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Mark Cliffe-Phillips
Executive Director
Mackenzie Valley Environmental Impact Review Board
P.O. Box 938
Yellowknife, NT X1A 2N7

9 August 2019

Dear Mr. Cliffe-Phillips:

Subject: DDMI Response to MVEIRB Supplemental Information Request#5 for the Environmental Assessment of the Processed Kimberlite to Mine Workings Proposal (MVEIRB File No.: EA1819-01)

Diavik Diamond Mines (2012) Inc. (DDMI) is pleased to provide the Mackenzie Valley Environmental Impact Review Board (MVEIRB or the Board) with a response to the Board's Supplemental Information Request #5 (MVEIRB-Supplemental IR#5) as an addition to DDMI's previous responses to the Board's Supplemental Information Requests issued on July 26, 2019 as part of the ongoing Review of the Process Kimberlite to Mine Workings Project Proposal. DDMI's response to MVEIRB-Supplemental IR#5 is appended to this letter.

As part of DDMI's response to MVEIRB-Supplemental IR#5, DDMI has provided water quality modelling results for two (2) closure scenarios as requested by the Board:

- Pit lake remains completely isolated from Lac de Gras (Scenario 1).
- Dikes are not breached, but water from the pit lake can still mix with Lac de Gras (Scenario 2).

DDMI notes that it does not consider a closure scenario where pit lake(s) remain completely isolated from Lac de Gras as a practical closure option.

We thank the MVEIRB for the opportunity to clarify our previous responses to the Board's and Parties' IRs. Please do not hesitate to contact the undersigned or Kofi Boa-Antwi (867 447 3001 or kofi.boa-antwi@riotinto.com) if you have any questions related to this submission.

Sincerely,

Sean Sinclair
Superintendent, Environment

cc: Catherine Fairbairn, MVEIRB
Kate Mansfield, MVEIRB
Ryan Fequet, WLWB
Anneli Jokela, WLWB

Diavik Diamond Mines Inc.

Processed Kimberlite to Mine Workings

Response to Supplemental Information Request#5 from the Mackenzie Valley Environmental Impact Review Board

Document #: ENVI-988-0819 R0

9 August 2019

1. MVEIRB-Supplemental IR#5

Using deposition scenario 3A for pit A418[1] as a basis for modelling, please provide responses to the following:

Scenario 1: pit lake remains completely isolated from Lac de Gras (that is, no water flows between the pit lake and Lac de Gras).

Please provide:

a) long term water quality modelling results (from closure until pit lake water quality stabilizes). Include modelled maximum water quality concentrations in the pit lake at surface and 40 m depths, and describe when those maximums would occur.

b) a description of how this would change the effects assessment provided in the *Summary Impact Statement*.

Scenario 2: dikes are not breached, but water from the pit lake can still mix with Lac de Gras (for example, as a result of fracturing the water-retaining plastic concrete wall that forms the core of the dike).

Please provide:

a) long term water quality modelling results (from closure until pit water quality reaches equilibrium [as defined in Diavik's response to IR12]).

- Include modelled maximum water quality concentrations in the pit lake at surface and 40 m depths, and describe when those maximums would occur.
- Describe the size of the mixing zone, if any.
- Describe predicted changes to water quality for the mixing zone and far field areas of Lac de Gras.

[1] This scenario includes the largest volume of processed kimberlite and the shallowest freshwater cap for pit A418, which is Diavik's preferred location for depositing kimberlite.

b) a description of how this would change the effects assessment provided in the *Summary Impact Statement*.

1.1 Developer's Response to MVEIRB-Supplemental IR#5

Scenario 1

a) The request is to model a condition where the A418 dike remains intact after the pit lake has been developed. In this case no water will flow from Lac de Gras into the pit lake but in time water will, by necessity, flow from the pit lake into Lac de Gras. Modelling estimates that it will take just under 7 years before water levels in the pit lake would rise to a level where water would over top the plastic concrete wall (the water retaining element in the dike) and flow into Lac de Gras. The top of the plastic concrete wall in the A418 dike is at an elevation of 417.5 m versus a typical Lac de Gras water level of around 416 m. The rise in the pit lake water level is expected to be on average 22 cm per year based on direct precipitation plus local runoff from the East Island less evaporation.

Water quality was modelled for this scenario using the A418 Scenario 3a assumptions as requested but with no water exchange between Lac de Gras and the pit lake for the first 7 years as water levels increased within the pit lake and then once water levels reached 417.5m water was allowed to discharge to Lac de Gras and so pit lake water levels remain at around 417.5m. At no time was Lac de Gras water allowed to enter the pit lake.

It should be noted that this is a theoretical scenario requested by the MVEIRB. DDMI would not consider this as a practical closure option because in addition to it creating worse water quality conditions in the top 40 m, it would require the dike to operate in perpetuity as a water retaining structure with an uncontrolled water discharge.

Figure 1 shows the model results for this isolation scenario as compared with the Summary Impact Statement (SIS) prediction Scenario 3a (where the pit lake is connected to Lac de Gras through breaches in the dikes (SIS, Appendix B, Figure B1).

As can be seen in Figure 1, under the “isolated pit lake scenario” stratification is weaker because there is no inflow from Lac de Gras to dilute the surface layers in the pit lake and create the density gradients that are the basis for meromixis. In this scenario there is greater vertical mixing and higher total dissolved solids (TDS) concentrations compared with the original reconnection scenario.

Predicted daily maximum water quality in the pit lake in the top section and at 40 m below surface is presented in Table 1. In the same table, predicted water quality for original Scenario 3a (pit lake connected to Lac de Gras through breaches; SIS, Table 4-7) is also presented. Maximum concentrations of all water quality parameters are predicted to be higher under the isolated pit lake conditions compared to the connected pit lake conditions, except for aluminum, lead and lithium (for these parameters processed kimberlite [PK] pore water concentrations are lower than Lac de Gras). Concentrations in the top section and at depth of 40 m below surface are predicted to remain below the benchmarks over the simulation period (Table 1) however after 100 years of simulation, concentrations of most parameters are predicted to still be rising (see Appendix A).

b) There would be no change to the assessment of effects on water quality based on the results to year 100. Any changes in water quality would be limited to within the local study area (LSA). The effects to fish and fish habitat would be marginally greater due to the inability for fish to access the pit lakes and we would expect a marginal increase in effects to cultural use due to the inability to access the pit lakes by boat from Lac de Gras.

Figure 1. Predicted TDS Concentrations with no connection to Lac de Gras (left) compared with the SIS prediction with a full connection (right)

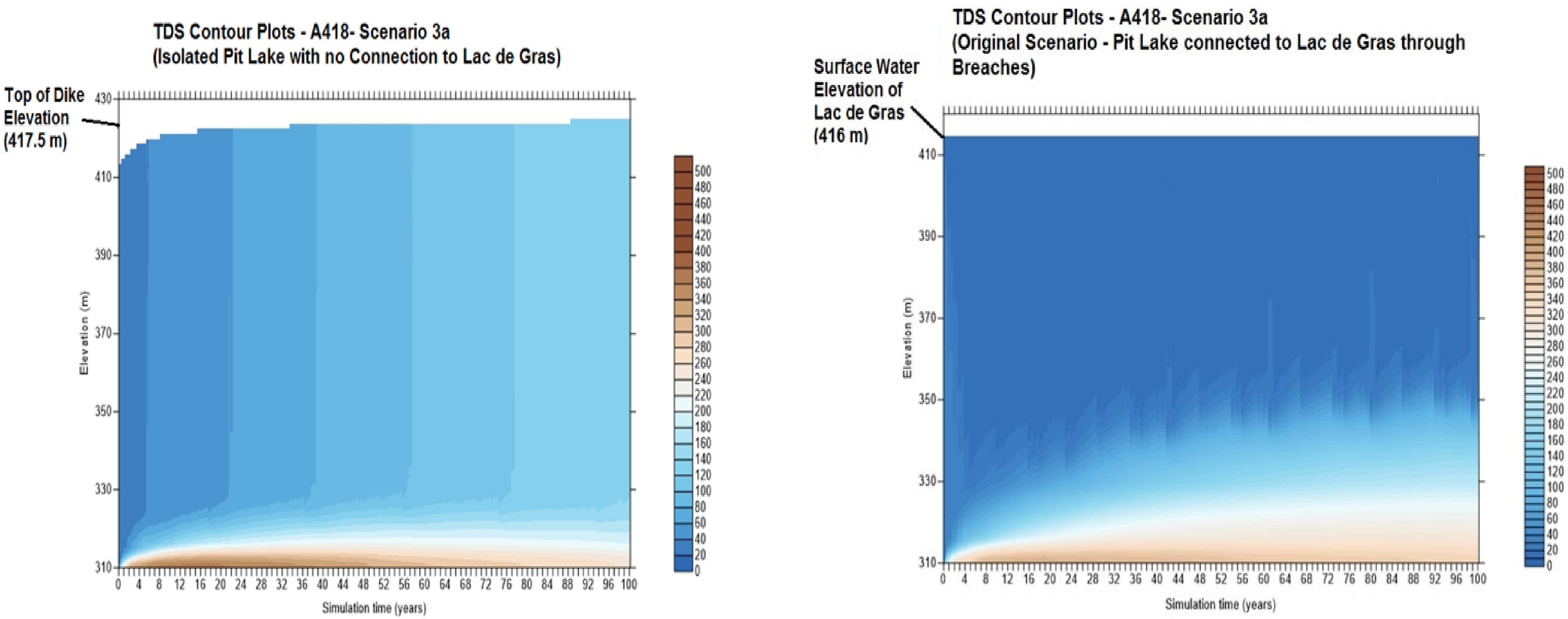


Table 1: Predicted Daily Maximum Concentrations in the A418 Pit Lake over 100-year Period after Closure (under isolated and connected pit lake conditions)

Parameters	Unit	Benchmark	Scenario 3-a (Isolated from Lac de Gras)				Scenario 3-a (Connected to Lac de Gras)	
			Top Section	Year	at Depth of 40 m Below Surface	Year	Top Section	at Depth of 40 m Below Surface
Calcium	mg/L	-	3.3	100	3.3	100	2.8	2.8
Chloride	mg/L	120	7.0	100	7.0	100	4.7	4.7
Fluoride	mg/L	0.12	0.039	100	0.039	100	0.036	0.036
Magnesium	mg/L	-	2.3	100	2.3	100	1.6	1.6
Potassium	mg/L	-	8.2	100	8.2	100	3.6	3.6
Sodium	mg/L	52	8.1	100	8.1	100	4.8	4.8
Sulfate	mg/L	100	19	100	19	100	9.1	9.1
Nitrite as nitrogen	mg/L	0.06	0.045	100	0.045	100	0.016	0.016
Nitrate as nitrogen	mg/L	3	1.3	100	1.3	100	0.5	0.5
Ammonia_N	mg/L	4.7	0.2	100	0.2	100	0.094	0.094
Phosphate, Ortho	mg/L	-	0.0038	100	0.0038	100	0.0024	0.0024
Phosphorus	mg/L	-	0.0061	100	0.0061	100	0.0044	0.0044
Aluminum	µg/L	87	6.2	1	6.2	2	6.3	6.3
Antimony	µg/L	33	0.79	100	0.79	100	0.3	0.3
Arsenic	µg/L	5	0.66	100	0.66	100	0.41	0.41
Barium	µg/L	1000	11	100	11	100	6.1	6.1
Beryllium	µg/L	-	0.15	100	0.15	100	0.056	0.056
Boron	µg/L	1500	6.5	100	6.5	100	4.2	4.2
Cadmium	µg/L	0.1	0.029	100	0.029	100	0.012	0.012
Cobalt	µg/L	-	0.028	100	0.028	100	0.021	0.021
Copper	µg/L	2	0.68	100	0.68	100	0.62	0.62
Iron	µg/L	300	6.2	100	6.2	100	4.9	4.9
Lead	µg/L	1	0.032	100	0.032	100	0.014	0.014
Lithium	µg/L	-	2.2	100	2.2	100	-	-
Manganese	µg/L	-	3.3	1	3.3	2	3.3	3.3
Molybdenum	µg/L	73	24	100	24	100	9.1	9.1
Nickel	µg/L	25	1.2	100	1.2	100	0.91	0.91
Selenium	µg/L	1	0.064	100	0.064	100	0.036	0.036
Silicon	µg/L	2100	336	100	336	100	239	239
Silver	µg/L	0.25	0.02	100	0.02	100	0.0087	0.0087

Parameters	Unit	Benchmark	Scenario 3-a (Isolated from Lac de Gras)				Scenario 3-a (Connected to Lac de Gras)	
			Top Section	Year	at Depth of 40 m Below Surface	Year	Top Section	at Depth of 40 m Below Surface
Strontium	µg/L	30000	56	100	56	100	43	43
Sulfur	µg/L	-	6926	100	6932	100	3461	3461
Thallium	µg/L	0.8	0.011	100	0.011	100	0.0046	0.0046
Tin	µg/L	73	0.22	100	0.22	100	0.084	0.084
Titanium	µg/L	-	0.53	100	0.53	100	0.52	0.52
Uranium	µg/L	15	0.14	100	0.14	100	0.12	0.12
Vanadium	µg/L	-	0.2	100	0.2	100	0.14	0.14
Zinc	µg/L	30	5.4	100	5.4	100	2.0	2.0

Bold indicates concentrations is exceeding benchmark

Scenario 2

a) This scenario is the same as the MVEIRB IR#30 and the response is the same. DDMI would expect the water quality conditions to be largely the same regardless of whether the hydrologic connection is through fractures (as described for Scenario 2) or as excavations. This is because the water exchange back and forth between the pit lakes and Lac de Gras will have to be similar with or without the passageway to manage water levels. On this basis we would predict water quality for the pit lakes to be comparable to those already provided for the original scenario 3a. Table 1 in the response to Scenario 1 includes the maximum modelled concentrations from this original scenario.

