

Appendix C3

Water Chemistry – Baker Lake

LIST OF TABLES

Table C3-1.	Water quality results from Baker Lake, 2024.....	1
Table C3-2.	Water and phytoplankton sampling location coordinates (GPS, UTM, NAD83) from Baker Lake, 2024.	1

LIST OF FIGURES

Note: Water quality results in Baker Lake study areas since 2008 are shown in each figure.

Figure C3-1.	Laboratory-measured conductivity ($\mu\text{S}/\text{cm}$).....	3
Figure C3-2.	Laboratory-measured hardness (mg/L).	4
Figure C3-3.	Field-measured pH.	5
Figure C3-4.	Laboratory-measured pH.	6
Figure C3-5.	Total dissolved solids (TDS; mg/L).....	7
Figure C3-6.	Total suspended solids (TSS; mg/L).....	8
Figure C3-7.	Carbonate alkalinity (mg/L).....	9
Figure C3-8.	Bicarbonate alkalinity (mg/L).	10
Figure C3-9.	Total alkalinity (mg/L).	11
Figure C3-10.	Ammonia-N (mg/L).....	12
Figure C3-11.	Chloride (mg/L).	13
Figure C3-12.	Fluoride (mg/L).....	14
Figure C3-13.	Nitrate-N (mg/L).....	15
Figure C3-14.	Nitrite-N (mg/L).....	16
Figure C3-15.	Total Kjeldahl Nitrogen (TKN; mg/L).	17
Figure C3-16.	Ortho-phosphate (mg/L).	18
Figure C3-17.	Total phosphorous (mg/L).....	19
Figure C3-18.	Reactive silica (mg/L).	20
Figure C3-19.	Sulphate (mg/L).....	21
Figure C3-20.	Dissolved organic carbon (DOC; mg/L).	22
Figure C3-21.	Total organic carbon (TOC; mg/L).	23
Figure C3-22.	Total aluminum (mg/L).....	24
Figure C3-23.	Total antimony (mg/L).	25
Figure C3-24.	Total arsenic (mg/L).	26

Figure C3-25.	Total barium (mg/L).	27
Figure C3-26.	Total beryllium (mg/L).....	28
Figure C3-27.	Total boron (mg/L).	29
Figure C3-28.	Total cadmium (mg/L).....	30
Figure C3-29.	Total calcium (mg/L).....	31
Figure C3-30.	Total chromium (mg/L).	32
Figure C3-31.	Total copper (mg/L).....	33
Figure C3-32.	Total iron (mg/L).	34
Figure C3-33.	Total lead (mg/L).	35
Figure C3-34.	Total lithium (mg/L).	36
Figure C3-35.	Total magnesium (mg/L).	37
Figure C3-36.	Total manganese (mg/L).	38
Figure C3-37.	Total mercury (mg/L).	39
Figure C3-38.	Total molybdenum (mg/L).	40
Figure C3-39.	Total nickel (mg/L).....	41
Figure C3-40.	Total potassium (mg/L).	42
Figure C3-41.	Total selenium (mg/L).	43
Figure C3-42.	Total silicon (mg/L).....	44
Figure C3-43.	Total silver (mg/L).	45
Figure C3-44.	Total sodium (mg/L).....	46
Figure C3-45.	Total strontium (mg/L).....	47
Figure C3-46.	Total thallium (mg/L).....	48
Figure C3-47.	Total tin (mg/L).....	49
Figure C3-48.	Total titanium (mg/L).	50
Figure C3-49.	Total uranium (mg/L).	51
Figure C3-50.	Total vanadium (mg/L).....	52
Figure C3-51.	Total zinc (mg/L).....	53
Figure C3-52.	Dissolved aluminum (mg/L).	54
Figure C3-53.	Dissolved antimony (mg/L).	55
Figure C3-54.	Dissolved arsenic (mg/L).	56
Figure C3-55.	Dissolved barium (mg/L).	57

Figure C3-56.	Dissolved beryllium (mg/L).	58
Figure C3-57.	Dissolved boron (mg/L).	59
Figure C3-58.	Dissolved cadmium (mg/L).	60
Figure C3-59.	Dissolved chromium (mg/L).	61
Figure C3-60.	Dissolved copper (mg/L).	62
Figure C3-61.	Dissolved iron (mg/L).	63
Figure C3-62.	Dissolved lead (mg/L).	64
Figure C3-63.	Dissolved lithium (mg/L).	65
Figure C3-64.	Dissolved manganese (mg/L).	66
Figure C3-65.	Dissolved mercury (mg/L).	67
Figure C3-66.	Dissolved molybdenum (mg/L).	68
Figure C3-67.	Dissolved nickel (mg/L).	69
Figure C3-68.	Dissolved selenium (mg/L).	70
Figure C3-69.	Dissolved silicon (mg/L).	71
Figure C3-70.	Dissolved silver (mg/L).	72
Figure C3-71.	Dissolved strontium (mg/L).	73
Figure C3-72.	Dissolved thallium (mg/L).	74
Figure C3-73.	Dissolved tin (mg/L).	75
Figure C3-74.	Dissolved titanium (mg/L).	76
Figure C3-75.	Dissolved uranium (mg/L).	77
Figure C3-76.	Dissolved vanadium (mg/L).	78
Figure C3-77.	Dissolved zinc (mg/L).	79

TABLES

Table C3-1. Water quality results from Baker Lake, 2024.

Month & Area

Area Replicate ID

Aquatic Life Guideline²

Triggers

Thresholds

Baker Lake Screening Values¹

July

July

August

August

September

September

BAP-23

BAP-22

BAP-22

BAP-21

BAP-21

BAP-21

14-Jul-2024

14-Jul-2024

12-Aug-2024

12-Aug-2024

09-Sep-2024

09-Sep-2024

14:15

14:35

12:20

12:20

11:35

11:15

Baker Lake - Barge Dock (BBD)

July

July

August

August

September

September

BBD-23

BBD-22

BBD-22

BBD-21

BBD-21

BBD-21

14-Jul-2024

14-Jul-2024

12-Aug-2024

12-Aug-2024

09-Sep-2024

09-Sep-2024

14:10

14:10

12:40

12:40

13:00

13:30

Baker Lake - Proposed Jetty (BPJ)

July

July

August

August

September

September

BPJ-23

BPJ-22

BPJ-22

BPJ-21

BPJ-21

BPJ-21

14-Jul-2024

14-Jul-2024

12-Aug-2024

12-Aug-2024

09-Sep-2024

09-Sep-2024

13:40

13:40

14:28

14:28

14:55

12:45

Field Measurements (3 m)

Dissolved Oxygen (mg/L)

Specific Conductivity (µS/cm)

pH

Temperature (°C)

13.4

381

6.7

5.1

13.5

300

6.9

11.45

11.5

177

6.9

11.45

11.4

150

6.8

11.93

11.4

145

7.0

9.7

11.4

142

6.8

9.7

13.6

26.3

6.8

5.6

13.5

21.1

6.8

6.4

10.4

27.8

6.8

13.73

10.4

27.8

6.8

13.45

11.2

29.8

6.8

9.9

11.3

33.0

6.8

9.8

13.4

54

6.4

5.5

13.3

48.8

6.4

5.5

10.7

37.2

6.9

13.80

10.7

33.2

6.9

13.44

11.3

65

6.9

9.6

11.3

65

6.9

9.6

Physical Tests (mg/L)

Conductivity (µS/cm)

Alkalinity - Bicarbonate

Alkalinity - Carbonate

Alkalinity - Hydroxide

Alkalinity - Total (as CaCO₃)

Hardness (as CaCO₃) dissolved

Hardness (as CaCO₃) from total Ca/Mg

Total Dissolved Solids (TDS)

Total Suspended Solids (TSS)

Turbidity (NTU)

pH (Laboratory)

642

8.6

2.0

10.6

10.6

65

20.8

245

3.0

0.35

7.2

279

8.9

<1.0

<1.0

8.6

18.7

33.5

84

5.0

0.37

7.2

175

10.3

<1.0

<1.0

9.9

22.9

25

101

<1.0

0.23

7.2

153

9.9

<1.0

<1.0

8.9

22.9

24.6

102

<1.0

0.25

7.3

160

9.8

<1.0

<1.0

8.9

22.9

24.6

88

<1.0

0.36

7.2

144

9.7

<1.0

<1.0

8.9

22.9

24.6

88

<1.0

0.45

7.2

27

8.5

<1.0

<1.0

8.7

10.6

12

20.8

<1.0

0.17

7.3

31.8

9.7

<1.0

<1.0

9.7

11.3

11.5

24.2

<1.0

0.24

7.2

28.7

10

<1.0

<1.0

9.7

11.7

12.1

27.9

<1.0

0.32

7.3

30.4

9.9

<1.0

<1.0

9.7

12.2

12.4

28.8

<1.0

0.28

7.2

35.8

9.8

<1.0

<1.0

9.8

12.7

12.6

22.6

<1.0

0.34

7.2

38.3

8.7

<1.0

<1.0

8.7

12.7

12.1

20.8

<1.0

0.32

7.2

48.1

8.9

<1.0

<1.0

8.9

11.5

11.2

25.6

<1.0

0.31

7.3

38.1

9.8

<1.0

<1.0

9.8

12.1

11.2

29.4

<1.0

0.23

7.3

38.9

9.3

<1.0

<1.0

9.3

12.7

12.1

26.5

<1.0

0.27

7.2

29.3

10.3

<1.0

<1.0

10.3

15.6

15.2

45.3

<1.0

0.31

7.2

76

9.9

<1.0

<1.0

9.9

14.4

14.4

19.7

<1.0

0.25

7.2

9.6

9.6

<1.0

<1.0

9.6

9.6

9.6

9.6

<1.0

0.25

7.2

Anions and Nutrients (mg/L)

Ammonia (as N)

Bromide

Chloride

Fluoride

Total Kjeldahl Nitrogen

Nitrate (as N)

Nitrite (as N)

Ortho Phosphate (as P)

Phosphorus (P) - Total

Phosphorus (P) - Total f.s.

