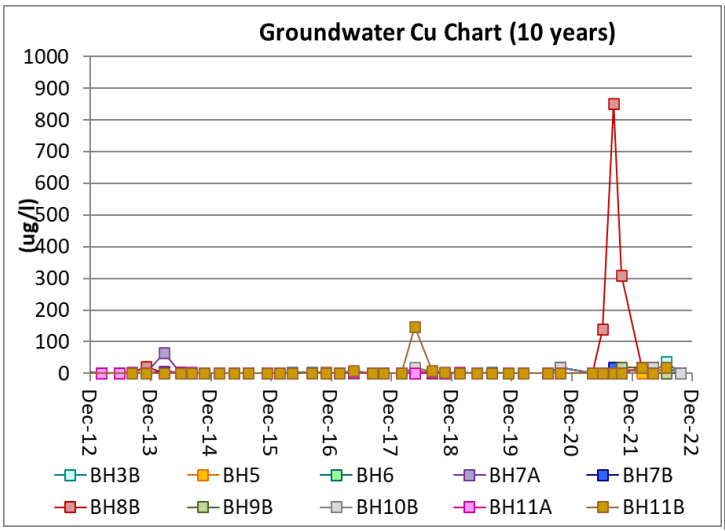


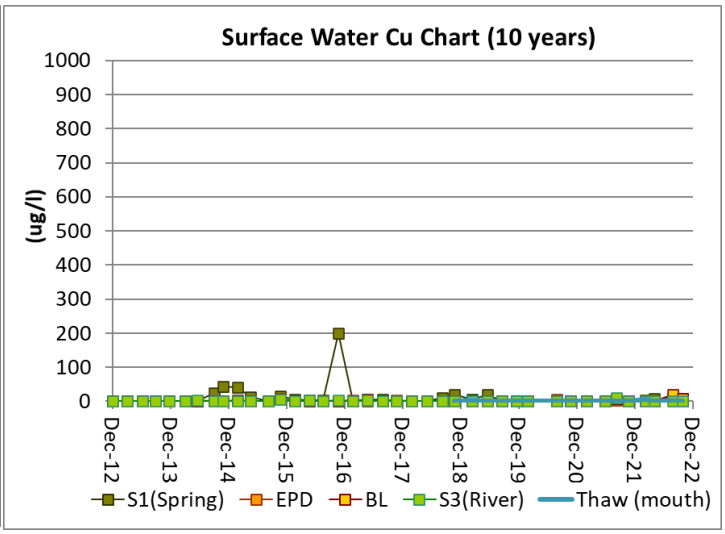


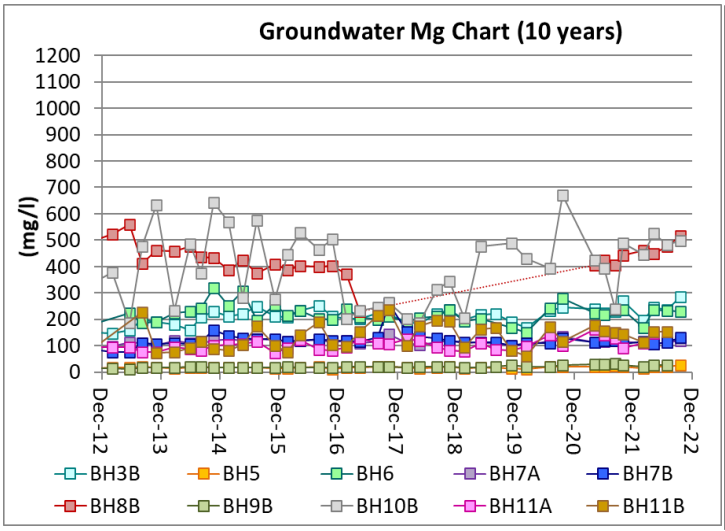


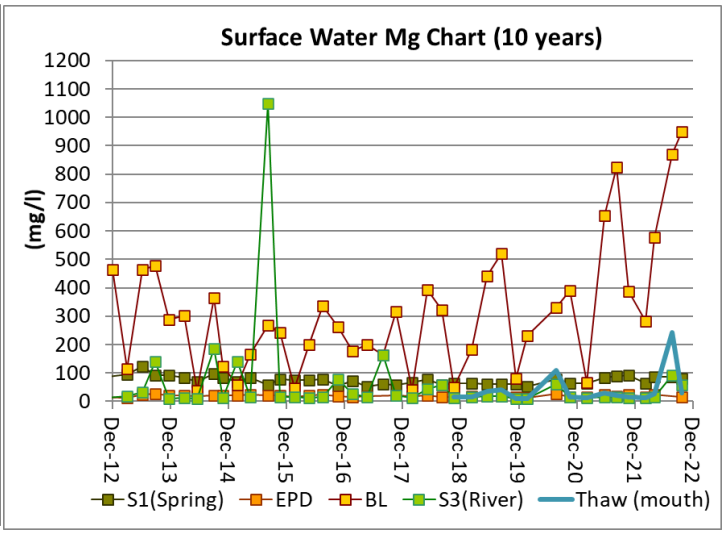


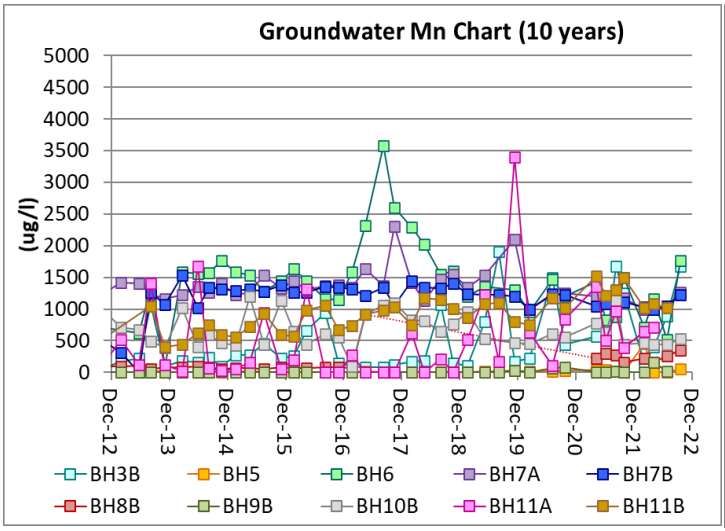
(Chromium VI not monitored in Surface water)