   Seasonally, water will tend to move from the pit lake into Lac de Gras when water levels in Lac de Gras are falling (fall/winter) and move from Lac de Gras into the pit lakes when Lac de Gras water levels are rising (spring/summer). A mixing zone will exist in Lac de Gras on the outside of the dike when water is moving from the pit lake area into Lac de Gras. The size of the mixing zone will depend on how the hydrologic connectivity is developed. For example, if the plastic concrete wall is fractured along the full length of the dike a mixing zone would be expected to exist along the full length of the dike but only extend less than 10 m into Lac de Gras. If hydrologic connections are limited to the proposed breach excavation areas then the mixing zone would be limited to those breach locations but could extend further, up to about 50 m into Lac de Gras.

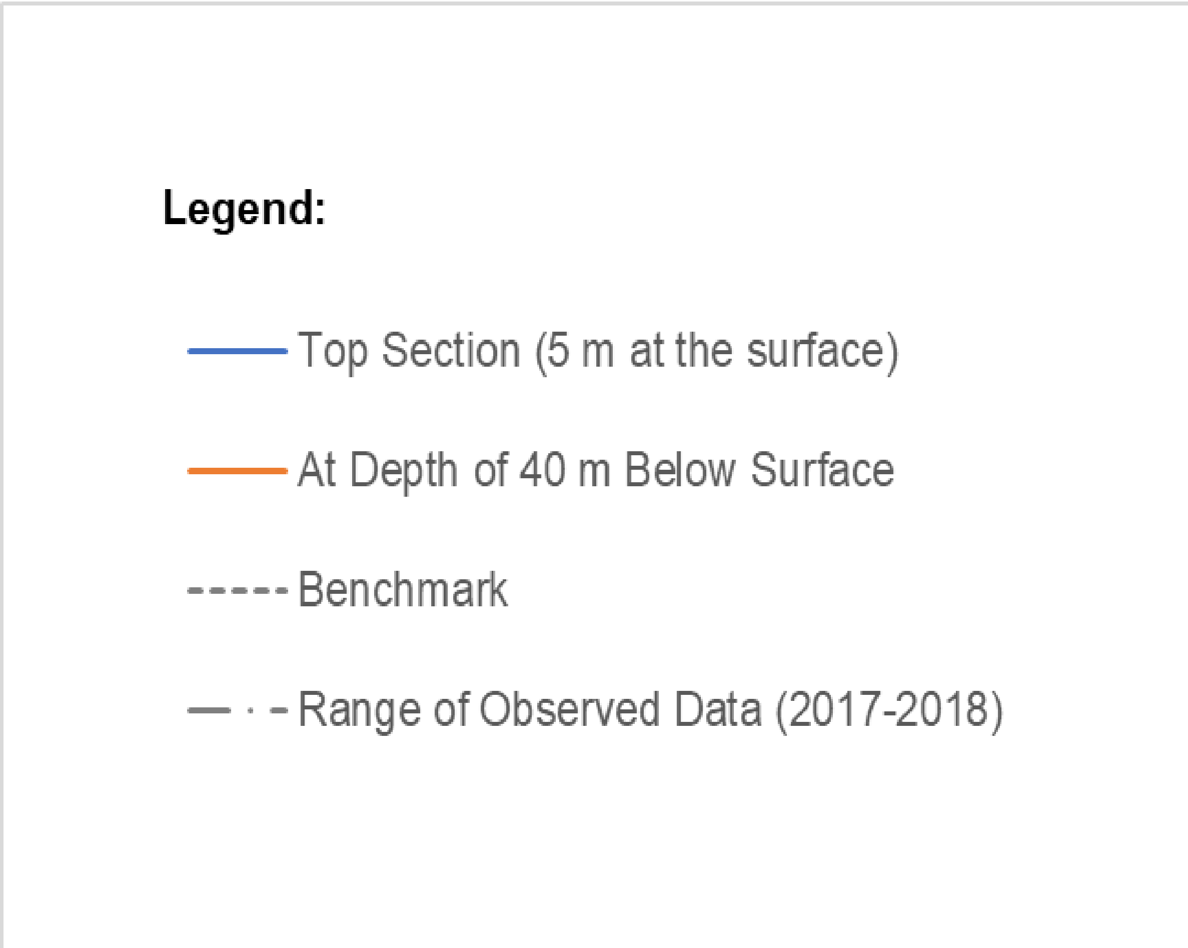
   Within the mixing zone pit lake water will rapidly mix with Lac de Gras water. Water quality within the mixing zone will have conditions in between the predicted pit lake concentrations and Lac de Gras concentrations. Far field water quality would effectively be the concentration of Lac de Gras.

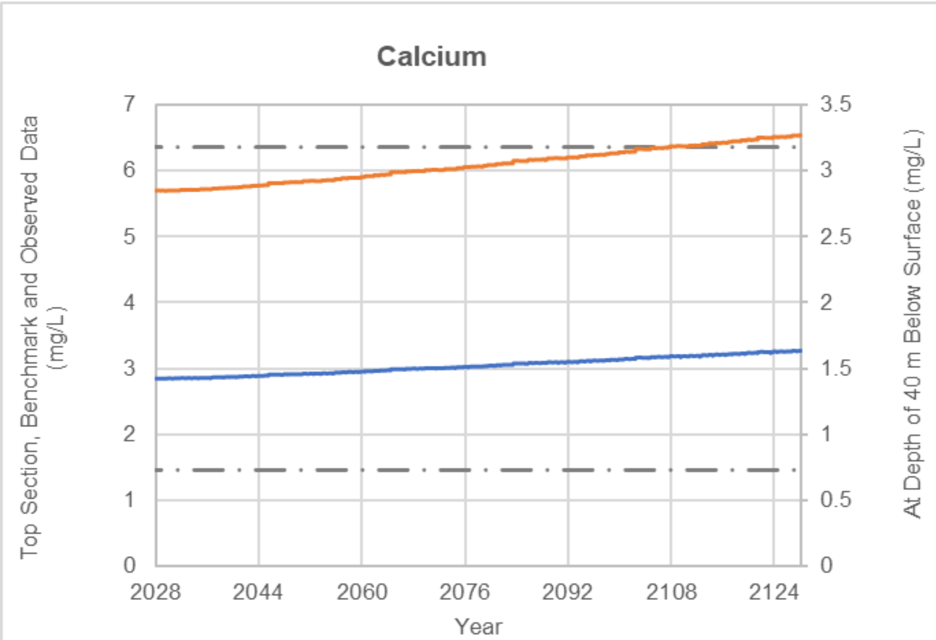
b) There would be no change to the assessment of effects on water quality. The effects to fish and fish habitat would be marginally greater due to the inability for fish to access the pit lakes and we would expect a marginal increase in effects to cultural use due to the inability to access the pit lakes by boat from Lac de Gras.

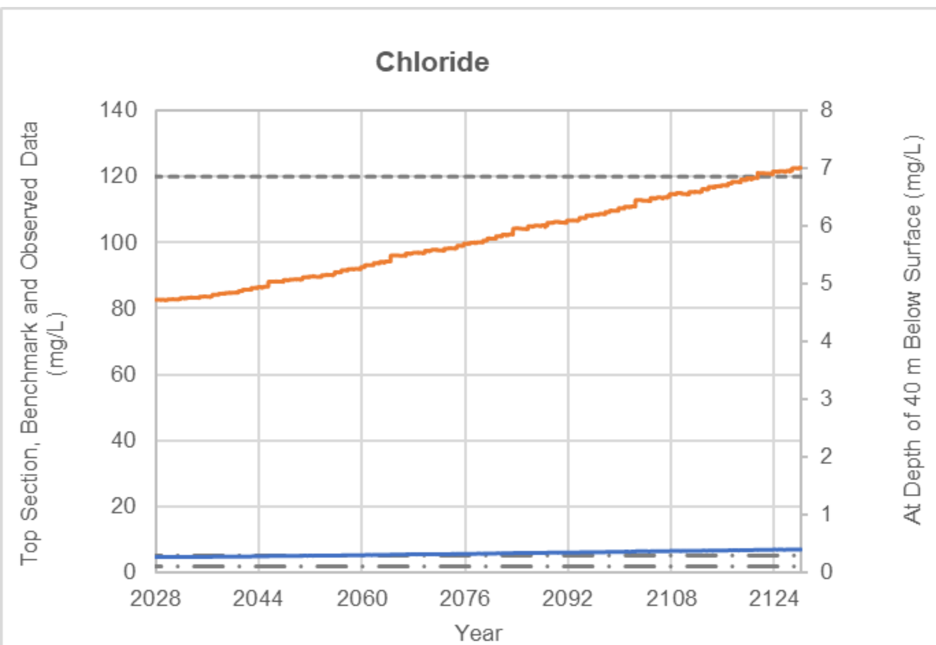
APPENDIX A

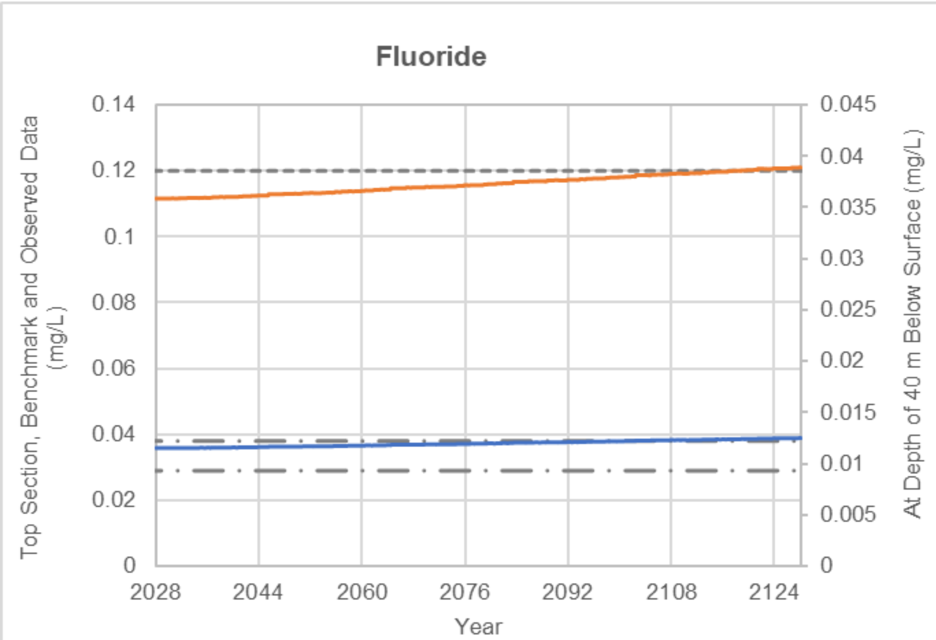
Predicted Time Series of A418 Pit Lake Constituent Concentrations – Scenario 3a. Isolated Pit Lake