Reactive Silica (as SiO₂)

Sulphate (SO₄)

equation

0.066

0.13

0.0060

0.010

0.010

0.010

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Notes:

- ¹ CMC (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2018.

123 Bolded values exceed the trigger.

123 bold and shaded values exceed the threshold.
Italicized numbers are below detection limits.
 . not analyzed/not sampled
underline = results were given a cautionary flag in the QC assessment (refer to [Appendix B](#) for details).

Table C3-2. Water and phytoplankton sampling location coordinates (GPS, UTM, NAD83) from Baker Lake, 2024.

Area ¹	Area Type ²	Area-Replicate	Water & Phytoplankton (Monthly)				
			Month	Depth (m)	Zone	Easting	Northing
BAP	Ref	BAP-91	July	26.7	15W	363620	7130984
		BAP-92	July	34.8	15W	362944	7131103
		BAP-93	August	20.5	15W	364346	7130731
		BAP-94	August	23	15W	362954	7131474
		BAP-95	September	>17	15W	363638	7131008
		BAP-96	September	17	15W	364241	7130970
BBD	NF	BBD-91	July	12.6	14W	644669	7135165
		BBD-92	July	8.06	14W	644058	7135439
		BBD-93	August	11.3	14W	644626	7135200
		BBD-94	August	8.5	14W	643959	7135338
		BBD-95	September	12.3	14W	644617	7135175
		BBD-96	September	14.28	14W	643906	7135191
BPJ	NF	BPJ-91	July	13.79	15W	357237	7134224
		BPJ-92	July	23	15W	356702	7134169
		BPJ-93	August	11.3	15W	357198	7134060
		BPJ-94	August	11.3	15W	356513	7133878
		BPJ-95	September	12.7	15W	357390	7133937
		BPJ-96	September	>15	15W	356716	7133413

Notes:

1. Area IDs are as follows: BAP = Baker Lake – Akilahaarjuk Point; BBD = Baker Lake – barge dock; BPJ= Baker Lake – proposed jetty
2. Area types: NF=near-field; Ref=reference.

FIGURES

Figure C3-1. Laboratory-measured conductivity ($\mu\text{S}/\text{cm}$).

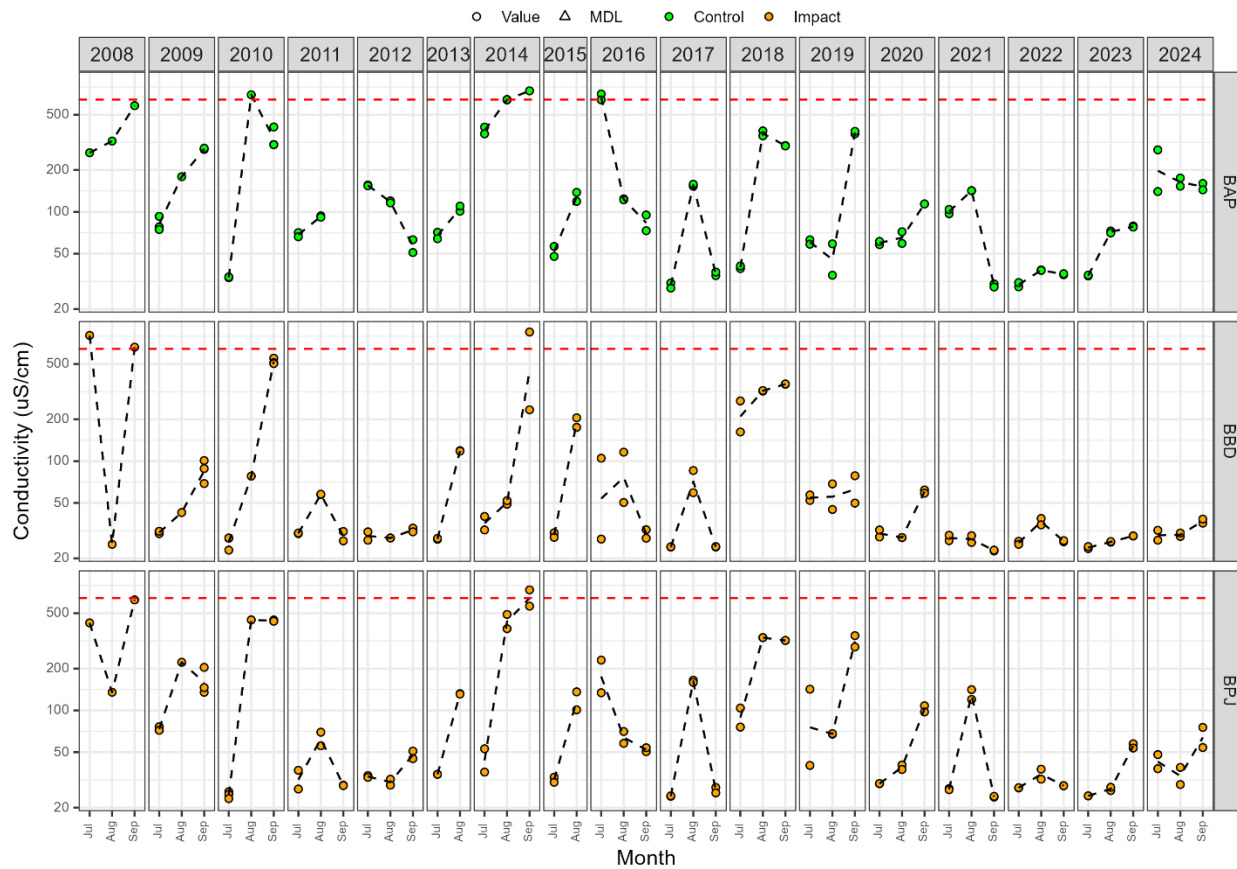


Figure C3-2. Laboratory-measured hardness (mg/L).

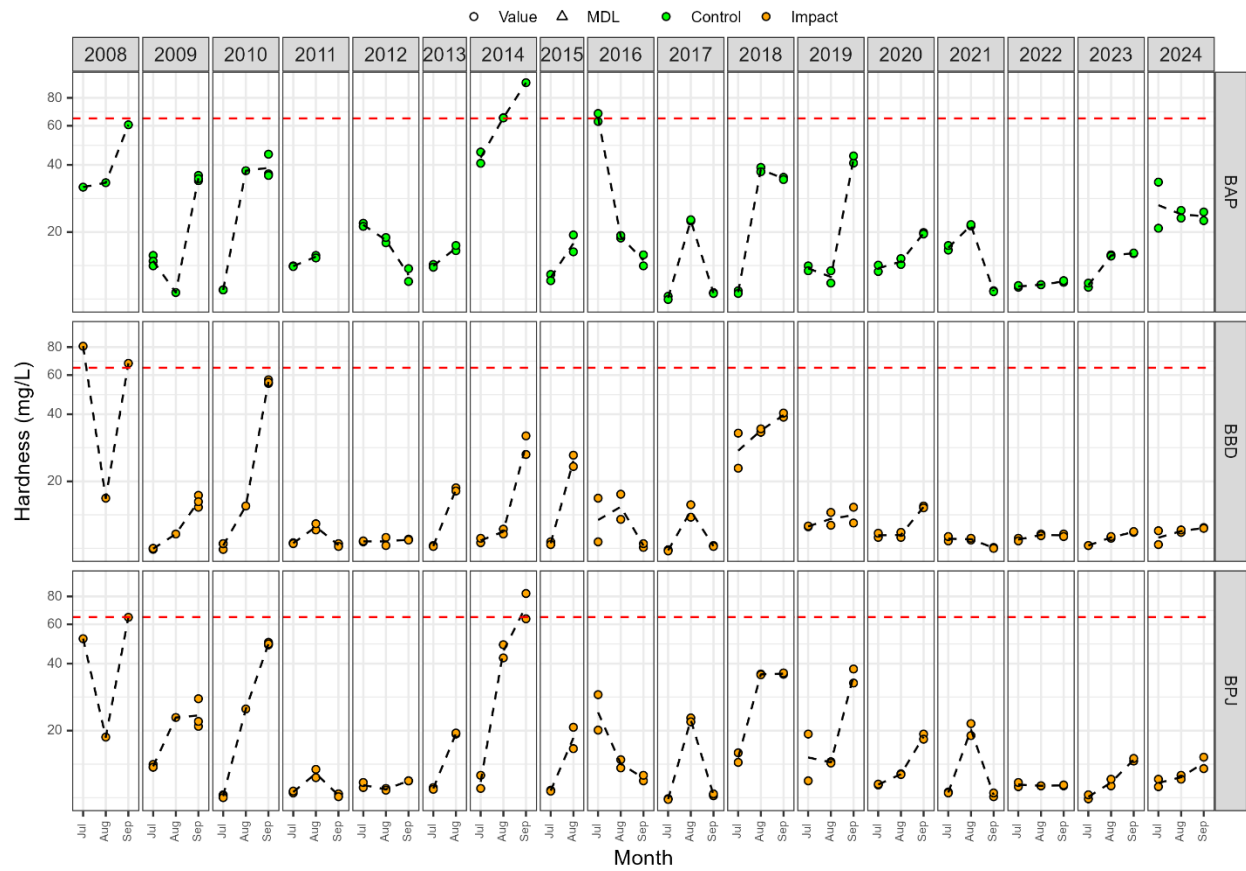


Figure C3-3. Field-measured pH.