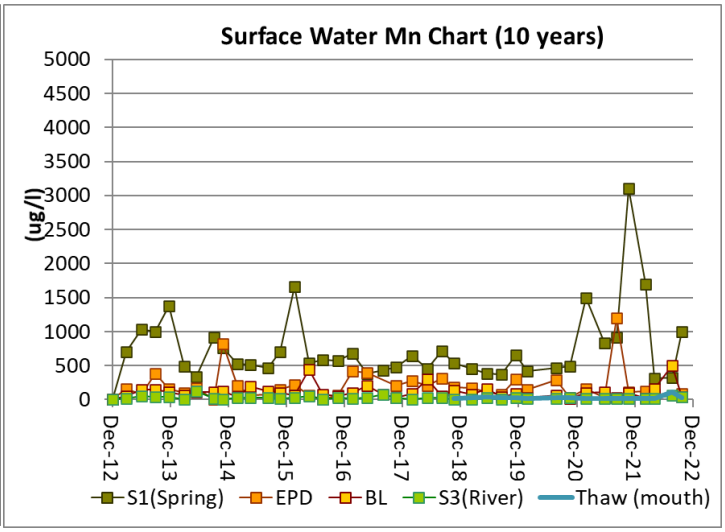

Groundwater Cu Chart (10 years)
1000
900
800
700
600
500
400
300
200
100
0
(µg/l)
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

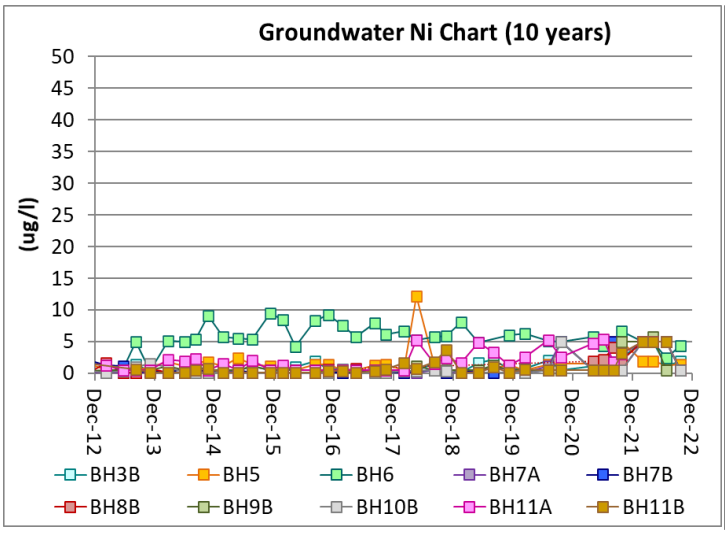

Surface Water Cu Chart (10 years)
1000
900
800
700
600
500
400
300
200
100
0
(µg/l)
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

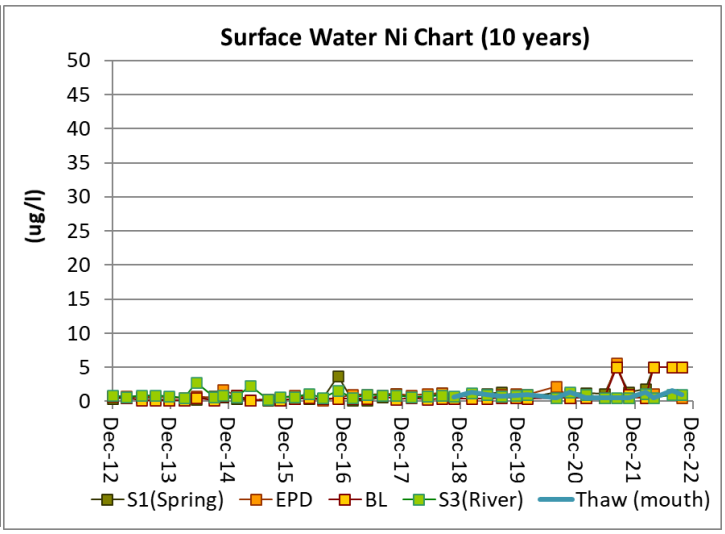

Groundwater Mg Chart (10 years)
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
(mg/l)
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

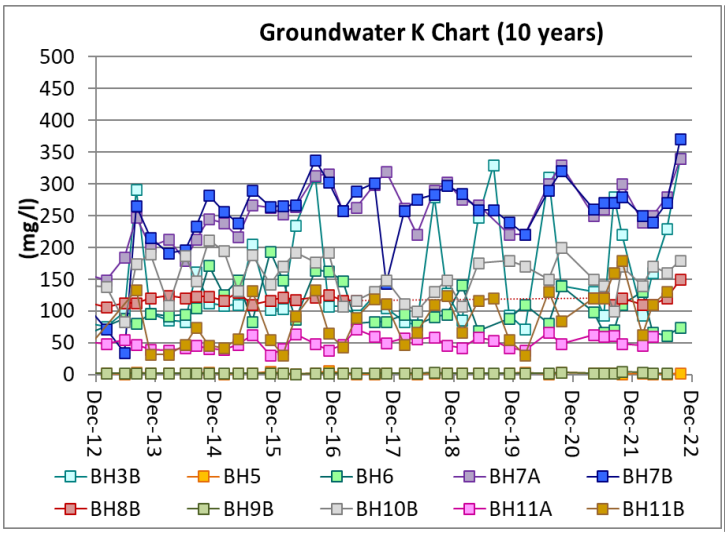

Surface Water Mg Chart (10 years)
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
(mg/l)
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