Rio Tinto

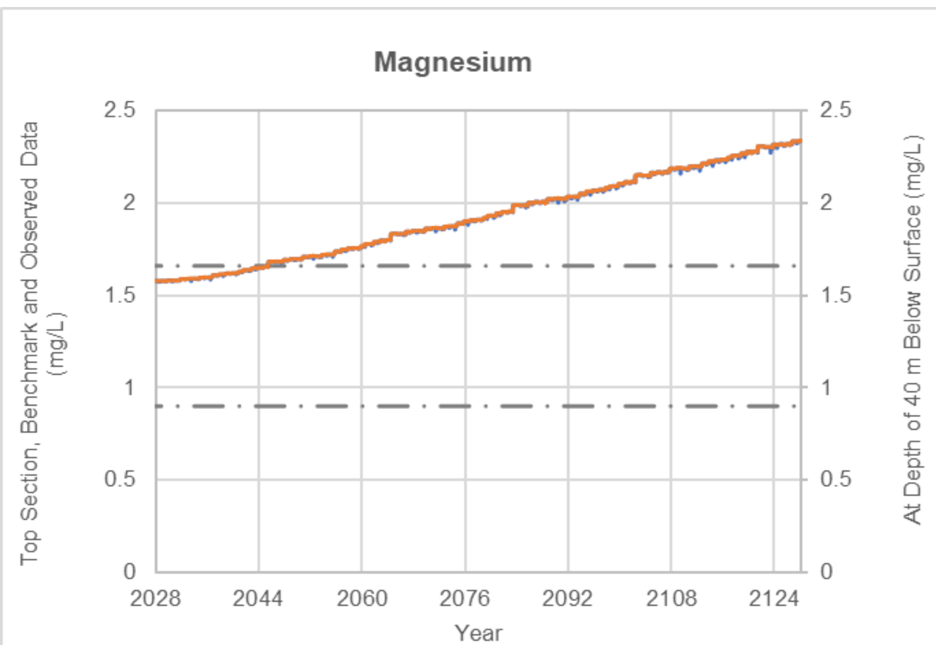

Legend:
Top Section (5 m at the surface)
At Depth of 40 m Below Surface
Benchmark
Range of Observed Data (2017-2018)


Calcium
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
Year
7
6
5
4
3
2
1
0
3.5
3
2.5
2
1.5
1
0.5
0
2028
2044
2060
2076
2092
2108
2124

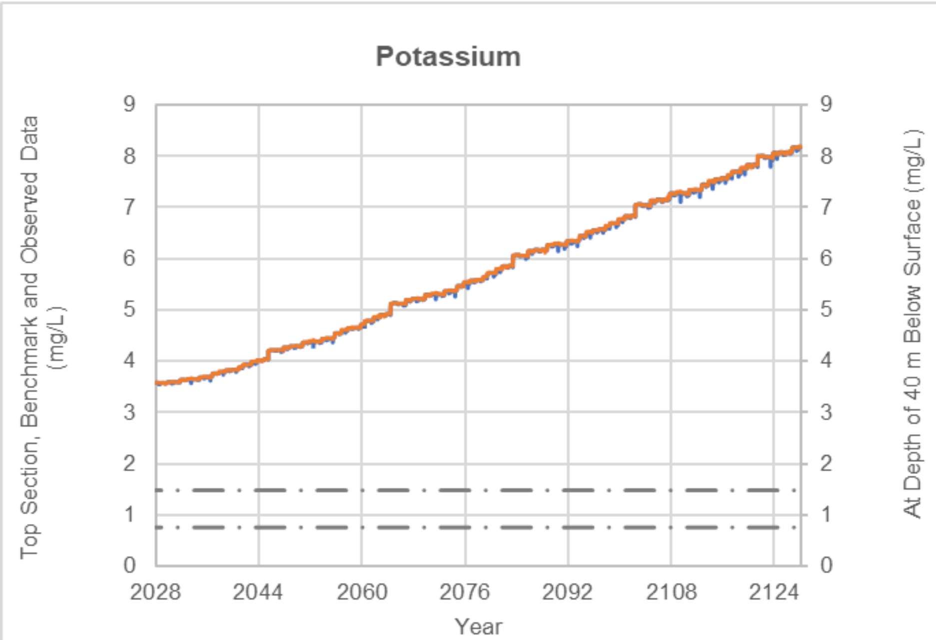

Chloride
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
Year
140
120
100
80
60
40
20
0
8
7
6
5
4
3
2
1
0
2028
2044
2060
2076
2092
2108
2124

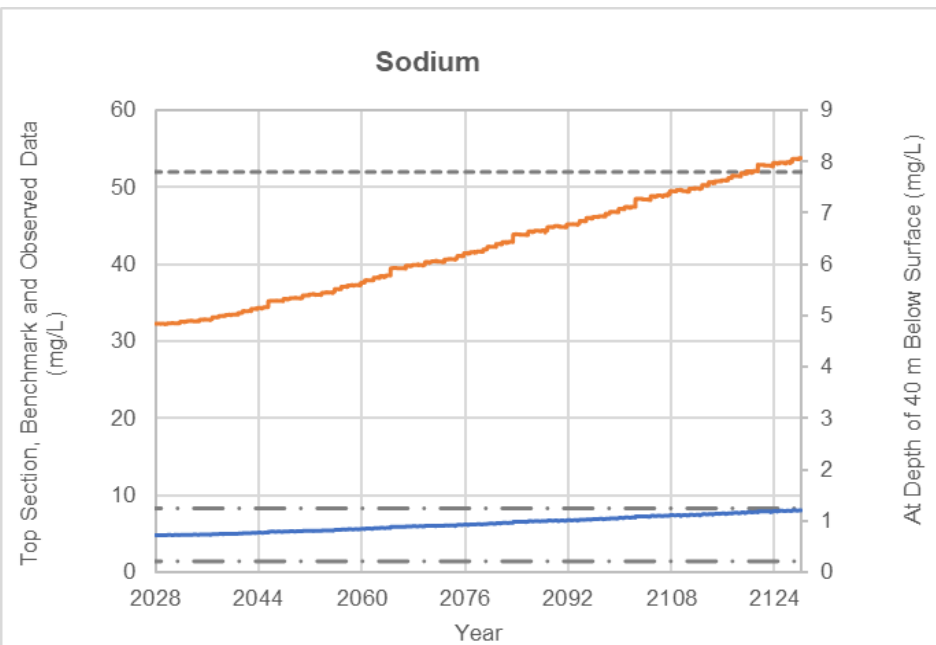


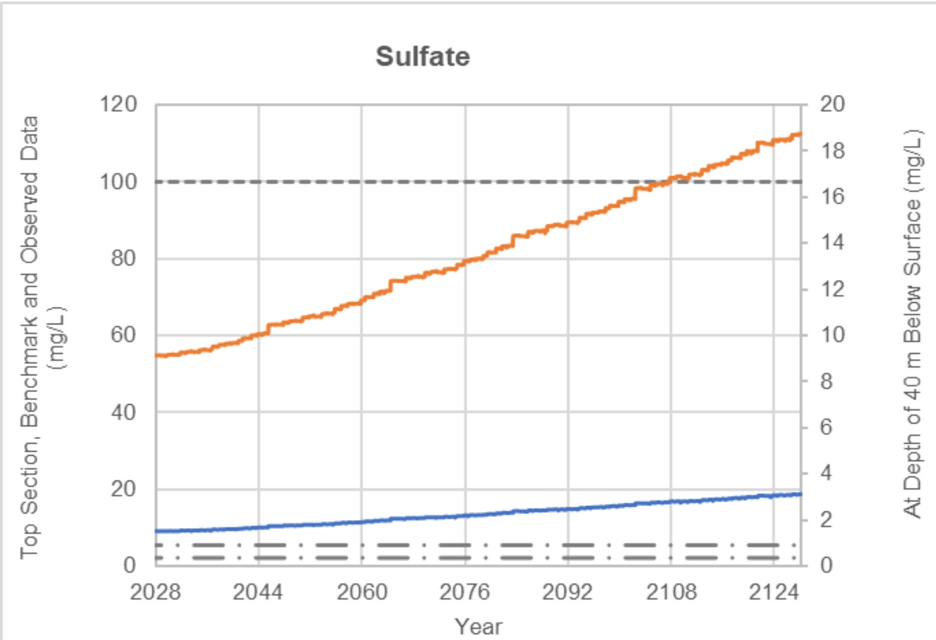
Fluoride
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Top Section, Benchmark and Observed Data (mg/L)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
At Depth of 40 m Below Surface (mg/L)
2028
2044
2060
2076
2092
2108
2124
Year

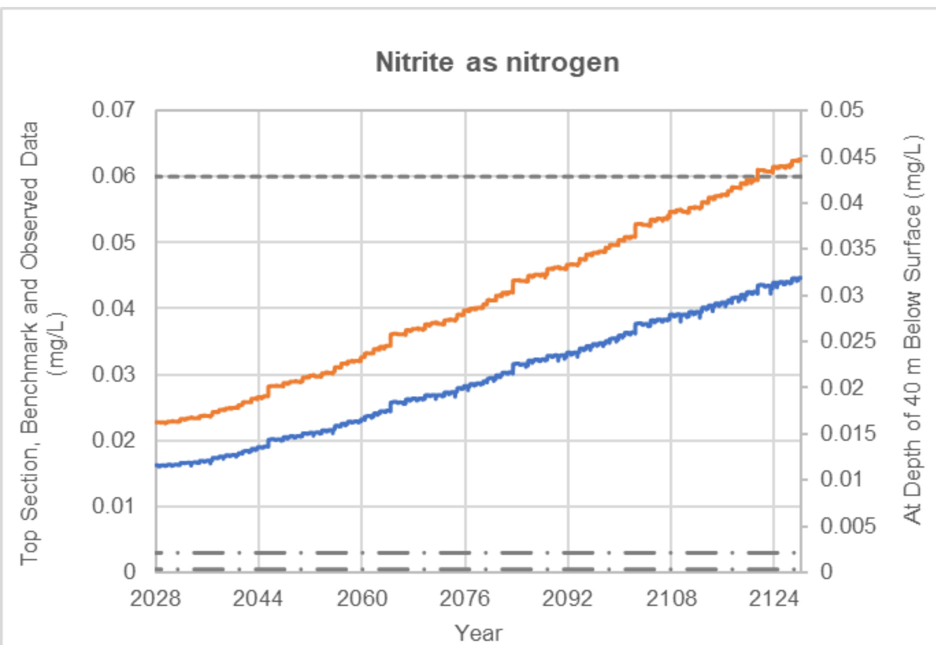


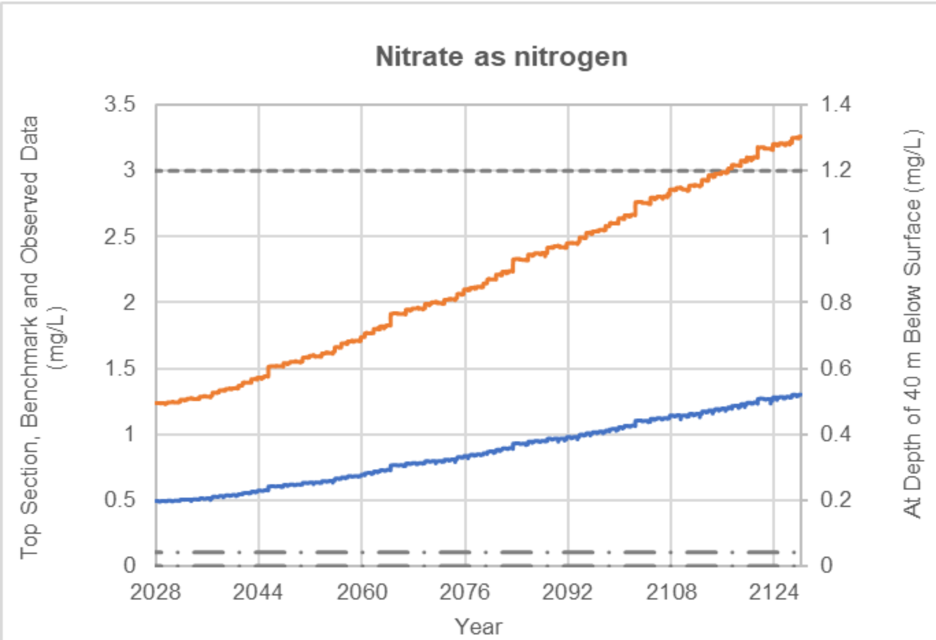
Magnesium
2.5
2
1.5
1
0.5
0
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
2028
2044
2060
2076
2092
2108
2124
Year