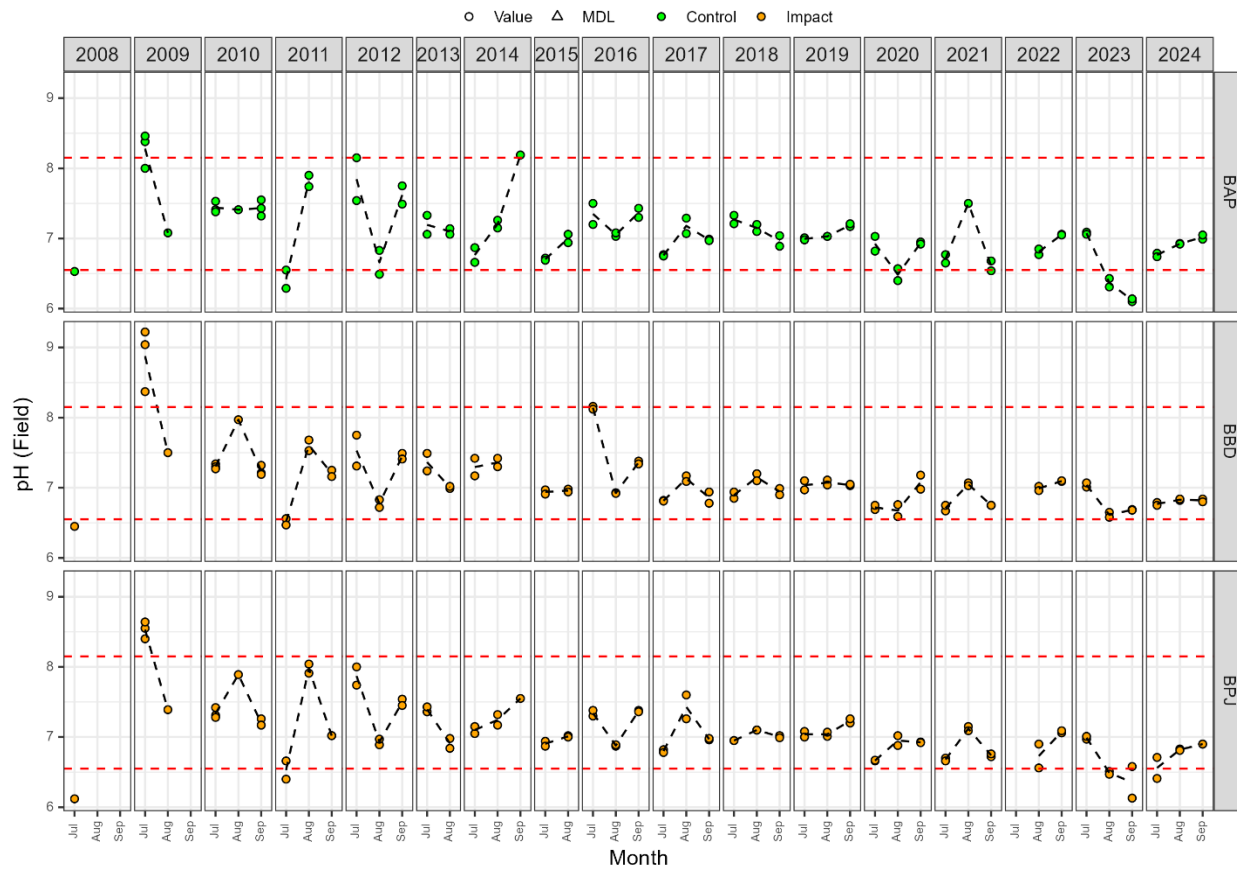


Figure C3-4. Laboratory-measured pH.

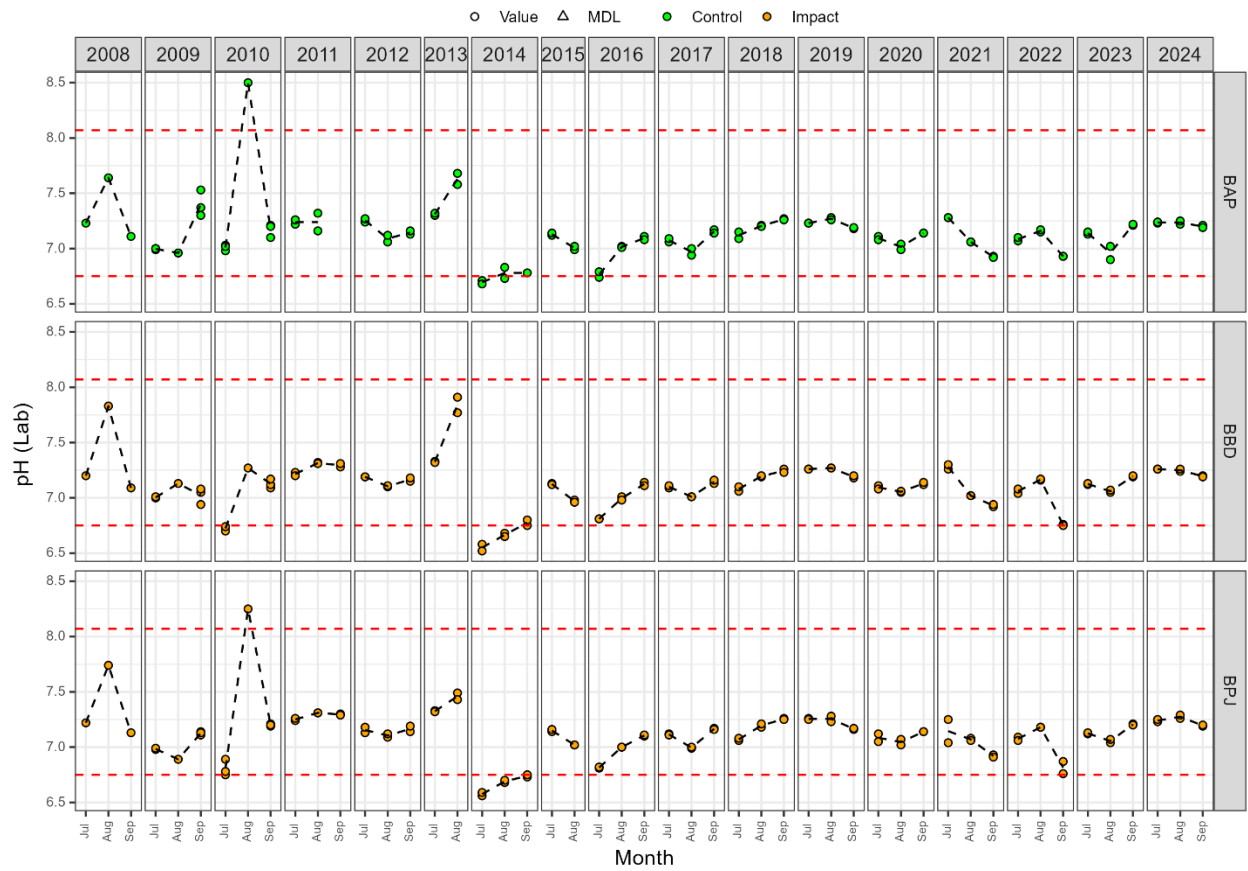


Figure C3-5. Total dissolved solids (TDS; mg/L).

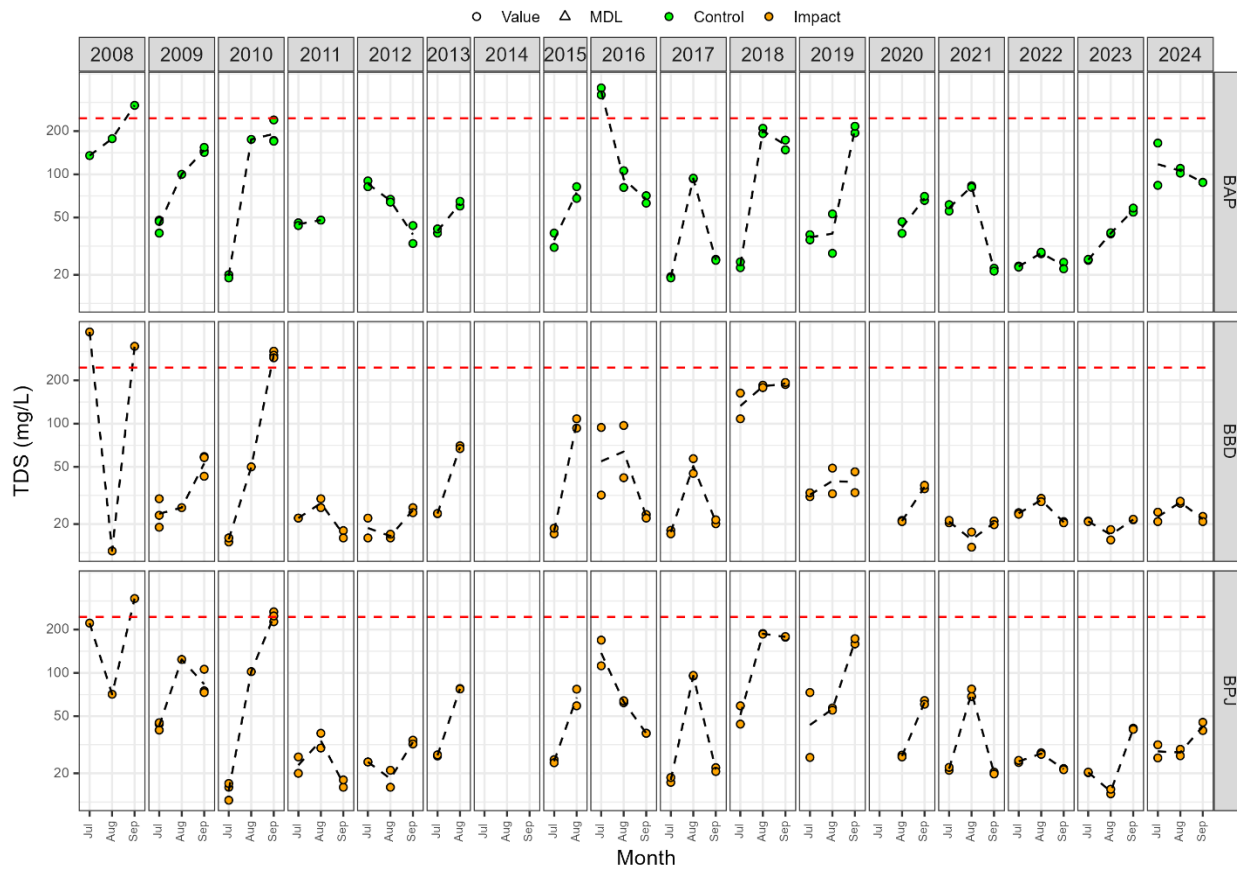


Figure C3-6. Total suspended solids (TSS; mg/L).