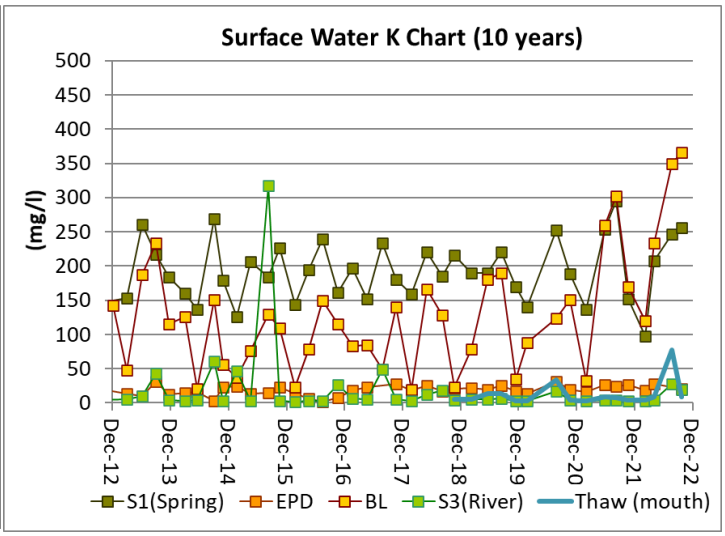

Groundwater Mn Chart (10 years)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
(µg/l)
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

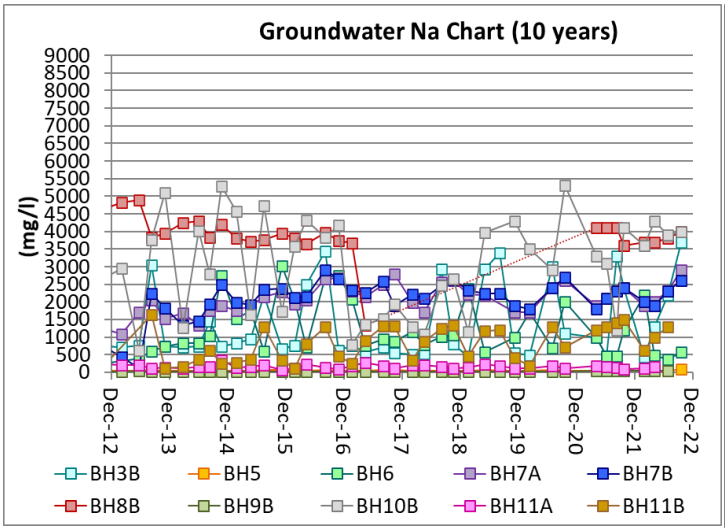

Surface Water Mn Chart (10 years)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
(µg/l)
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

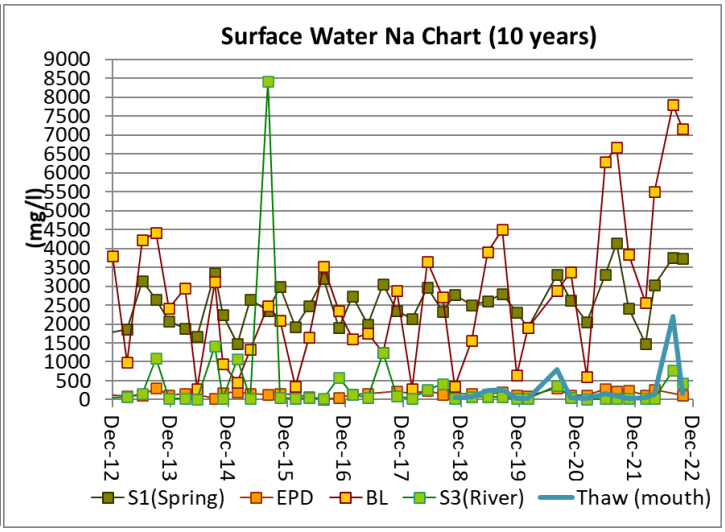

Groundwater Ni Chart (10 years)
(mg/l)
50
45
40
35
30
25
20
15
10
5
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

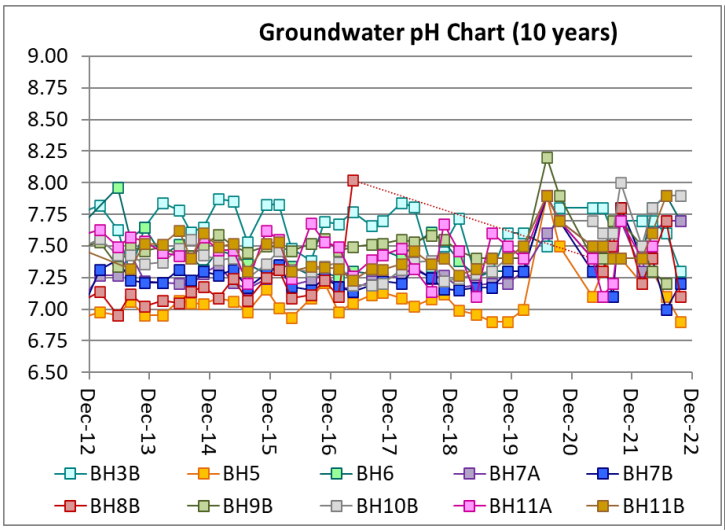

Surface Water Ni Chart (10 years)
(mg/l)
50
45
40
35
30
25
20
15
10
5
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