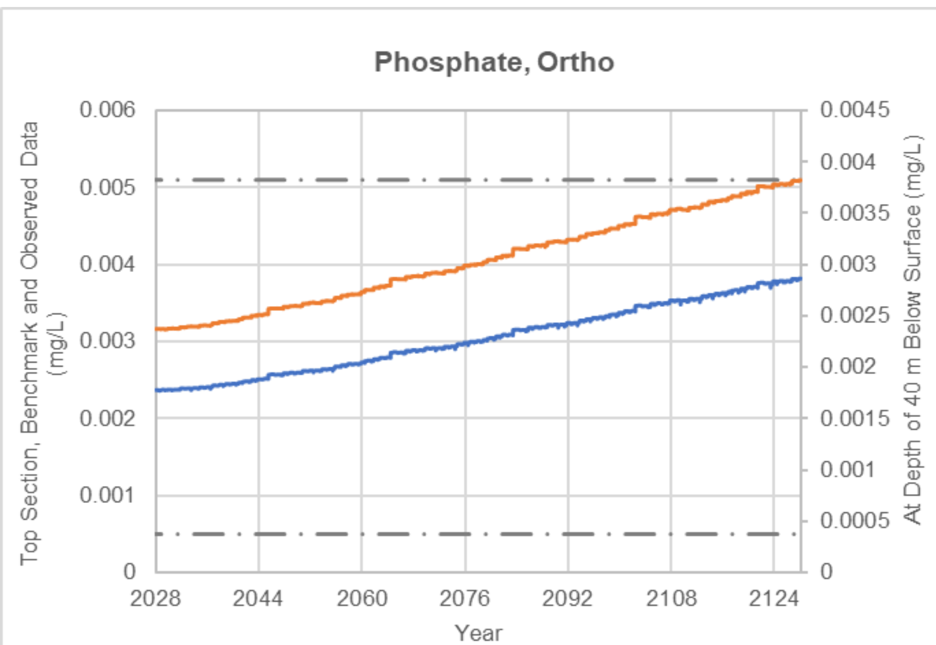

Potassium
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
Year
0
1
2
3
4
5
6
7
8
9
2028
2044
2060
2076
2092
2108
2124

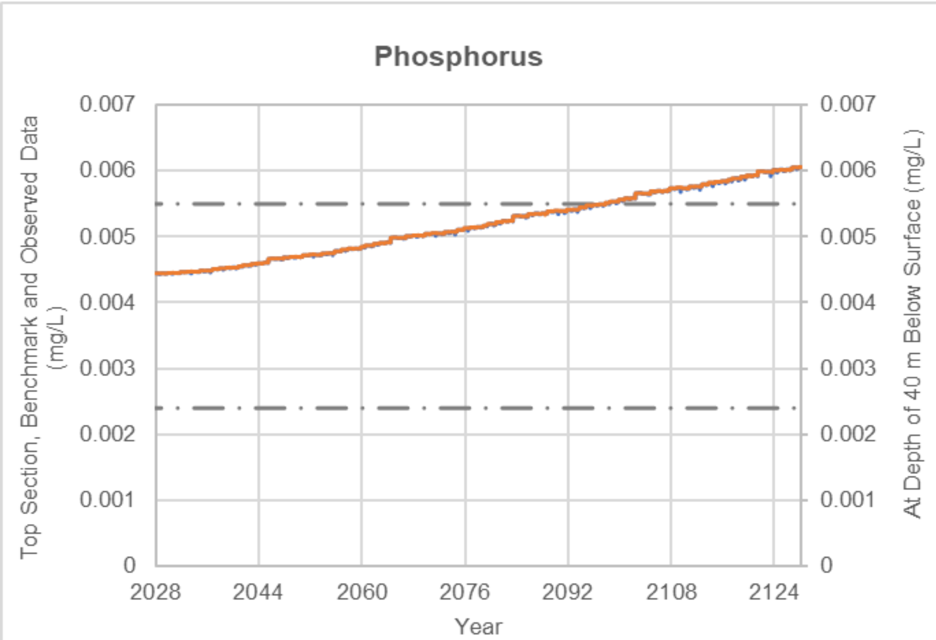

Sodium
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
Year
0
10
20
30
40
50
60
0
1
2
3
4
5
6
7
8
9
2028
2044
2060
2076
2092
2108
2124

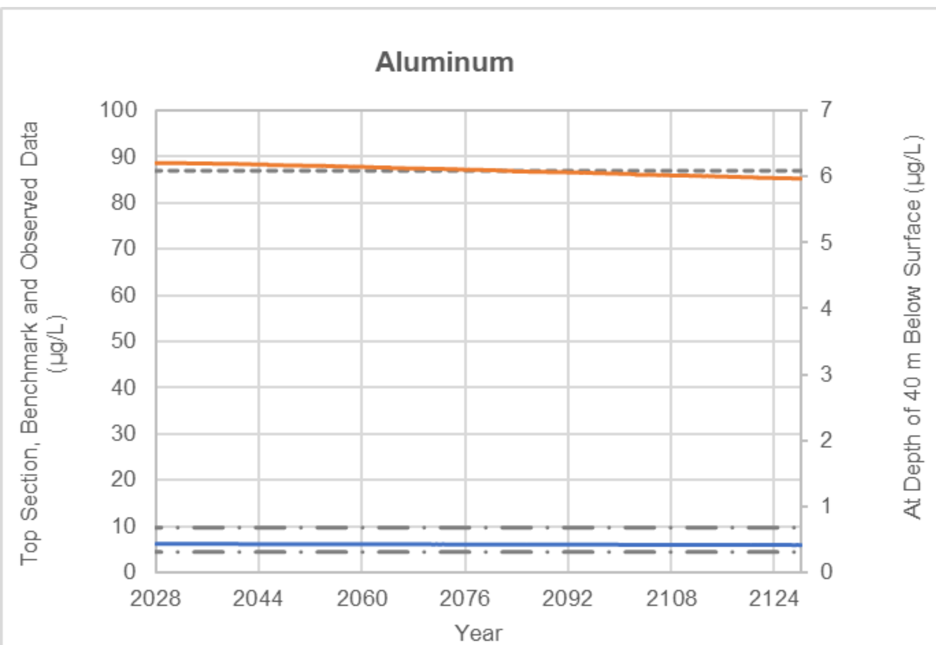

Sulfate
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
120
100
80
60
40
20
0
20
18
16
14
12
10
8
6
4
2
0
2028
2044
2060
2076
2092
2108
2124
Year

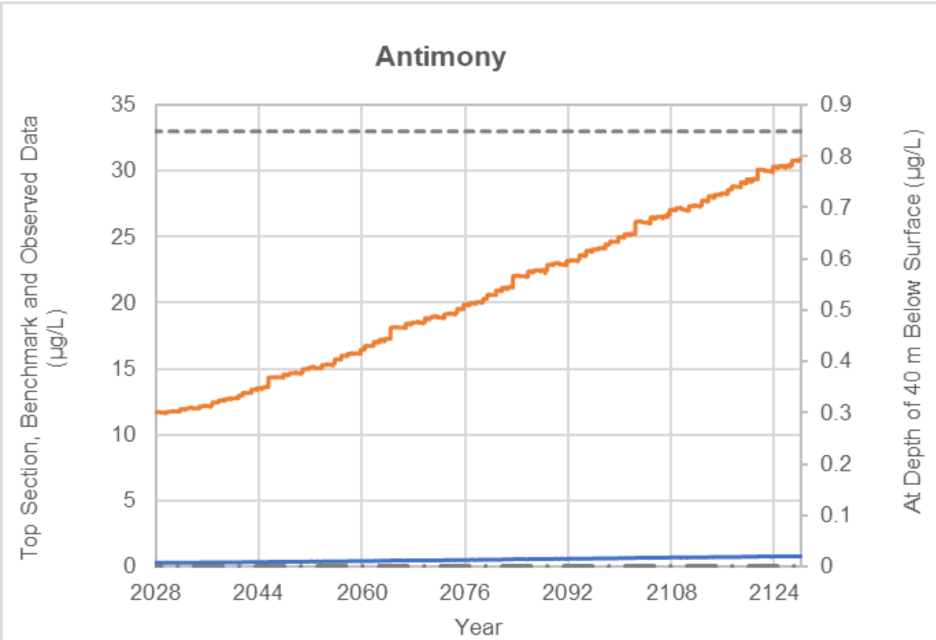

Nitrite as nitrogen
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2028
2044
2060
2076
2092
2108
2124
Year

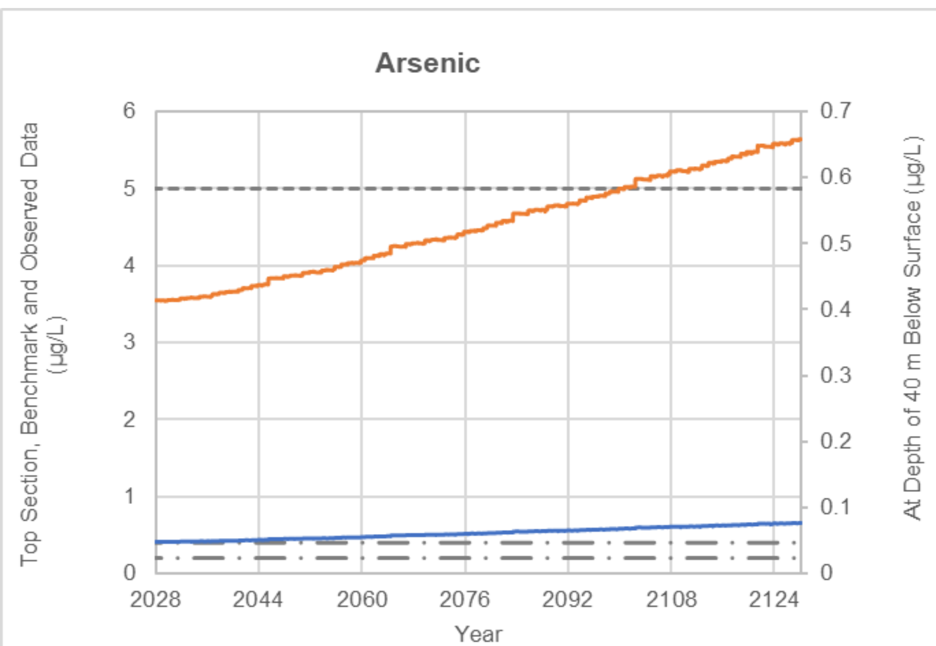

Nitrate as nitrogen
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2028
2044
2060
2076
2092
2108
2124
Year

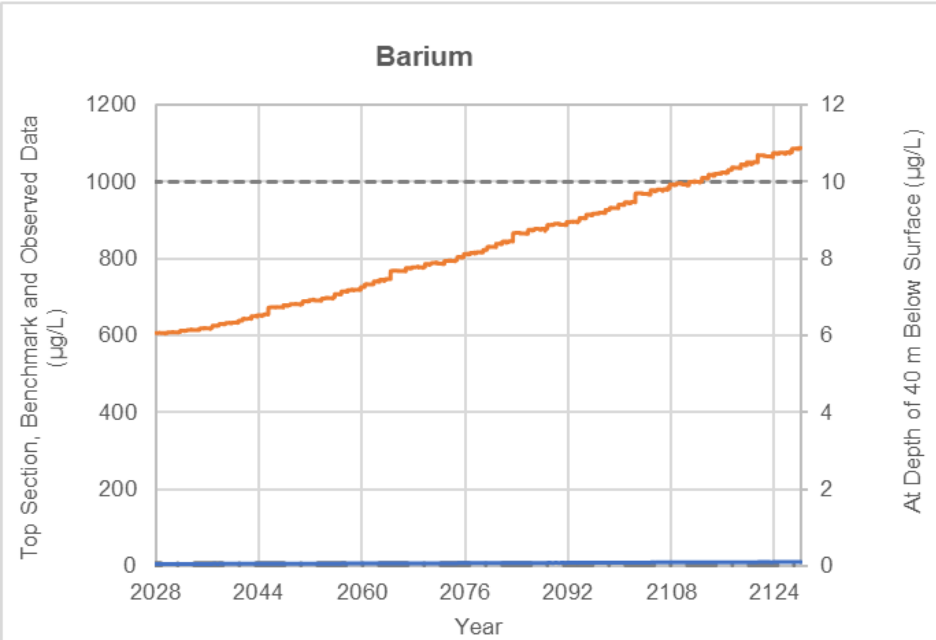

Phosphate, Ortho
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
2028
2044
2060
2076
2092
2108
2124
Year