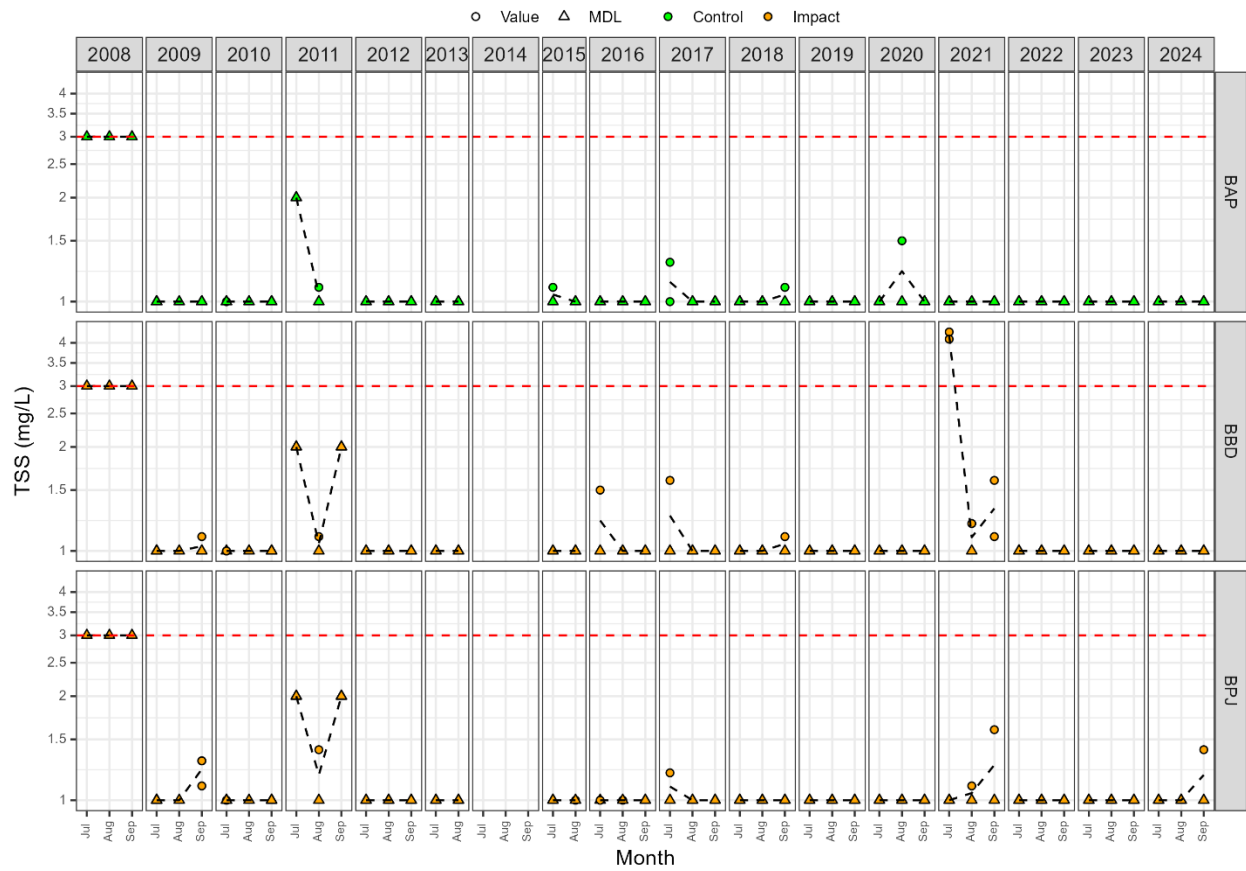


Figure C3-7. Carbonate alkalinity (mg/L).

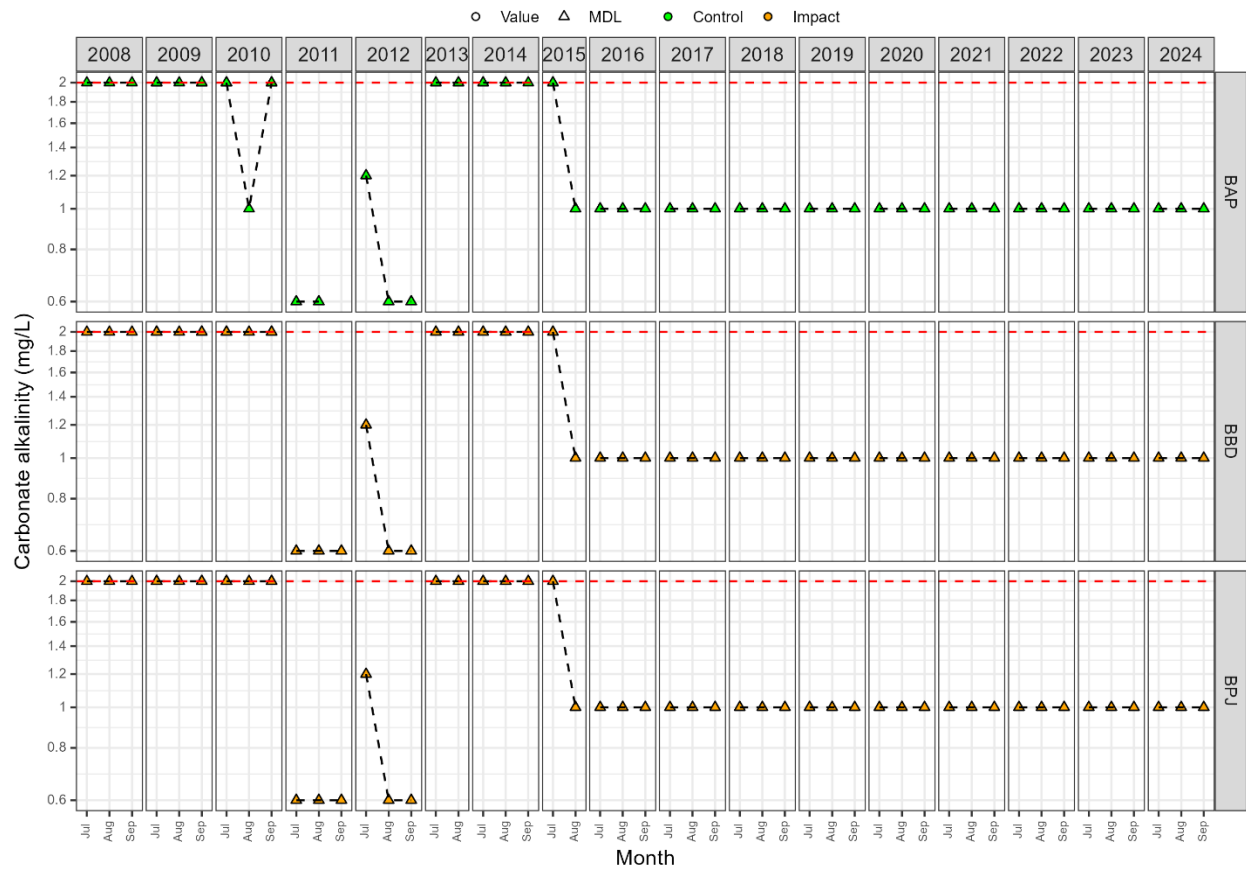


Figure C3-8. Bicarbonate alkalinity (mg/L).

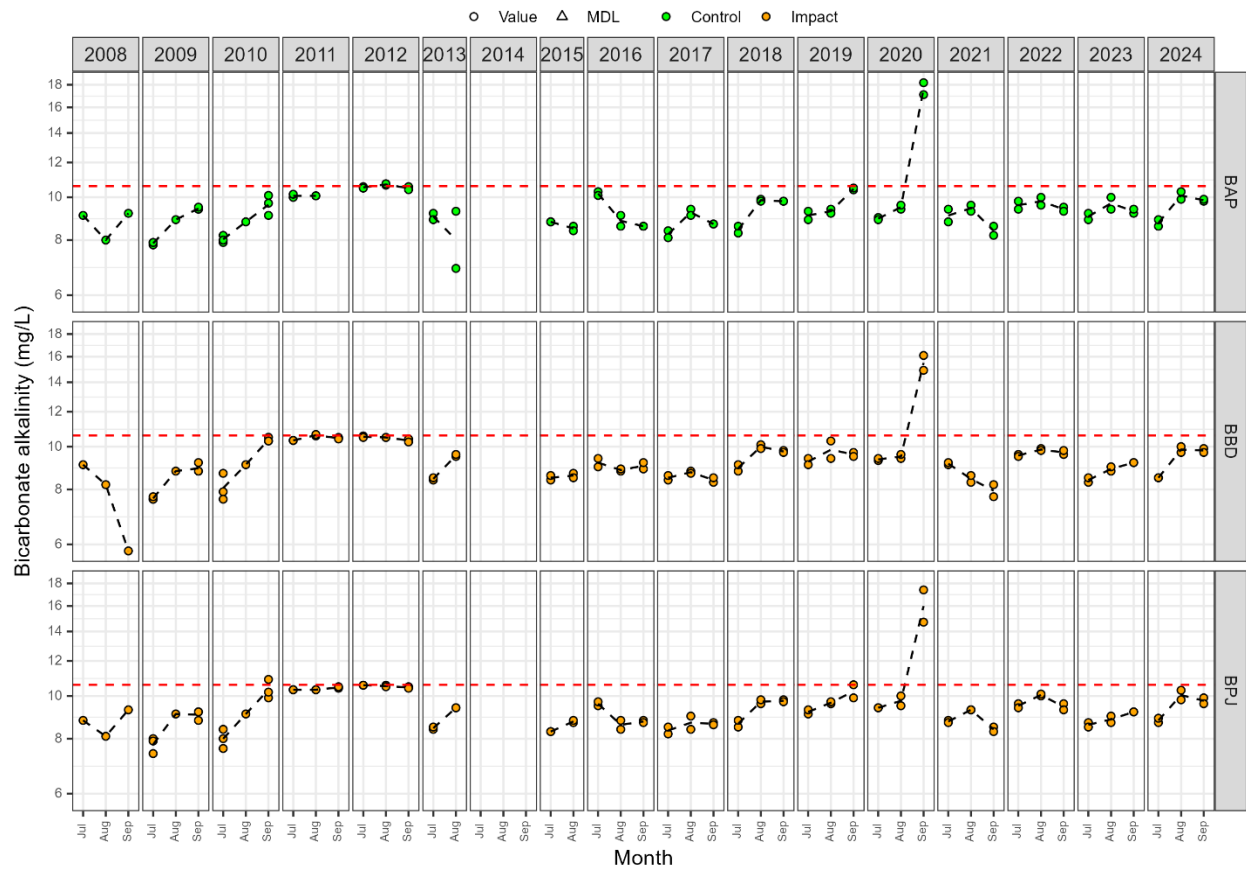


Figure C3-9. Total alkalinity (mg/L).