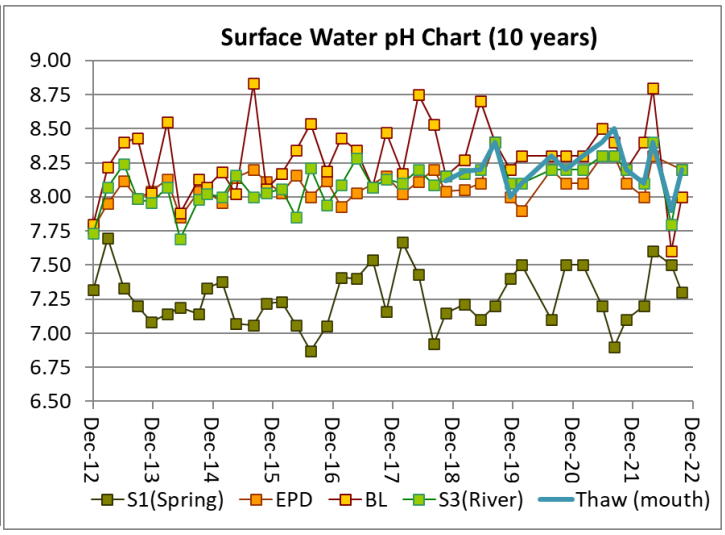

Groundwater K Chart (10 years)
(mg/l)
500
450
400
350
300
250
200
150
100
50
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

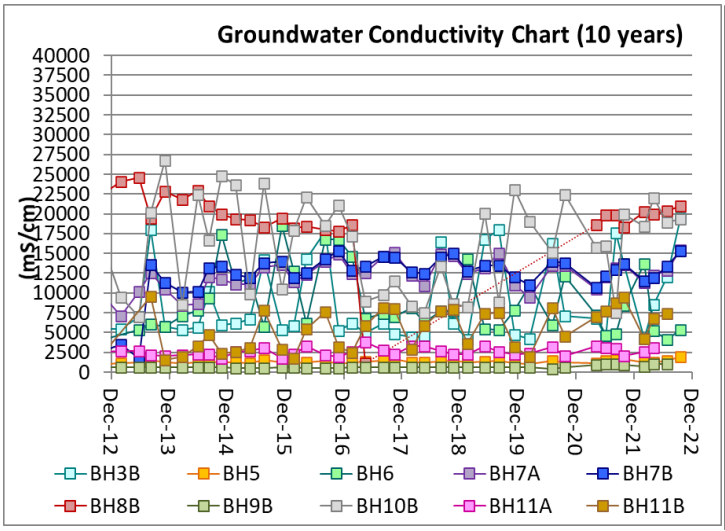

Surface Water K Chart (10 years)
(mg/l)
500
450
400
350
300
250
200
150
100
50
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

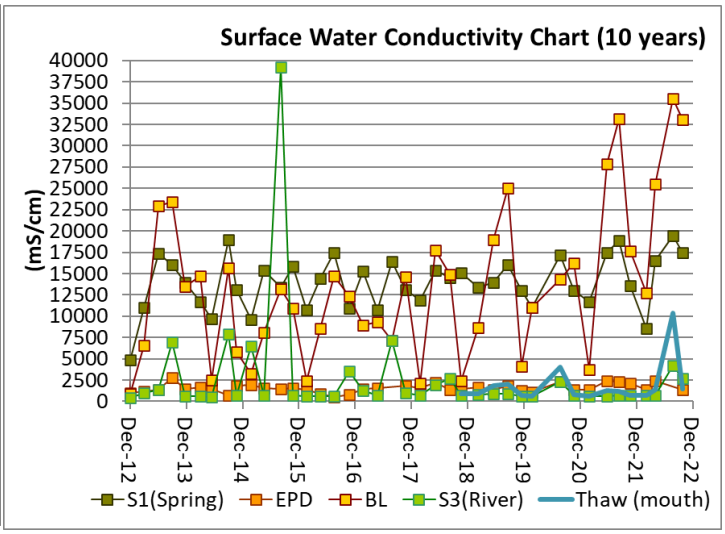

Groundwater Na Chart (10 years)
(mg/l)
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

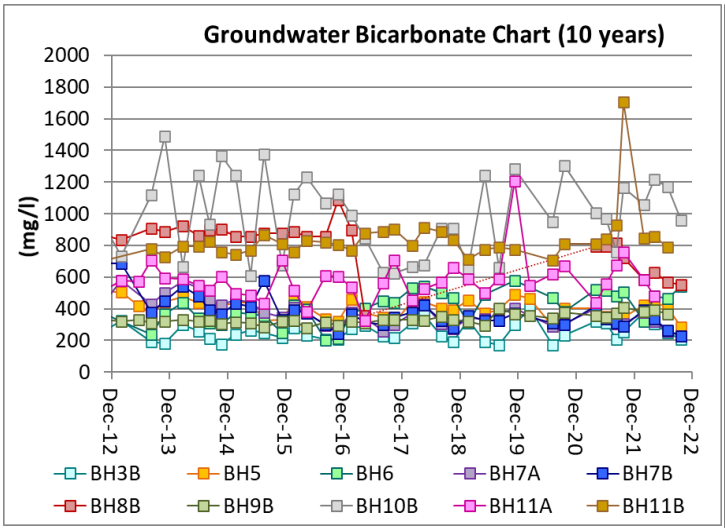

Surface Water Na Chart (10 years)
(mg/l)
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

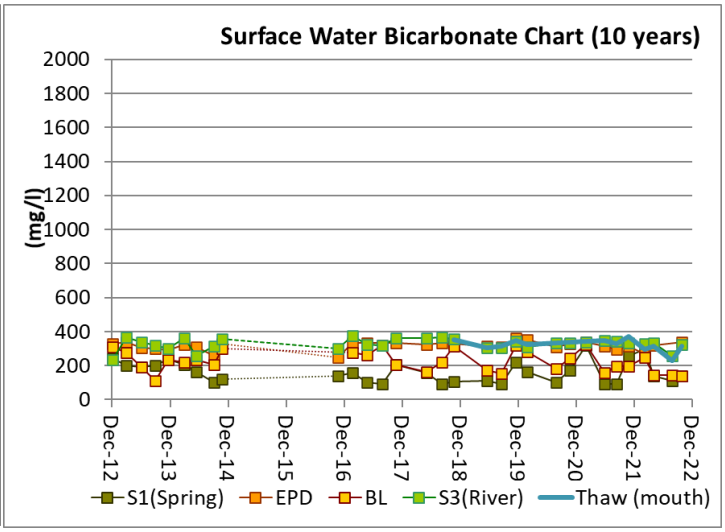

Groundwater pH Chart (10 years)
9.00
8.75
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