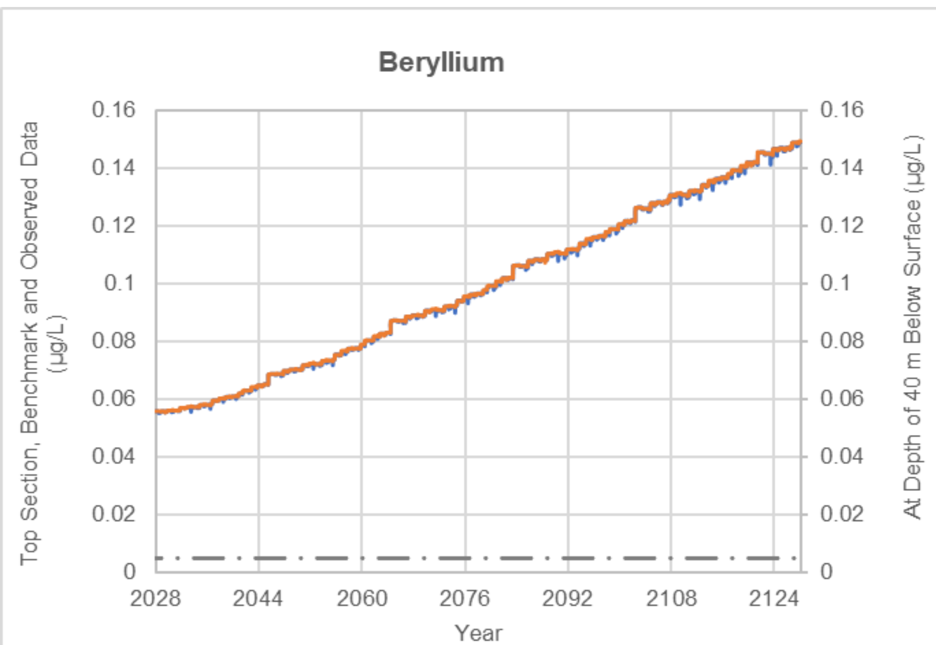

Phosphorus
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
2028
2044
2060
2076
2092
2108
2124
Year

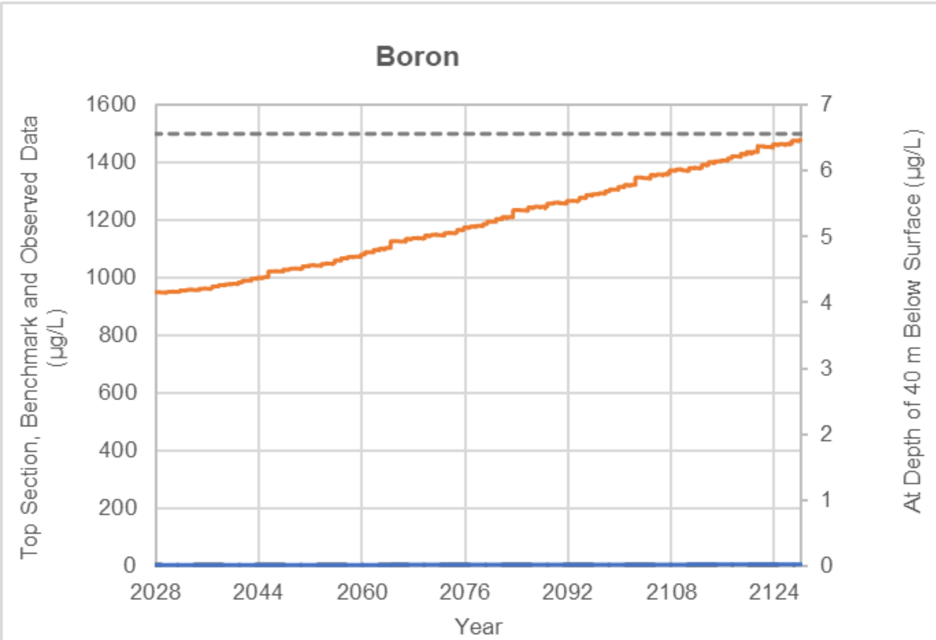

Aluminum
100
90
80
70
60
50
40
30
20
10
0
7
6
5
4
3
2
1
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
2028
2044
2060
2076
2092
2108
2124
Year

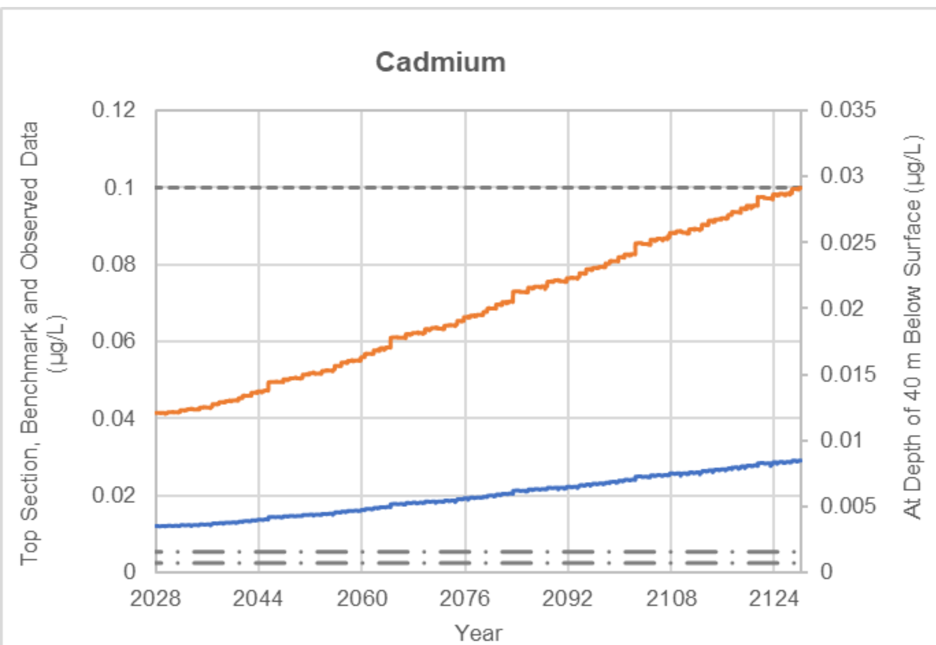

Antimony
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
Year
35
30
25
20
15
10
5
0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2028
2044
2060
2076
2092
2108
2124

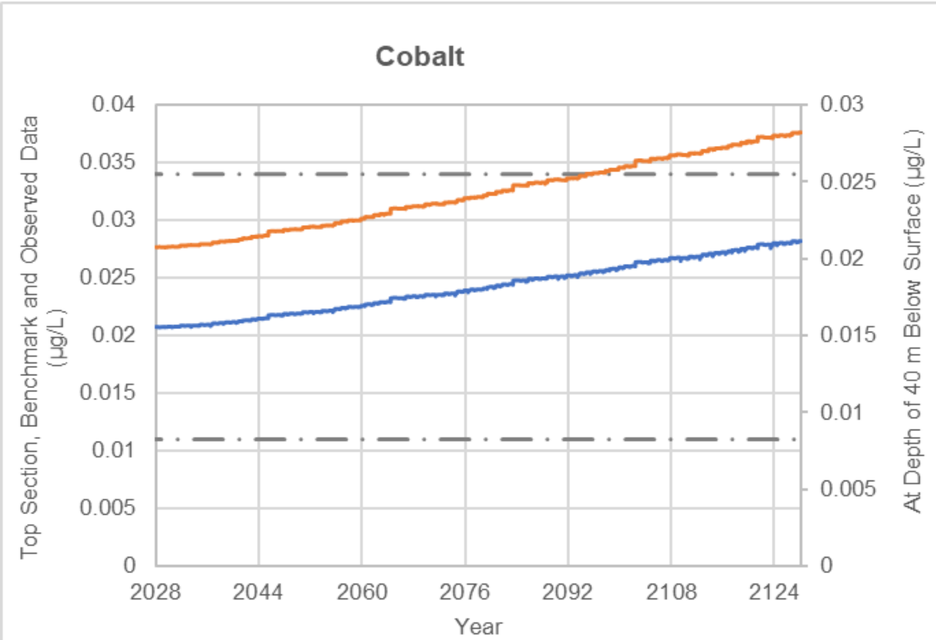

Arsenic
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
Year
6
5
4
3
2
1
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2028
2044
2060
2076
2092
2108
2124

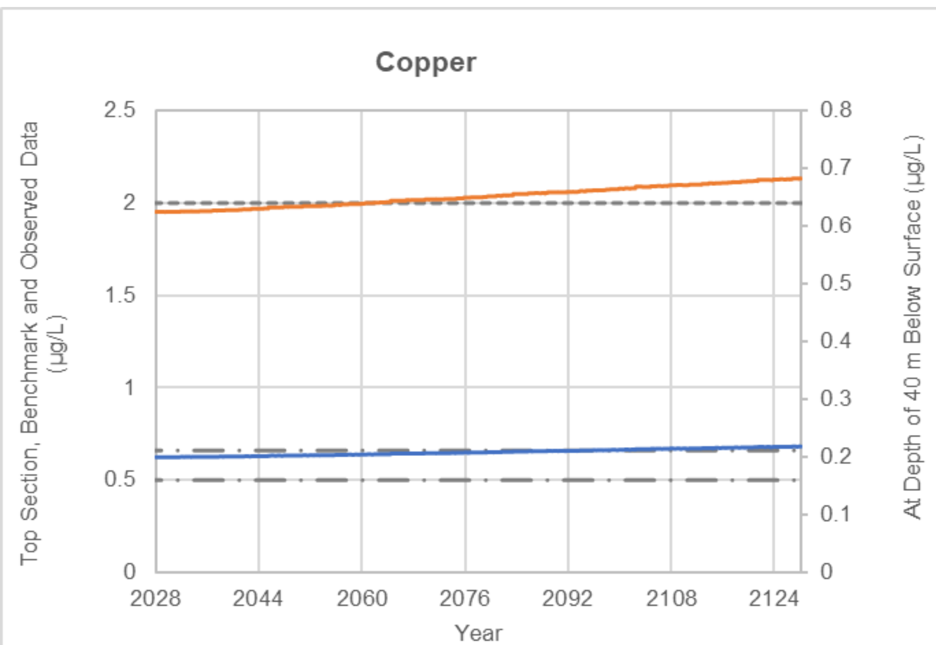

Barium
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
1200
1000
800
600
400
200
0
12
10
8
6
4
2
0
2028
2044
2060
2076
2092
2108
2124
Year

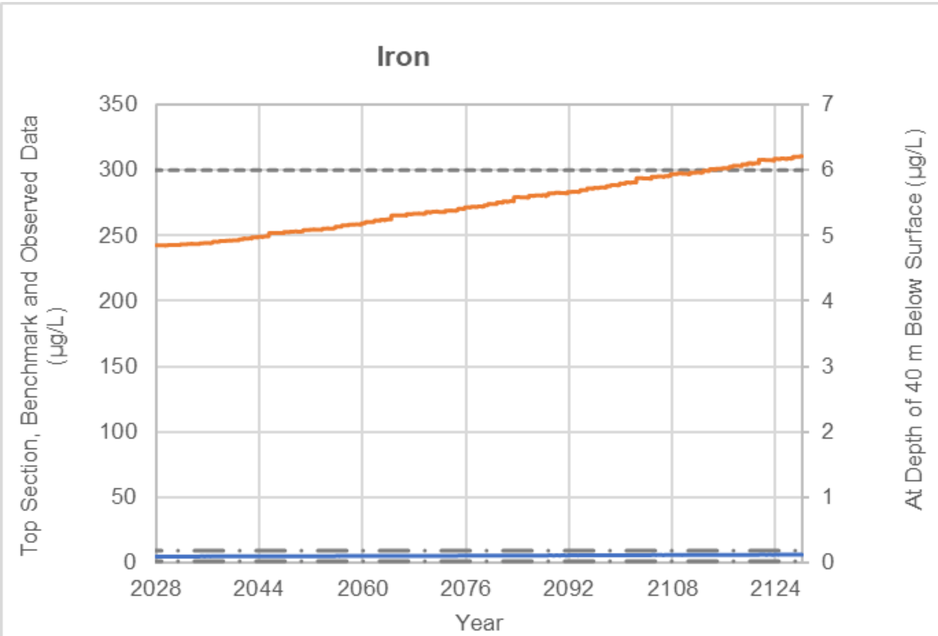

Beryllium
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2028
2044
2060
2076
2092
2108
2124
Year