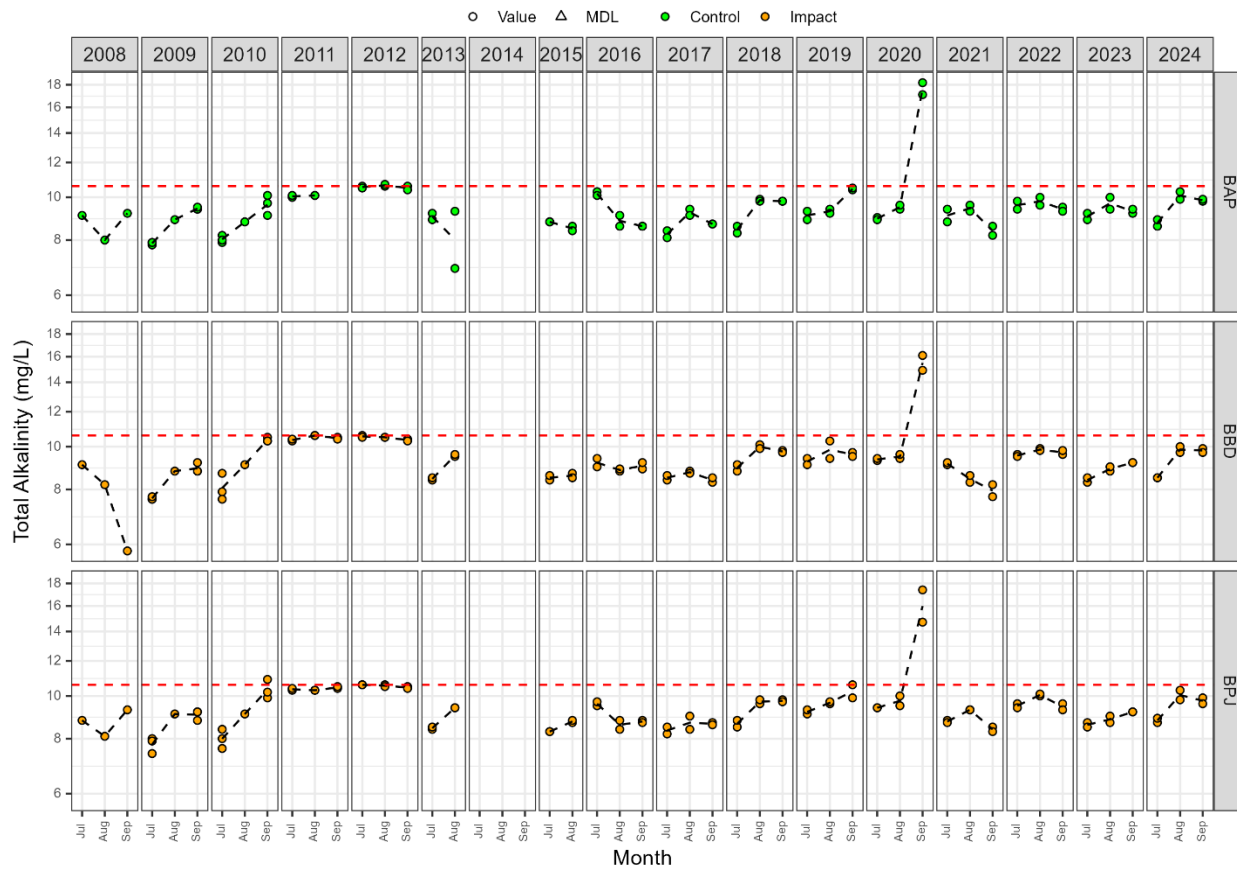


Figure C3-11. Chloride (mg/L).

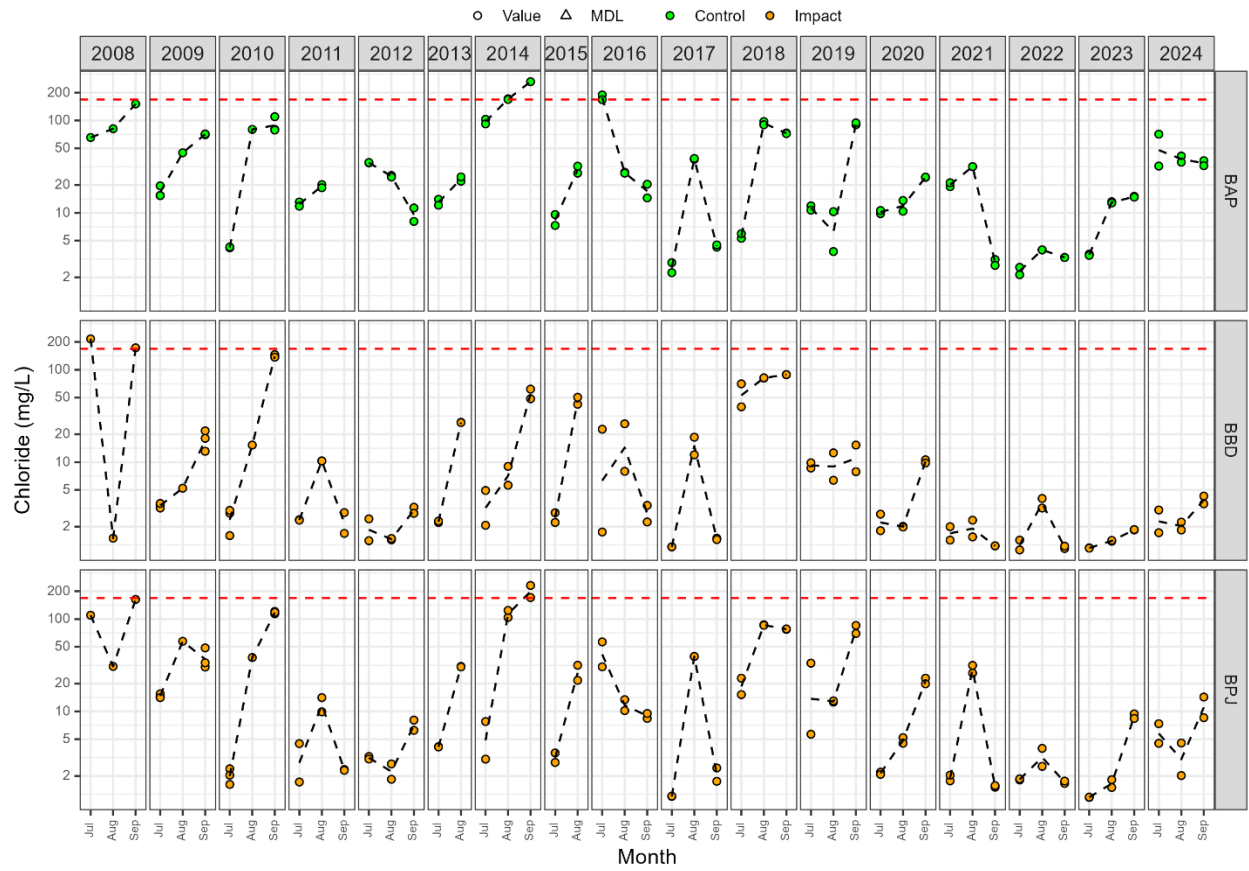


Figure C3-12. Fluoride (mg/L).

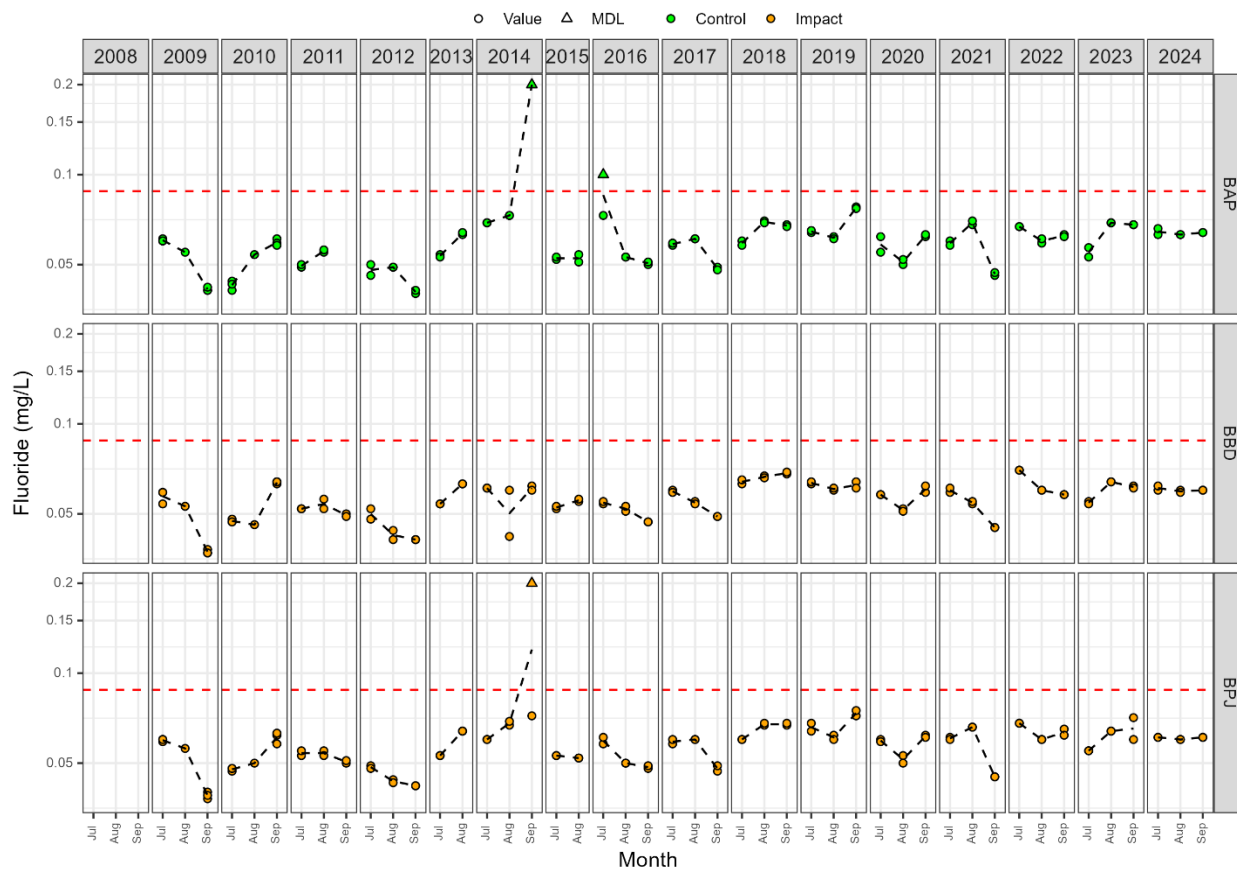


Figure C3-13. Nitrate-N (mg/L).