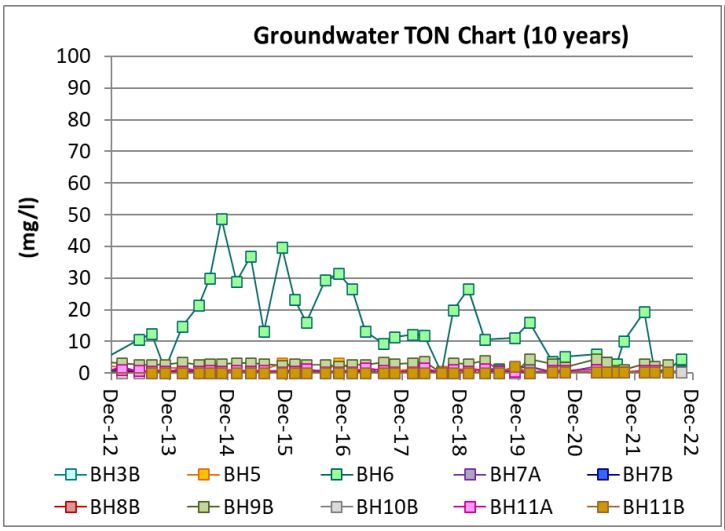

Surface Water pH Chart (10 years)
9.00
8.75
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

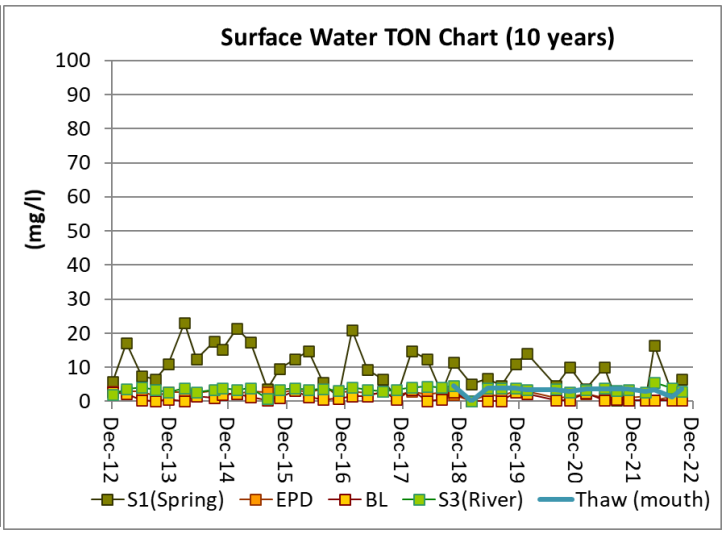

Groundwater Conductivity Chart (10 years)
(mS/cm)
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

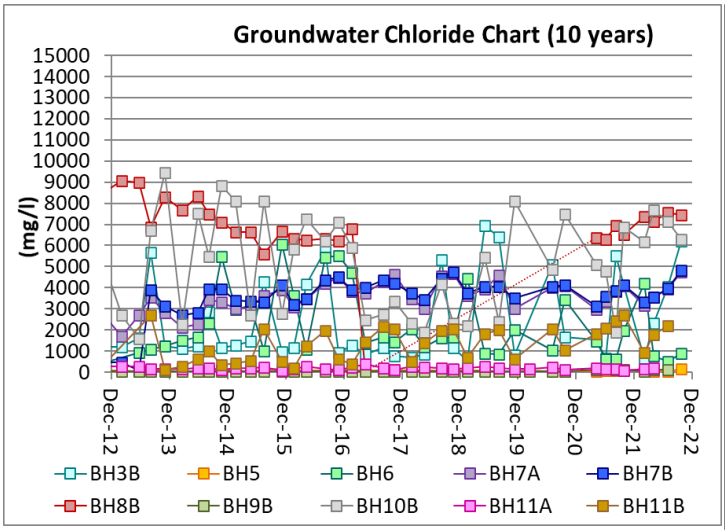

Surface Water Conductivity Chart (10 years)
(mS/cm)
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

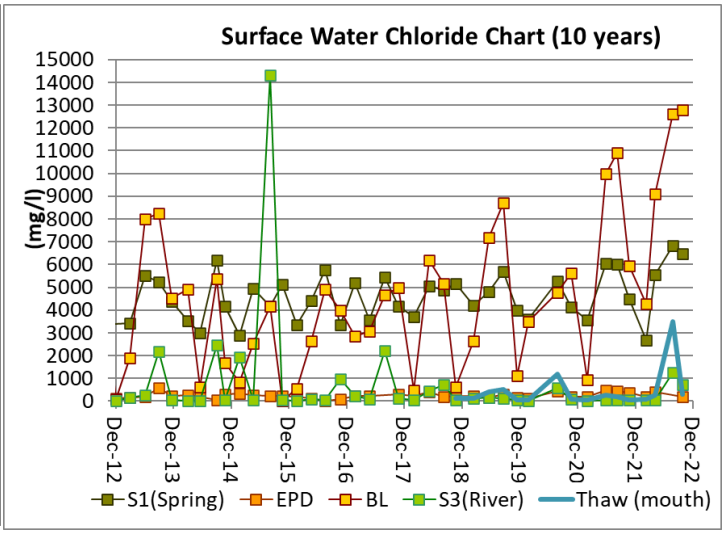

Groundwater Bicarbonate Chart (10 years)
(mg/l)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