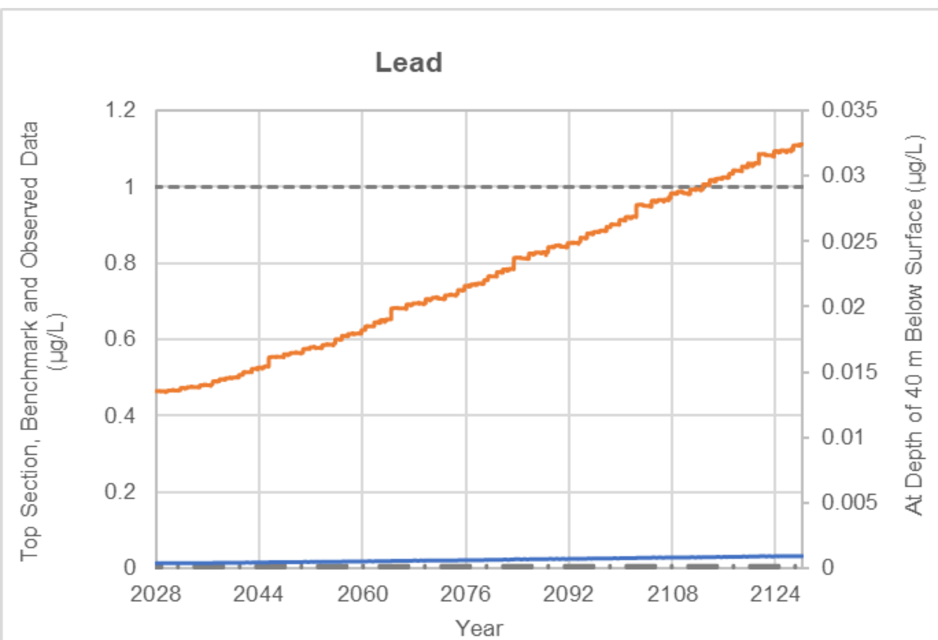

Boron
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
1600
1400
1200
1000
800
600
400
200
0
7
6
5
4
3
2
1
0
2028
2044
2060
2076
2092
2108
2124
Year

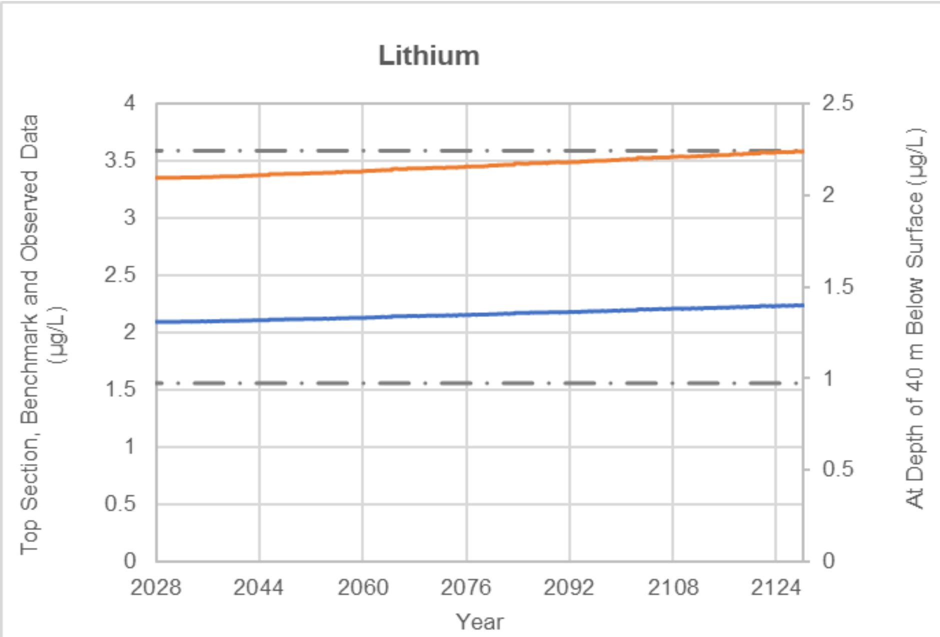

Cadmium
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2028
2044
2060
2076
2092
2108
2124
Year

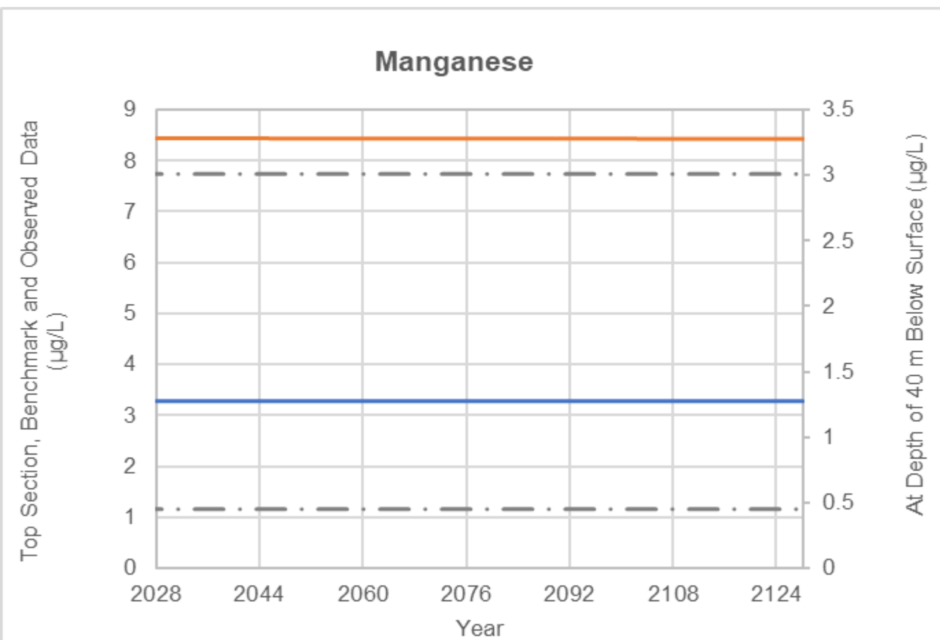

Cobalt
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Top Section, Benchmark and Observed Data (µg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
At Depth of 40 m Below Surface (µg/L)
2028
2044
2060
2076
2092
2108
2124
Year

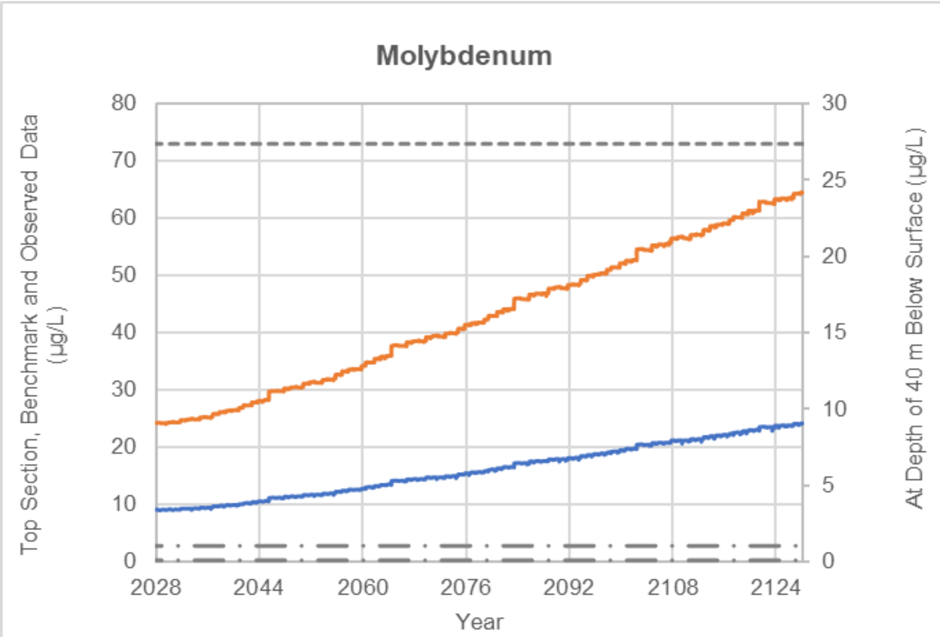

Copper
2.5
2
1.5
1
0.5
0
Top Section, Benchmark and Observed Data (µg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
At Depth of 40 m Below Surface (µg/L)
2028
2044
2060
2076
2092
2108
2124
Year

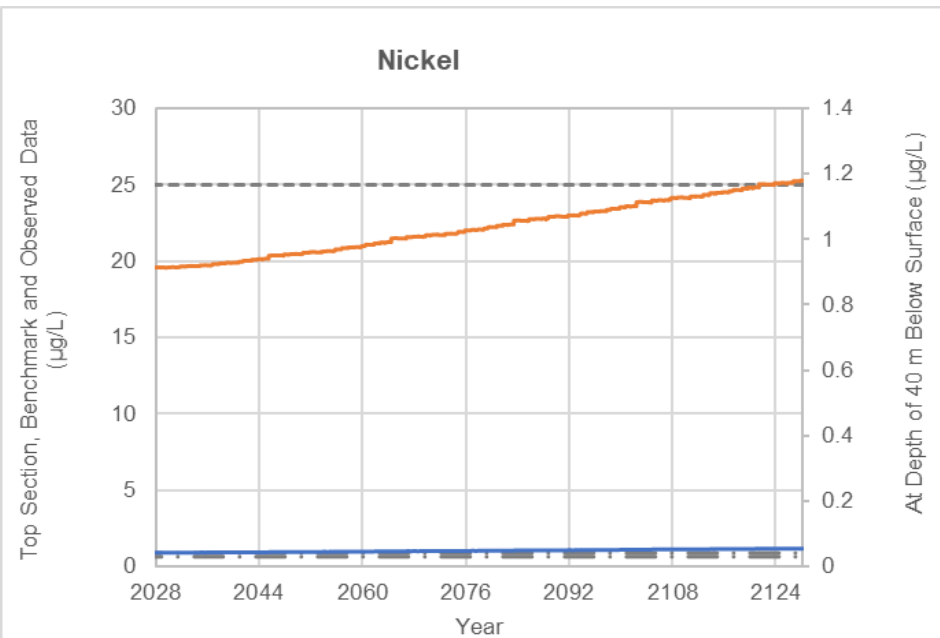

Iron
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
350
300
250
200
150
100
50
0
7
6
5
4
3
2
1
0
2028
2044
2060
2076
2092
2108
2124
Year

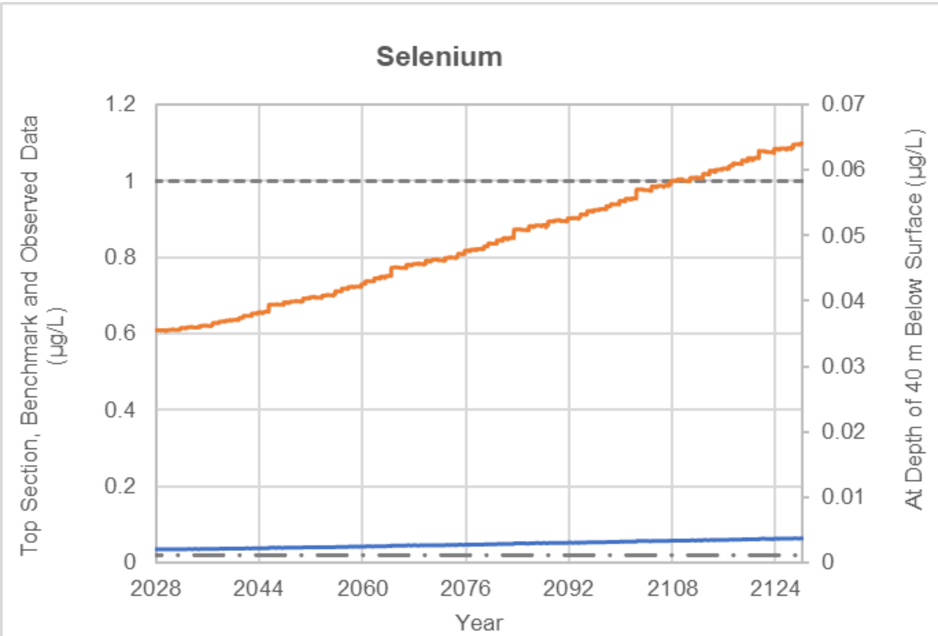

Lead
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
1.2
1
0.8
0.6
0.4
0.2
0
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
2028
2044
2060
2076
2092
2108
2124
Year