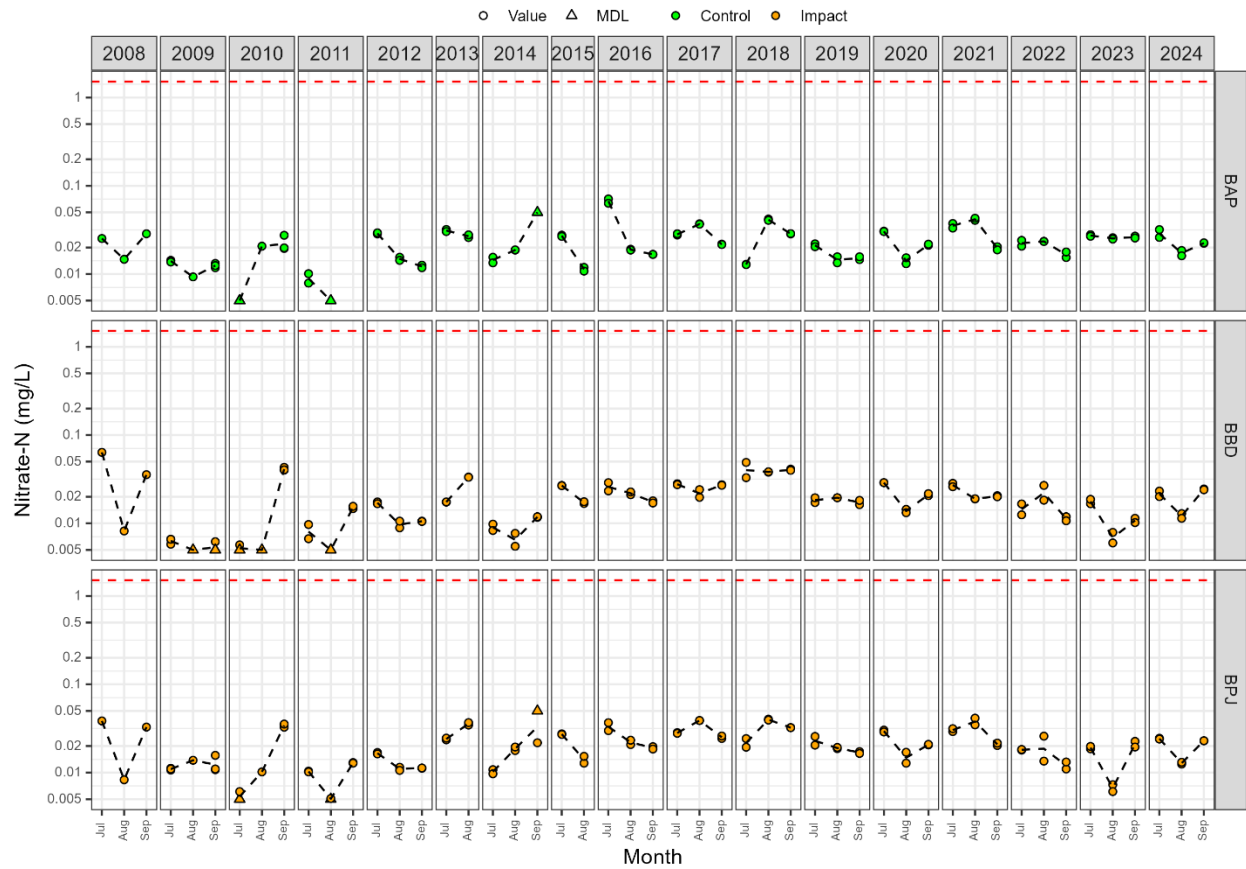


Figure C3-14. Nitrite-N (mg/L).

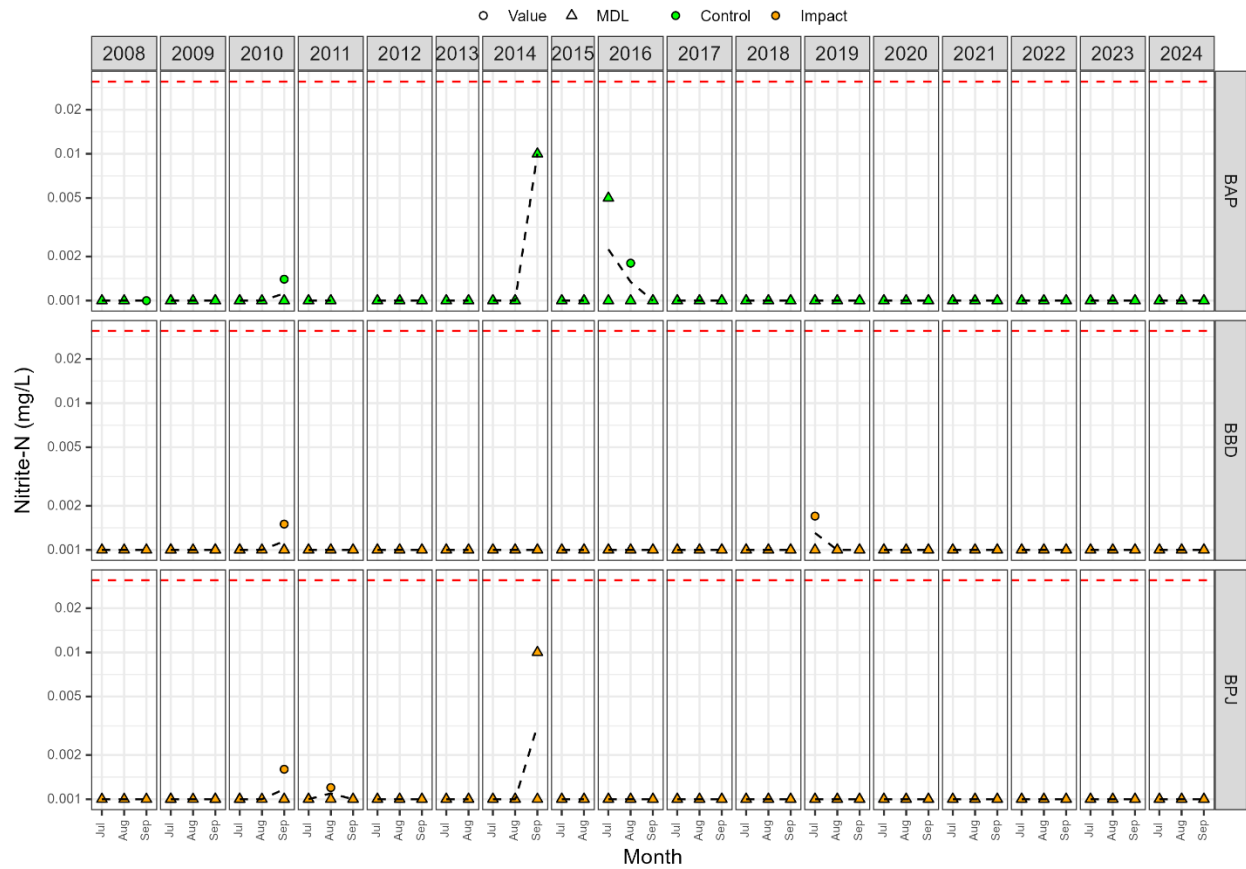


Figure C3-15. Total Kjeldahl Nitrogen (TKN; mg/L).