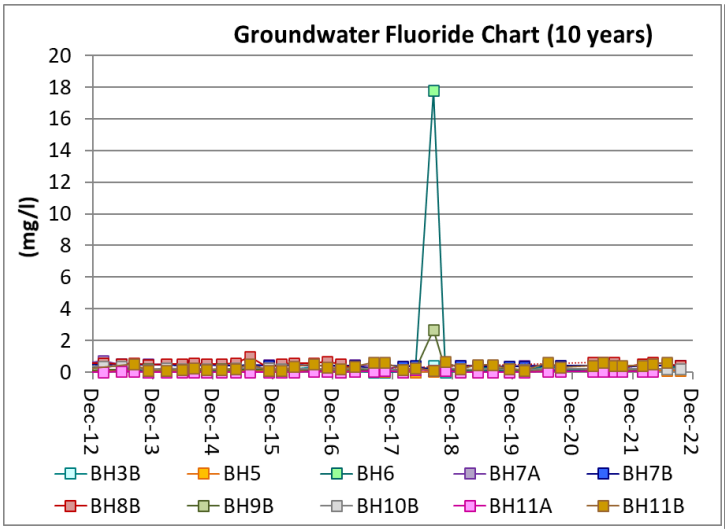

Surface Water Bicarbonate Chart (10 years)
(mg/l)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

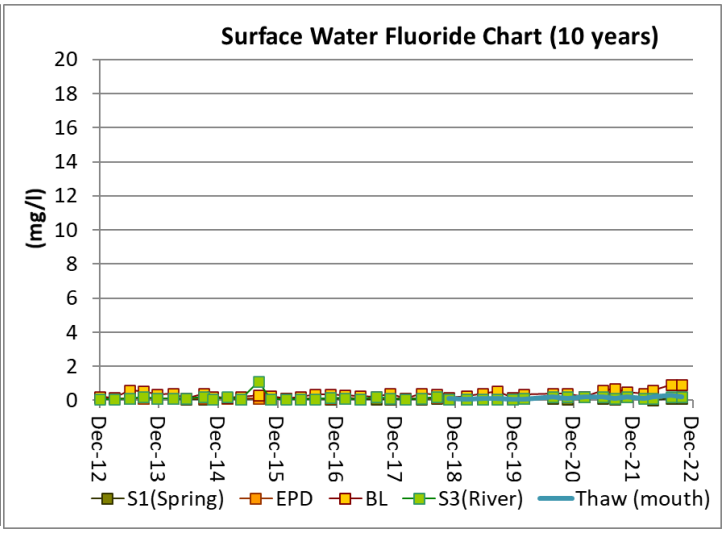

Groundwater TON Chart (10 years)
(mg/l)
100
90
80
70
60
50
40
30
20
10
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B

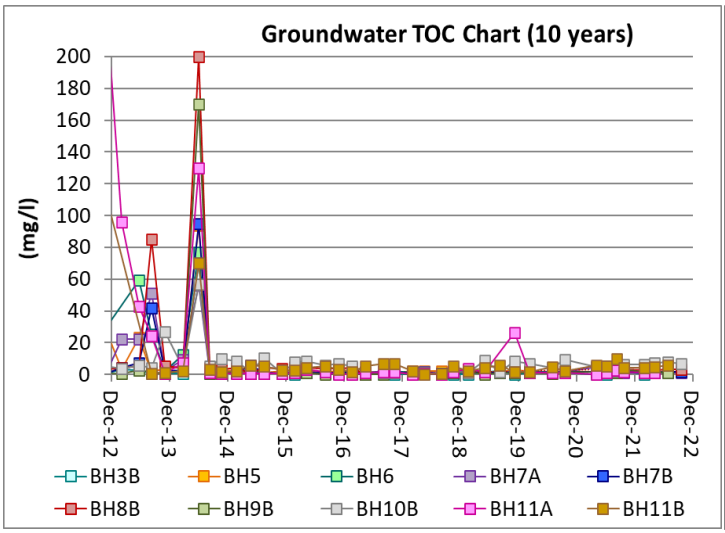

Surface Water TON Chart (10 years)
(mg/l)
100
90
80
70
60
50
40
30
20
10
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

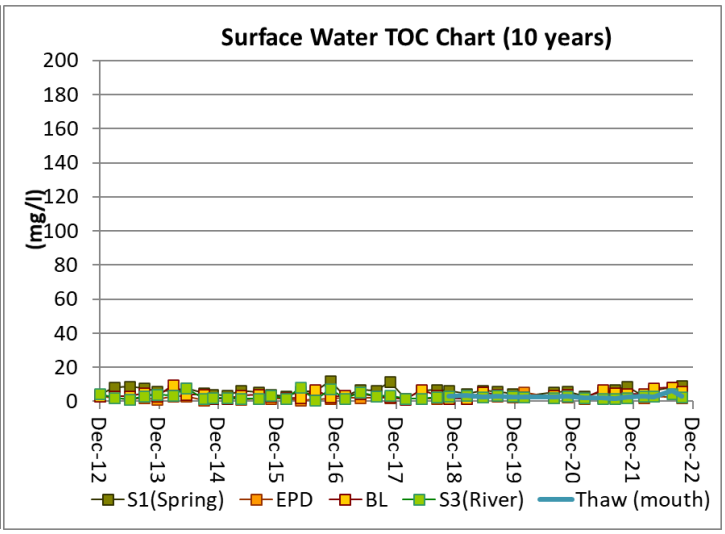

Groundwater Chloride Chart (10 years)
(mg/l)
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B


Surface Water Chloride Chart (10 years)
(mg/l)
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)


Groundwater Fluoride Chart (10 years)
(mg/l)
20
18
16
14
12
10
8
6
4
2
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B


Surface Water Fluoride Chart (10 years)
(mg/l)
20
18
16
14
12
10
8
6
4
2
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)


Groundwater TOC Chart (10 years)
(mg/l)
200
180
160
140
120
100
80
60
40
20
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
BH3B
BH5
BH6
BH7A
BH7B
BH8B
BH9B
BH10B
BH11A
BH11B


Surface Water TOC Chart (10 years)
(mg/l)
200
180
160
140
120
100
80
60
40
20
0
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
S1(Spring)
EPD
BL
S3(River)
Thaw (mouth)

Appendix C. General summary of Groundwater & Surface Water Quality (over the last 10 years).