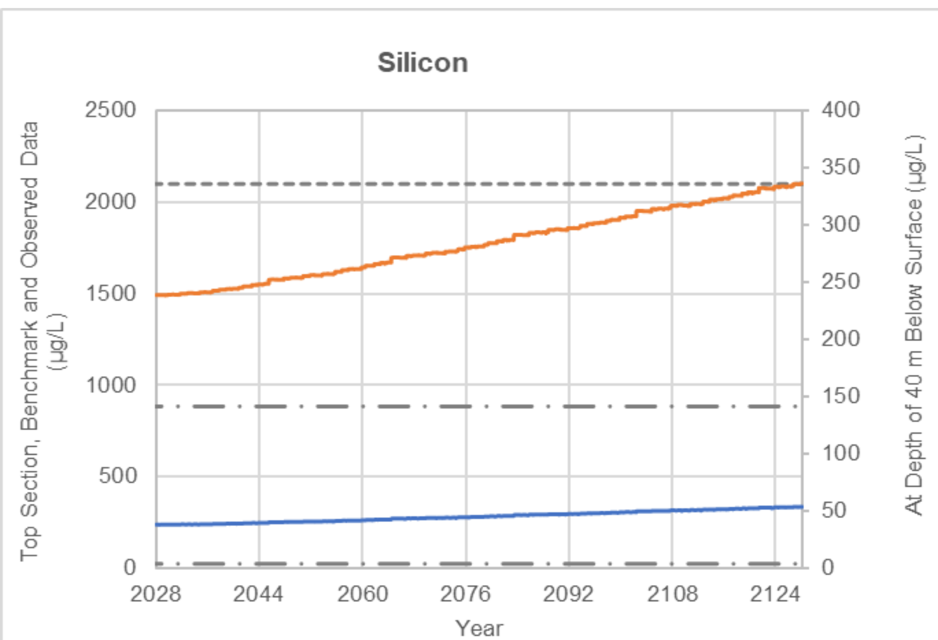

Lithium
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
2.5
2
1.5
1
0.5
0
2028
2044
2060
2076
2092
2108
2124
Year

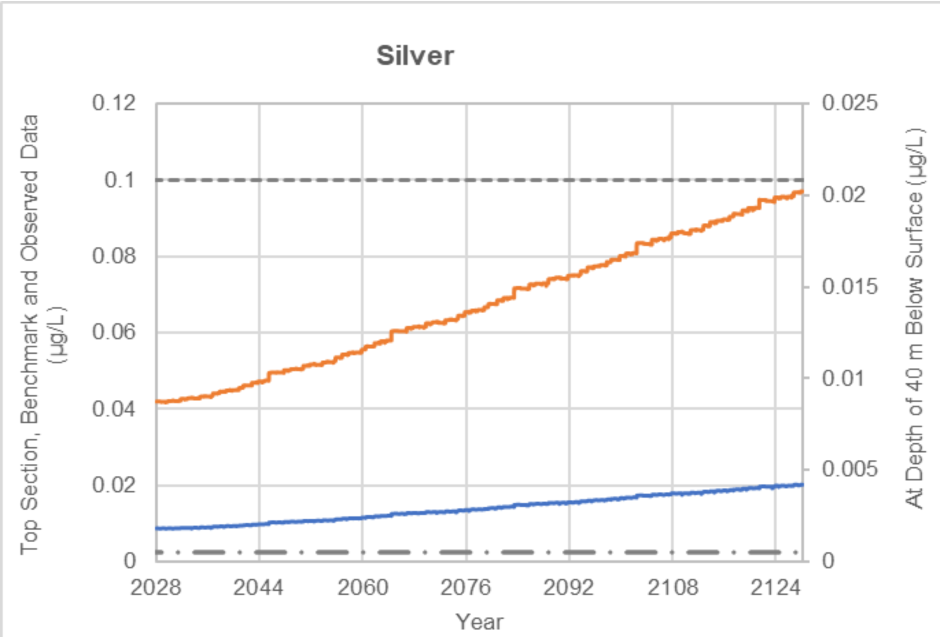

Manganese
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
9
8
7
6
5
4
3
2
1
0
3.5
3
2.5
2
1.5
1
0.5
0
2028
2044
2060
2076
2092
2108
2124
Year

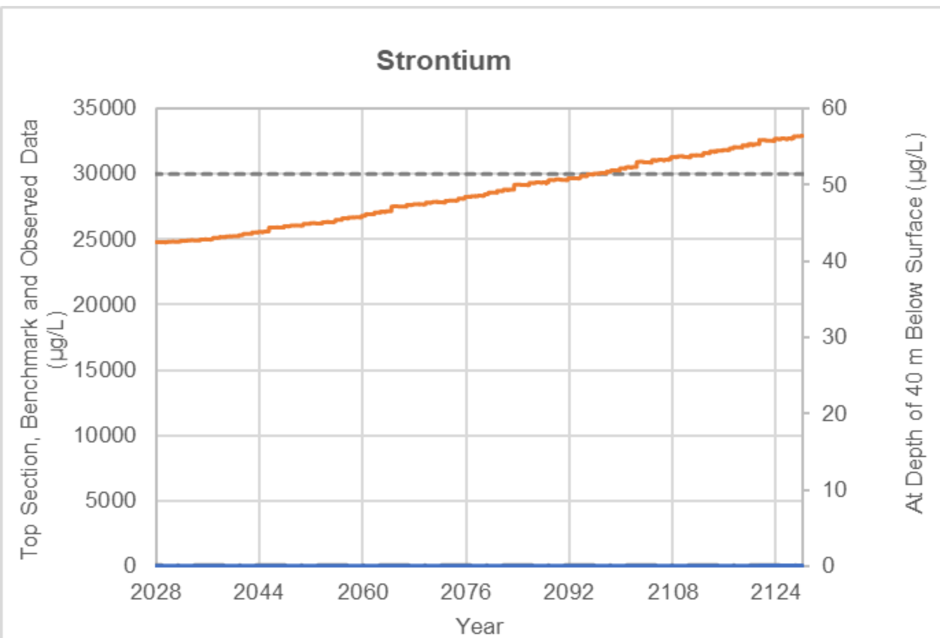

Molybdenum
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
80
70
60
50
40
30
20
10
0
30
25
20
15
10
5
0
2028
2044
2060
2076
2092
2108
2124
Year

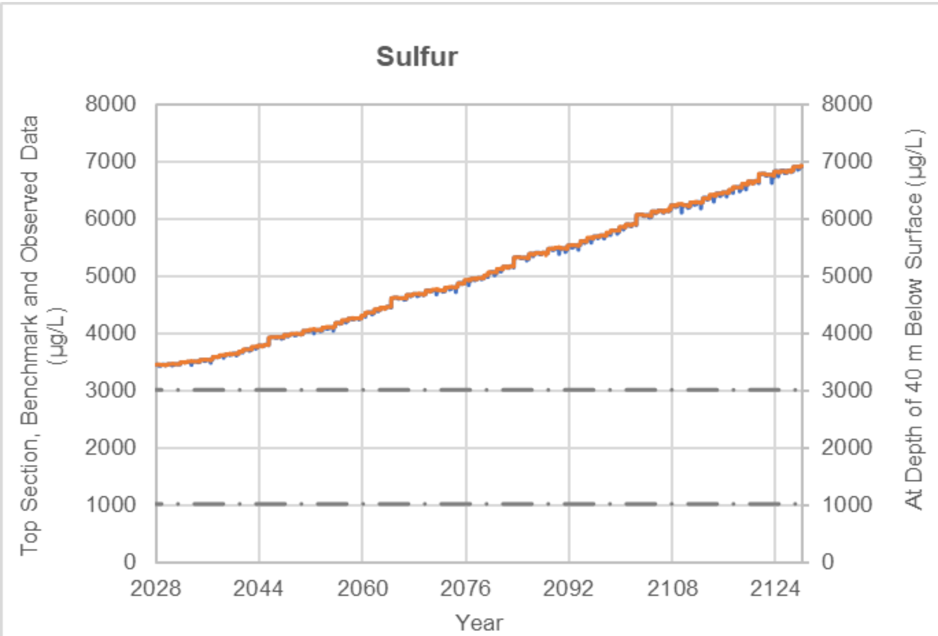

Nickel
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
30
25
20
15
10
5
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2028
2044
2060
2076
2092
2108
2124
Year

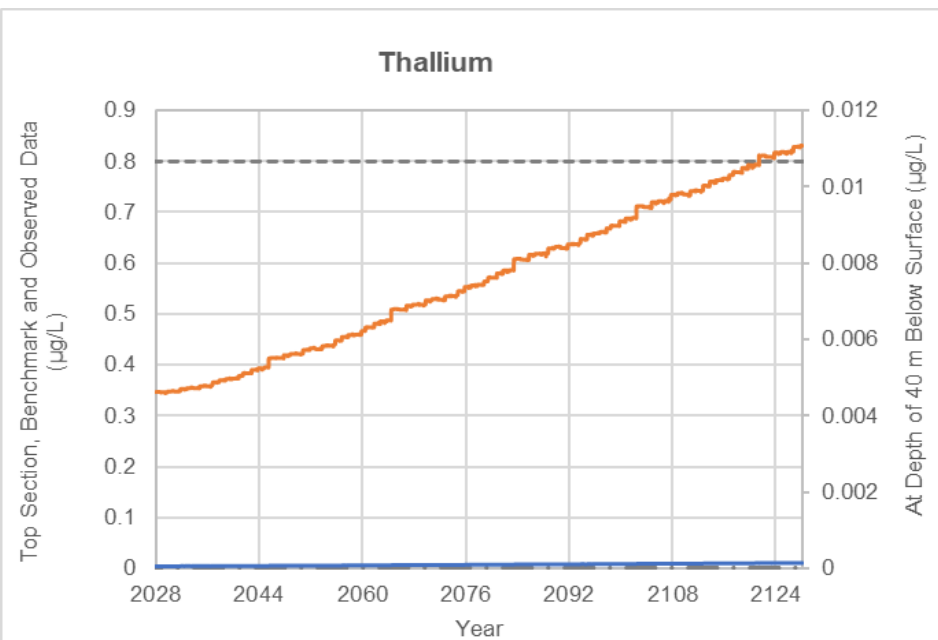

Selenium
1.2
1
0.8
0.6
0.4
0.2
0
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
2028
2044
2060
2076
2092
2108
2124
Year
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)

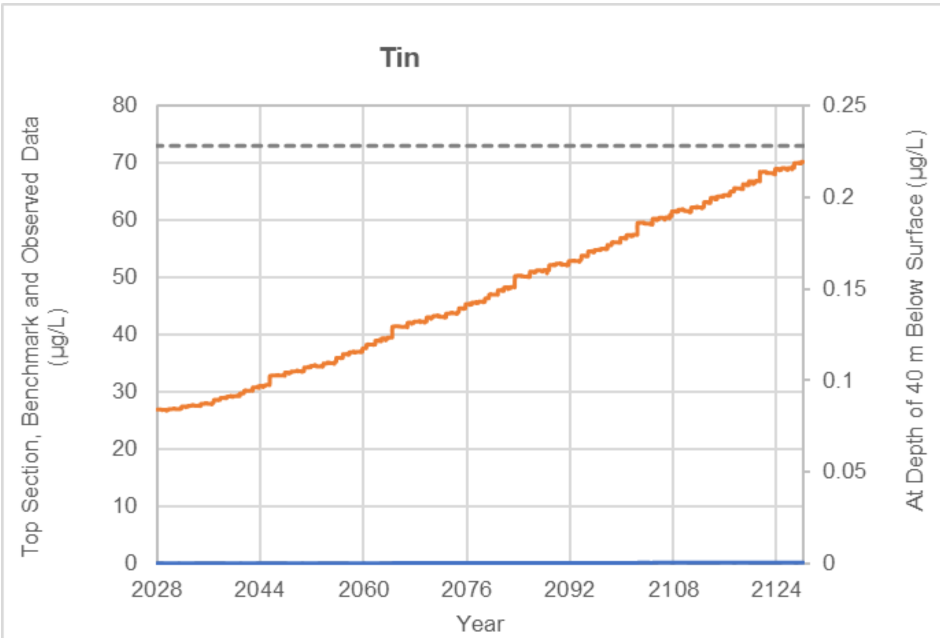

Silicon
2500
2000
1500
1000
500
0
400
350
300
250
200
150
100
50
0
2028
2044
2060
2076
2092
2108
2124
Year
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)