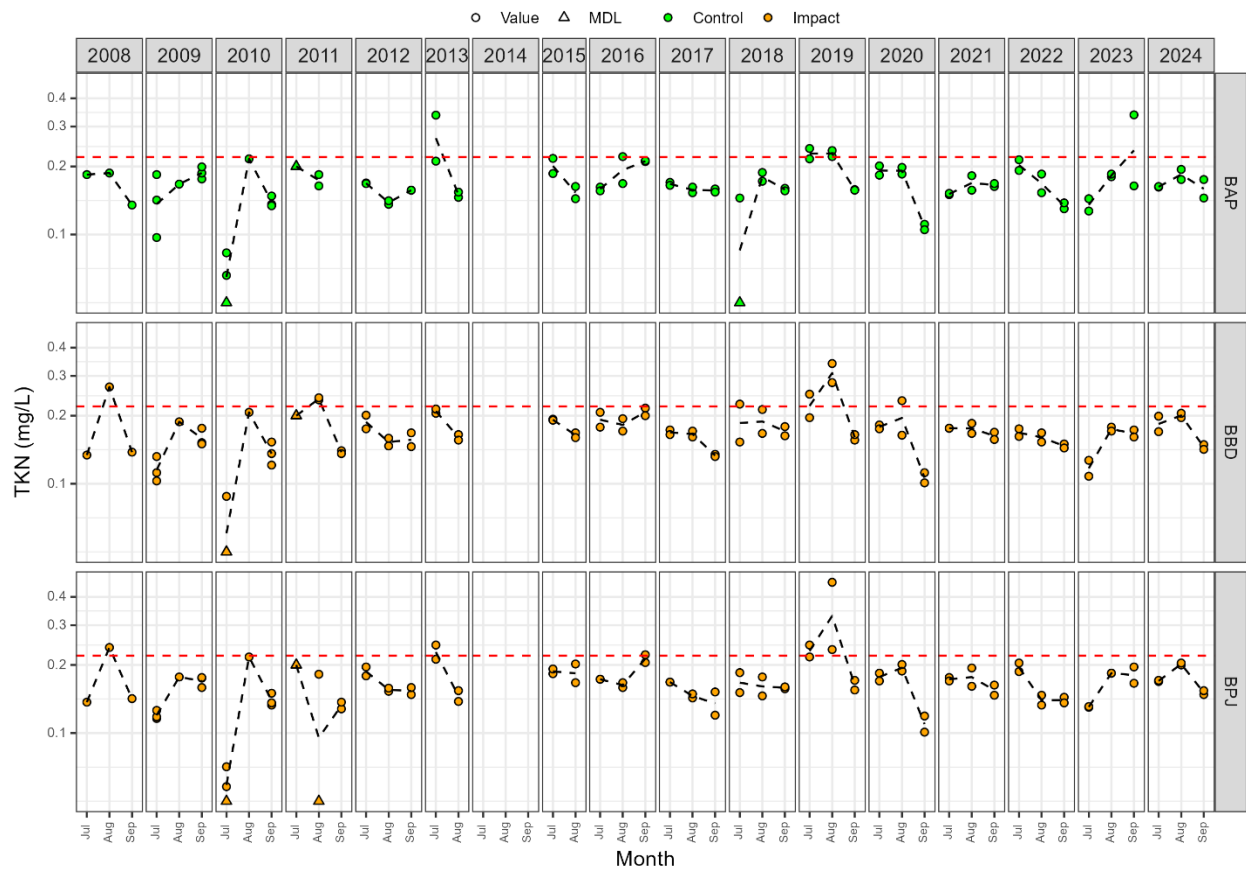


Figure C3-16. Ortho-phosphate (mg/L).

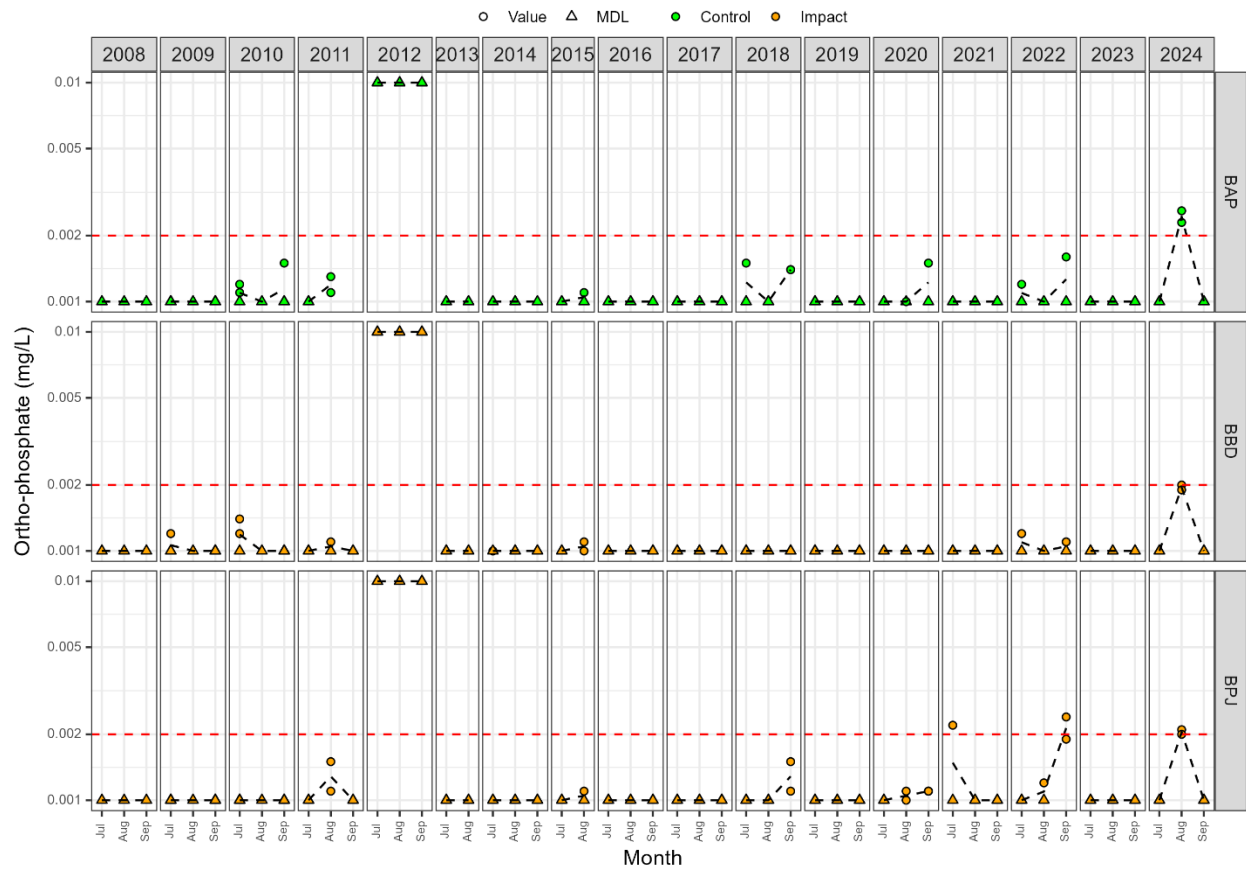


Figure C3-17. Total phosphorous (mg/L).

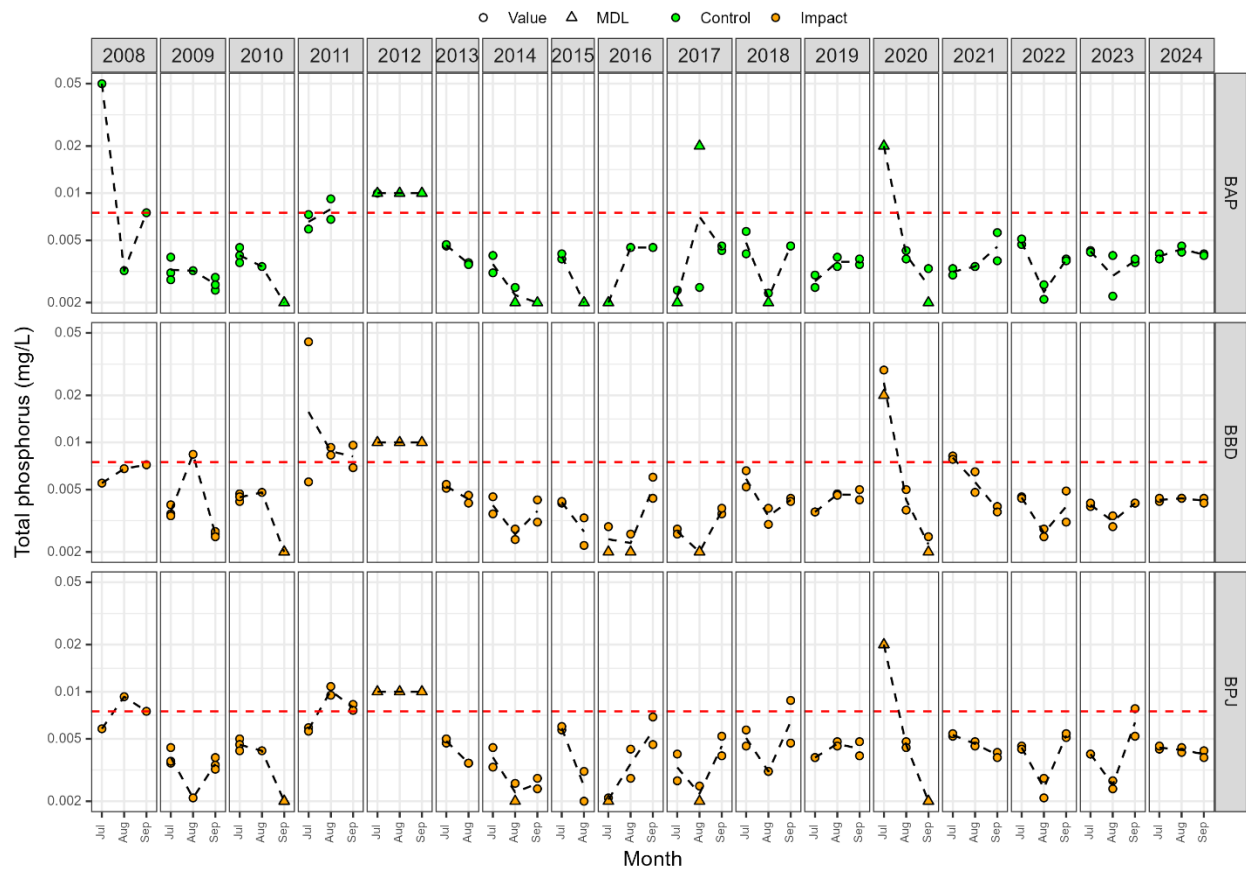


Figure C3-18. Reactive silica (mg/L).