Summary of Groundwater and Surface Water Quality (over the last 10 Years)

	Aquifer	Response Zone Interval [1] m b GL	Al µg/l	Sb µg/l	As µg/l	B µg/l	Cd µg/l	Ca mg/l	Cr µg/l	Cu µg/l	Mg mg/l
Background - Limestone [2]			6	1	1	88	0.1	151	1	3	17
Background - Seawater [3]			256	10	1.3	3700	2.3		0.36	12	
GW DWS/EQS Comparison			200	5	10	1000	5.0	250	50	2000	50
GW Compliance Limit					310	60000	15.0				
SW & GW Control Level			750		275	48000	13		135		
Upstream Groundwater			**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**
BH5	Limestone	2.5 - 11.5m	6.1	0.7	0.4	747.9	0.04	261.6	0.23	2.5	18.3
Downstream Groundwater											
BH3A - Last sampled 2015	PFA	2 - 6m	50.3	57.7	136.3	12,537.5	0.09	370.5	0.39	0.6	171.3
BH3B - COMPLIANCE LOCATION	Limestone	13.5 - 23m	17.9	10.2	137.5	23,702.6	0.16	535.3	0.30	2.6	214.7
BH6	Limestone	13 - 20.5m	25.7	6.8	29.7	23,378.4	0.28	784.1	0.64	1.8	222.0
BH7A	Gravelly CLAY	2 - 9.5m	23.7	4.8	3.0	20,744.7	0.16	776.4	0.34	4.8	115.3
BH7B - COMPLIANCE LOCATION	Limestone	18 - 26m	17.3	4.8	5.3	20,463.6	0.18	764.9	0.35	3.4	121.6
BH8A	Silty Sand	5.3 - 7m	224.4	19.3	89.4	8,924.1	0.15	263.9	0.89	8.8	45.0
BH8B	Limestone	30 - 38m	19.2	5.2	4.1	2,502.7	0.04	294.9	0.36	53.5	428.2
BH9A - Last sampled 2015	Fill	2.2 - 6m	8.7	0.5	0.5	75.5	0.05	77.2	0.25	2.1	8.3
BH9B	Limestone	6 - 13m	7.0	0.8	0.5	180.9	0.05	100.9	0.30	1.9	21.1
BH10A - Last sampled 2015	Fill	1 - 3m	15.6	12.1	71.3	7,330.0	0.09	165.8	0.25	1.2	85.8
BH10B	Clay	23 - 30m	16.9	5.0	20.5	12,033.7	0.07	410.3	0.35	3.2	400.7
BH11A	Fill - ash and clay	1.5 - 5m	19.8	7.3	45.5	13,992.4	0.16	380.5	0.43	2.2	103.7
BH11B	Clay	9.5 - 19m	21.0	4.6	28.7	9,285.8	0.04	311.7	0.37	6.3	136.9
Upstream Surface water											
River Thaw			166.4	3.9	0.6	374.1	0.05	123.7	0.50	1.8	64.1
Downstream Surface Water											
S1 Group 5 Spring			66.5	5.8	20.3	10,854.6	0.26	902.6	1.41	12.1	74.4
EPD Eastern Perimeter Drain			94.8	4.4	2.0	2,278.6	0.05	186.2	0.30	1.4	19.3
BL Brackish Lagoon			44.0	6.8	1.8	3,766.2	0.15	260.9	0.47	2.0	312.9
River Thaw (mouth) - Commenced Nov-18			159.1	2.6	0.7	312.5	0.04	118.1	0.68	1.7	40.5

1 Response zone interval for latest well where time series data are compiled from the original and replacement monitor well

2 Background - Limestone is mean of upstream boreholes (E05-09/1A,E05-09/1B, E05-09/2A, E05-09/2B)

3 Background - Seawater is mean of CW Inlet data collected 2011-12

Over Compliance Limit (GW)
Over Control Level (SW & GW)
Above DWS / EQS
Above Background by >25% (GW) (not pH)