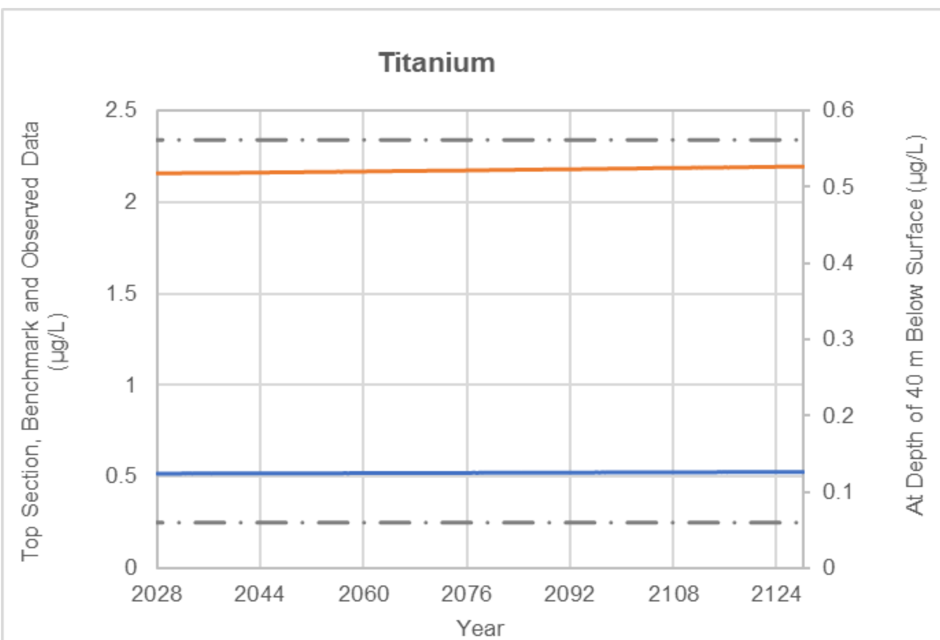

Silver
Top Section, Benchmark and Observed Data (µg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
0.025
0.02
0.015
0.01
0.005
0
At Depth of 40 m Below Surface (µg/L)
2028
2044
2060
2076
2092
2108
2124
Year

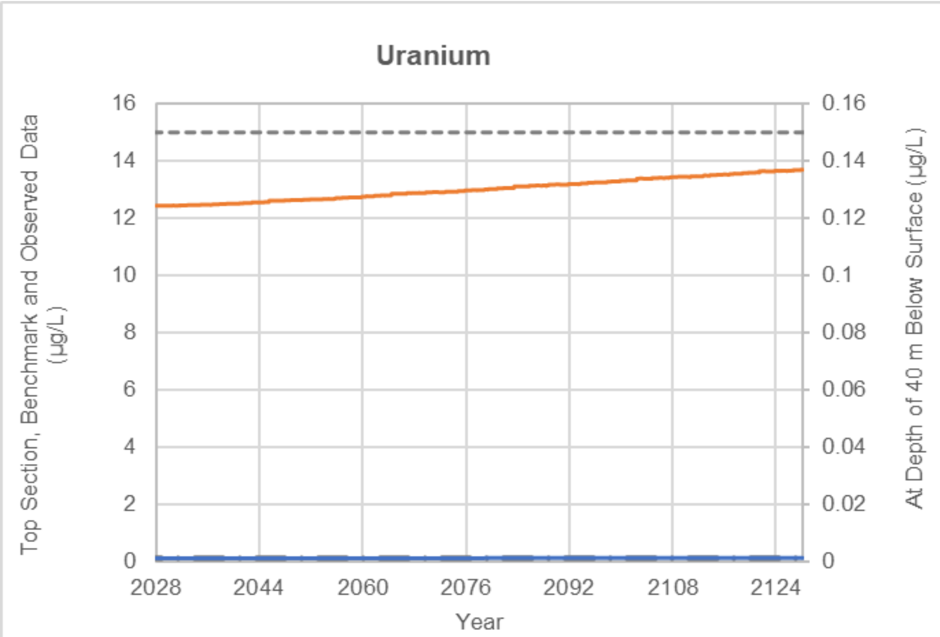

Strontium
Top Section, Benchmark and Observed Data (µg/L)
35000
30000
25000
20000
15000
10000
5000
0
60
50
40
30
20
10
0
At Depth of 40 m Below Surface (µg/L)
2028
2044
2060
2076
2092
2108
2124
Year

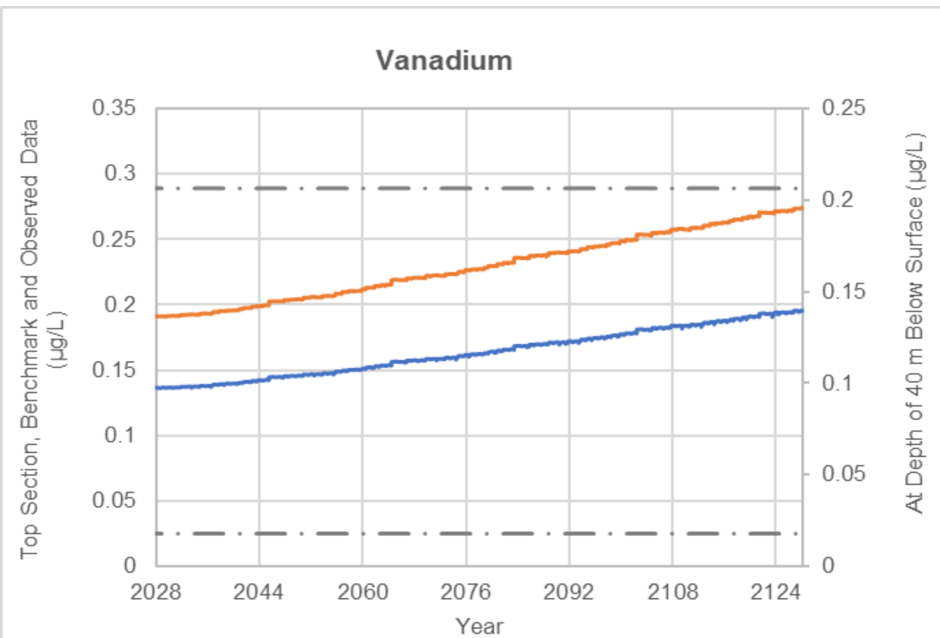

Sulfur
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
Year
0
1000
2000
3000
4000
5000
6000
7000
8000
2028
2044
2060
2076
2092
2108
2124

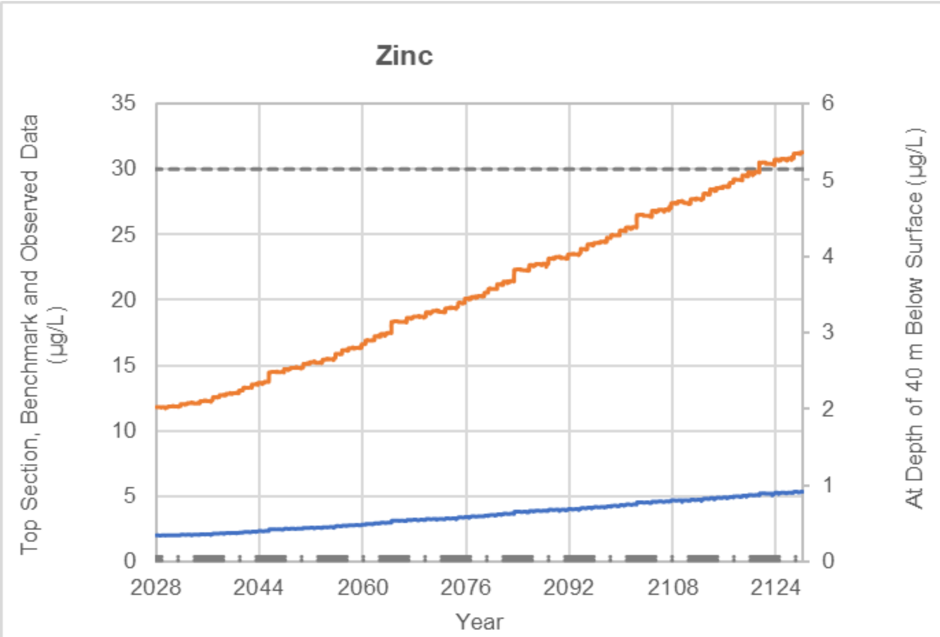

Thallium
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
Year
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.002
0.004
0.006
0.008
0.01
0.012
2028
2044
2060
2076
2092
2108
2124

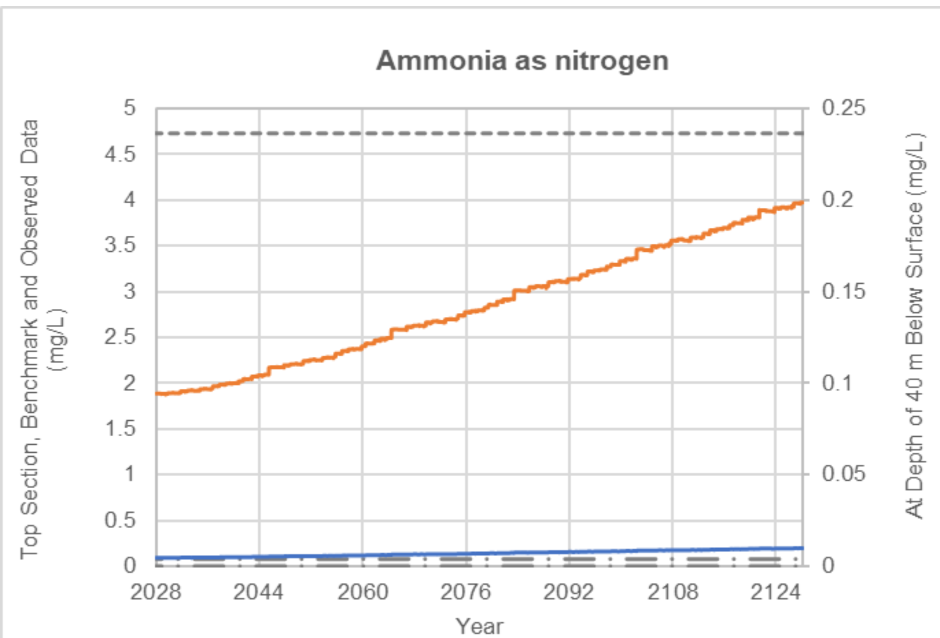

Tin
Top Section, Benchmark and Observed Data (µg/L)
80
70
60
50
40
30
20
10
0
0.25
0.2
0.15
0.1
0.05
0
At Depth of 40 m Below Surface (µg/L)
2028
2044
2060
2076
2092
2108
2124
Year


Titanium
Top Section, Benchmark and Observed Data (µg/L)
2.5
2
1.5
1
0.5
0
0.6
0.5
0.4
0.3
0.2
0.1
0
At Depth of 40 m Below Surface (µg/L)
2028
2044
2060
2076
2092
2108
2124
Year


Uranium
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
16
14
12
10
8
6
4
2
0
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2028
2044
2060
2076
2092
2108
2124
Year


Vanadium
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.25
0.2
0.15
0.1
0.05
0
2028
2044
2060
2076
2092
2108
2124
Year


Zinc
Top Section, Benchmark and Observed Data (µg/L)
At Depth of 40 m Below Surface (µg/L)
35
30
25
20
15
10
5
0
6
5
4
3
2
1
0
2028
2044
2060
2076
2092
2108
2124
Year


Ammonia as nitrogen
Top Section, Benchmark and Observed Data (mg/L)
At Depth of 40 m Below Surface (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.25
0.2
0.15
0.1
0.05
0
2028
2044
2060
2076
2092
2108
2124
Year