Summary of Groundwater and Surface Water Quality

	Aquifer	Response Zone Interval [1] m b GL	Mn µg/l	Hg µg/l	Mo µg/l	Ni µg/l	K mg/l	Se µg/l	Na mg/l	V µg/l	pH
Background - Limestone [2]			23	0.01	2	3	2	1	23	1	7.4
Background - Seawater [3]			20	0.02	30	9	380	1.7		10	7.9
GW DWS/EQS Comparison			50	1.0	70	20	12	10	200	60	
GW Compliance Limit				20	9000			350		N/A	
SW & GW Control Level				18	7700			290		180	
Upstream Groundwater			**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**
BH5	Limestone	2.5 - 11.5m	24.7	0.007	6.5	1.6	2.2	0.5	51.3	0.8	7.1
Downstream Groundwater											
BH3A - Last sampled 2015	PFA	2 - 6m	641.0	0.005	1,830.0	1.7	79.5	18.1	782.3	128.5	7.9
BH3B - COMPLIANCE LOCATION	Limestone	13.5 - 23m	502.0	0.007	2,970.8	1.0	156.7	10.0	1,407.0	38.5	7.7
BH6	Limestone	13 - 20.5m	1,447.8	0.006	3,652.2	5.7	105.3	13.7	1,242.4	32.8	7.5
BH7A	Gravelly CLAY	2 - 9.5m	1,345.0	0.005	3,266.1	0.9	257.3	0.5	2,094.2	12.0	7.3
BH7B - COMPLIANCE LOCATION	Limestone	18 - 26m	1,174.2	0.007	3,258.6	0.9	253.8	0.5	2,095.4	9.9	7.3
BH8A	Silty Sand	5.3 - 7m	22.5	0.005	2,640.6	1.1	34.8	18.2	150.3	141.1	8.4
BH8B	Limestone	30 - 38m	161.2	0.006	103.9	1.2	118.9	1.1	3,866.5	7.2	7.3
BH9A - Last sampled 2015	Fill	2.2 - 6m	5.0	0.005	5.0	0.8	7.0	0.5	24.2	1.0	7.7
BH9B	Limestone	6 - 13m	14.6	0.007	4.0	1.0	2.3	0.5	26.2	0.8	7.5
BH10A - Last sampled 2015	Fill	1 - 3m	30.0	0.005	653.2	1.6	29.1	1.3	88.3	70.3	7.9
BH10B	Clay	23 - 30m	655.0	0.006	969.3	0.8	152.9	0.5	3,053.7	8.8	7.5
BH11A	Fill - ash and clay	1.5 - 5m	522.0	0.005	1,292.7	2.0	50.4	6.4	158.5	6.4	7.5
BH11B	Clay	9.5 - 19m	920.3	0.006	530.6	1.0	88.0	0.5	817.6	8.0	7.4
Upstream Surface water											
River Thaw			28.3	0.006	24.8	0.9	19.3	0.5	447.1	7.6	8.1
Downstream Surface Water											
S1 Group 5 Spring			755.6	0.011	3,638.5	1.2	194.4	13.9	2,569.7	23.9	7.3
EPD Eastern Perimeter Drain			207.2	0.008	401.7	0.9	18.6	1.7	155.7	8.1	8.1
BL Brackish Lagoon			115.7	0.008	564.8	0.9	128.9	3.4	2,752.5	8.0	8.3
River Thaw (mouth) - Commenced Nov-18			29.5	0.007	30.6	0.9	12.9	0.5	277.2	4.3	8.2

1 Response zone interval for latest well where time series data are compiled from the original and replacement monitor well

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3 Background - Seawater is mean of CW Inlet data collected 2011-12

Over Compliance Limit (GW)
Over Control Level (SW & GW)
Above DWS / EQS
Above Background by >25% (GW) (not pH)

Summary of Groundwater and Surface Water Quality

	Aquifer	Response Zone Interval [1]	Electrical Conductivity	Bicarbonate	Sulphate	Ammoniacal Nitrogen as N	Total Oxidised Nitrogen as N	Chloride	Fluoride	Total Organic Carbon	Cr VI (from May 2019)
		m b GL	µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	
Background - Limestone [2]			830	409.00	62	0.2	10	35	0.2	4	0.29
Background - Seawater [3]				97.00	2345	0.03		16300	1.3		
GW DWS/EQS Comparison					250	0.50		250	1.5		3.4
GW Compliance Limit						6.6					
SW & GW Control Level					2660	5.5					
Upstream Groundwater			**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**	
BH5	Limestone	2.5 - 11.5m	1,315	397.3	376.6	0.0	0.9	73.9	0.1	5.0	0.128
Downstream Groundwater											
BH3A - Last sampled 2015	PFA	2 - 6m	5,693	349.8	1,233.3	0.2	0.5	1,257.5	0.1	18.9	
BH3B - COMPLIANCE LOCATION	Limestone	13.5 - 23m	8,990	254.4	1,721.3	0.8	0.7	2,491.5	0.1	2.6	0.039
BH6	Limestone	13 - 20.5m	8,943	409.7	1,875.1	0.6	15.8	2,230.8	0.6	6.0	0.015
BH7A	Gravelly CLAY	2 - 9.5m	12,292	370.2	1,736.3	2.8	0.4	3,573.9	0.4	5.4	0.015
BH7B - COMPLIANCE LOCATION	Limestone	18 - 26m	12,443	368.4	1,729.0	3.0	0.2	3,616.2	0.4	5.0	0.015
BH8A	Silty Sand	5.3 - 7m	2,030	246.9	641.9	0.4	2.0	248.7	0.1	14.6	0.002
BH8B	Limestone	30 - 38m	19,357	802.2	483.5	6.5	0.2	6,802.5	0.5	14.3	0.002
BH9A - Last sampled 2015	Fill	2.2 - 6m	482	306.8	14.3	0.0	0.3	18.5	0.2	1.8	
BH9B	Limestone	6 - 13m	666	334.4	44.1	0.0	2.6	46.5	0.2	5.5	0.258
BH10A - Last sampled 2015	Fill	1 - 3m	1,522	544.1	312.1	0.1	0.2	136.8	0.3	101.6	
BH10B	Clay	23 - 30m	15,981	990.4	1,098.0	25.0	0.2	5,110.0	0.2	6.8	0.015
BH11A	Fill - ash and clay	1.5 - 5m	2,599	580.6	971.5	0.5	0.7	187.9	0.0	10.0	0.128
BH11B	Clay	9.5 - 19m	5,408	836.4	675.2	4.7	0.2	1,333.2	0.3	5.5	0.015
Upstream Surface water											
River Thaw			2,718	330.6	81.8	0.0	3.5	770.4	0.2	3.0	
Downstream Surface Water											
S1 Group 5 Spring			14,185	159.9	1,354.3	3.5	9.5	4,614.1	0.1	6.0	
EPD Eastern Perimeter Drain			1,580	316.4	274.1	0.0	2.2	246.2	0.1	2.0	
BL Brackish Lagoon			13,925	221.9	879.7	0.1	1.1	4,693.0	0.4	4.0	
River Thaw (mouth) - Commenced Nov-18			1,834	323.6	93.9	0.0	3.3	451.2	0.1	2.9	

1 Response zone interval for latest well where time series data are compiled from the original and replacement monitor well

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3 Background - Seawater is mean of CW Inlet data collected 2011-12

Over Compliance Limit (GW)
Over Control Level (SW & GW)
Above DWS / EQS
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