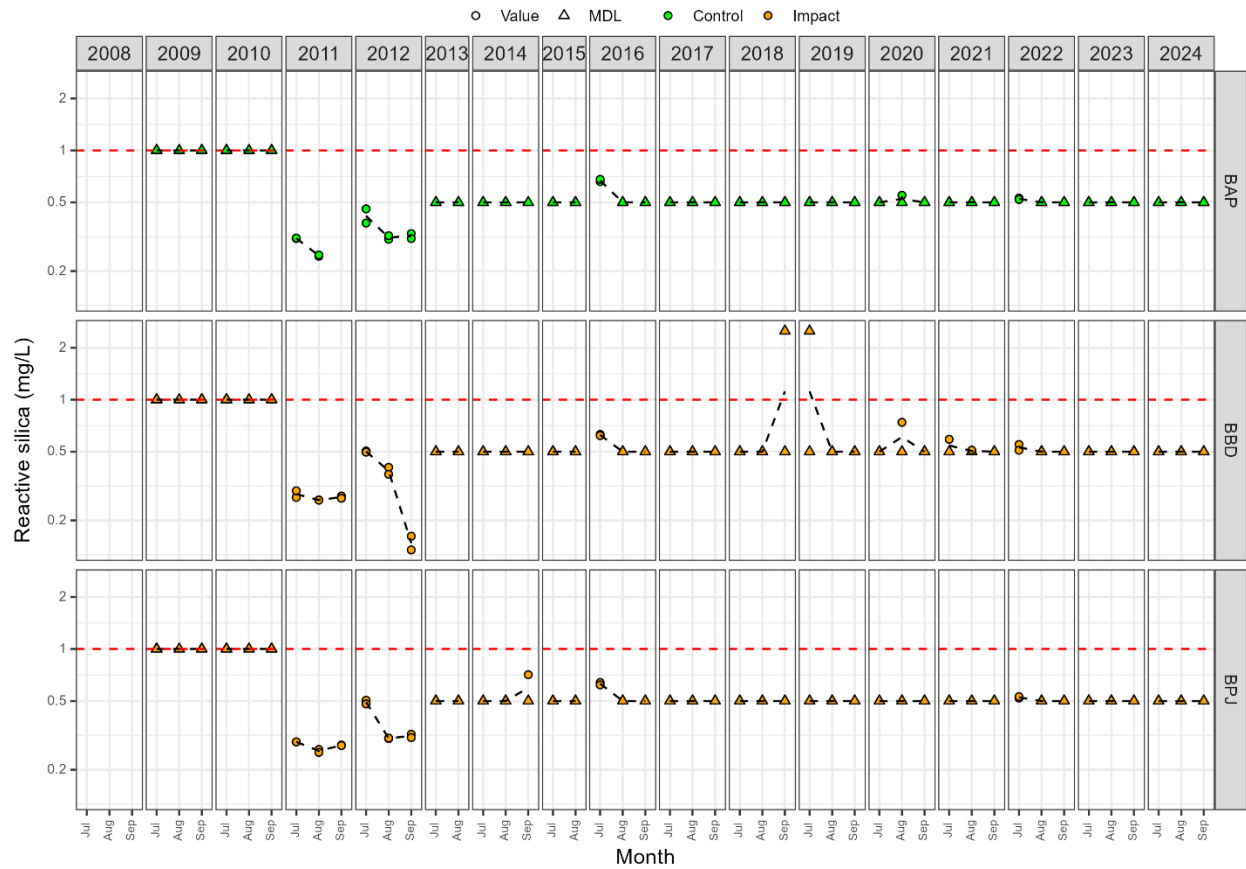


Figure C3-19. Sulphate (mg/L).

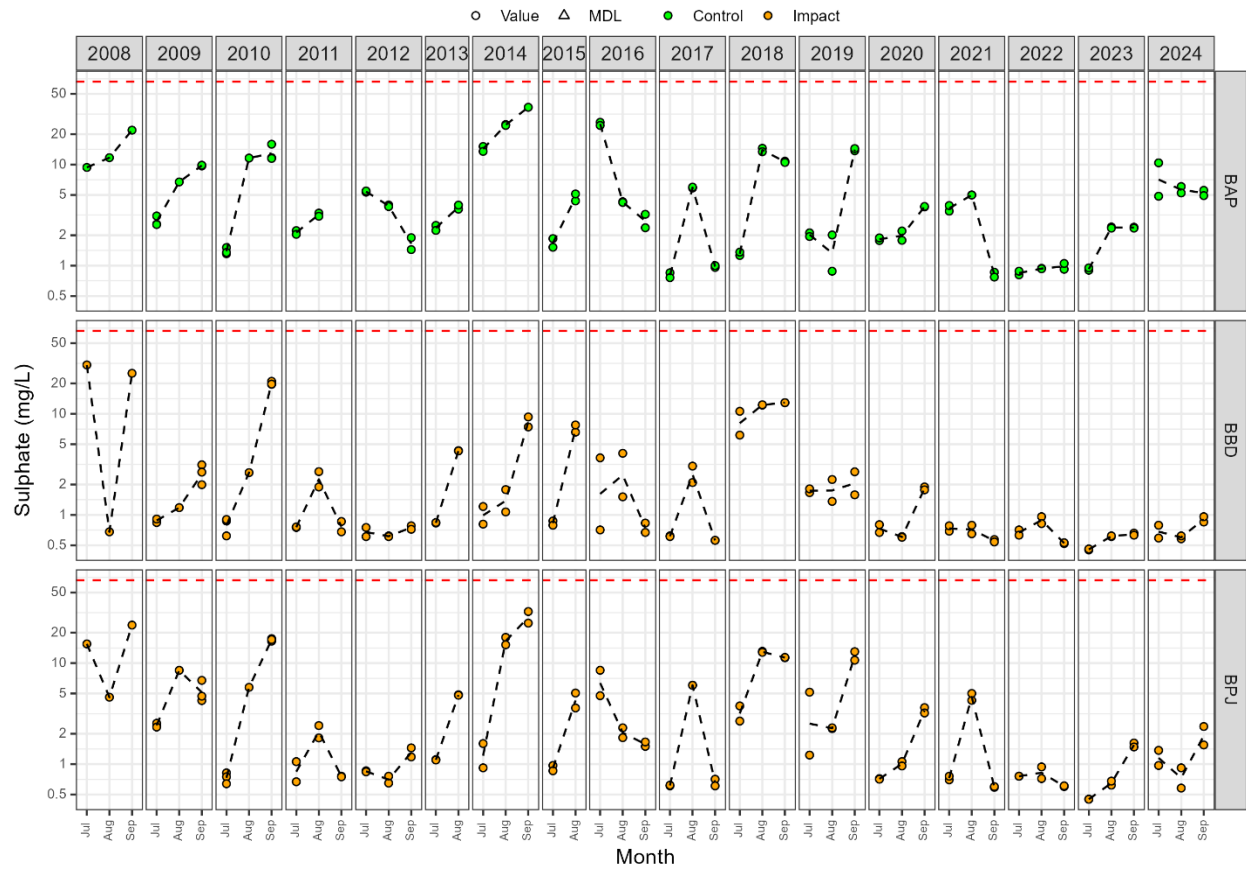


Figure C3-20. Dissolved organic carbon (DOC; mg/L).

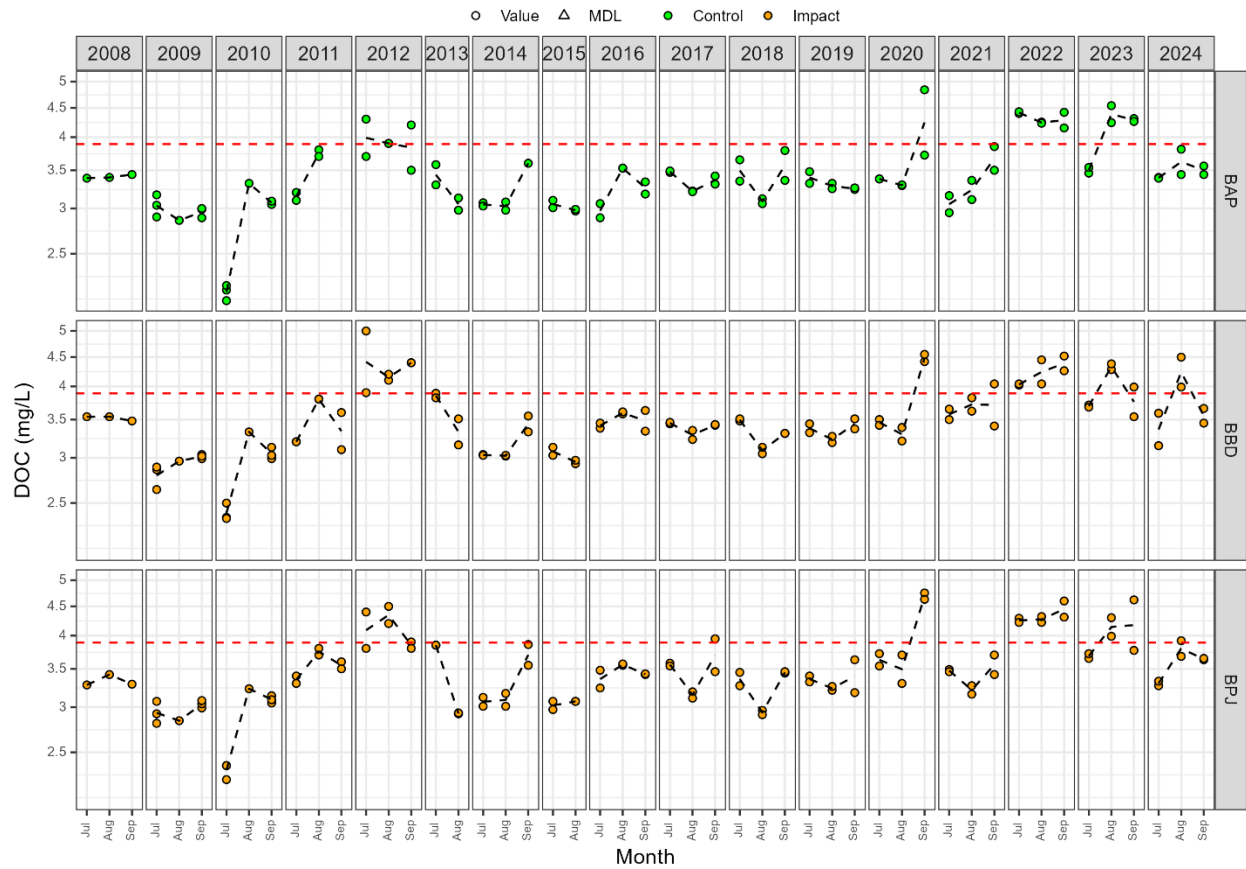


Figure C3-21. Total organic carbon (TOC; mg/L).

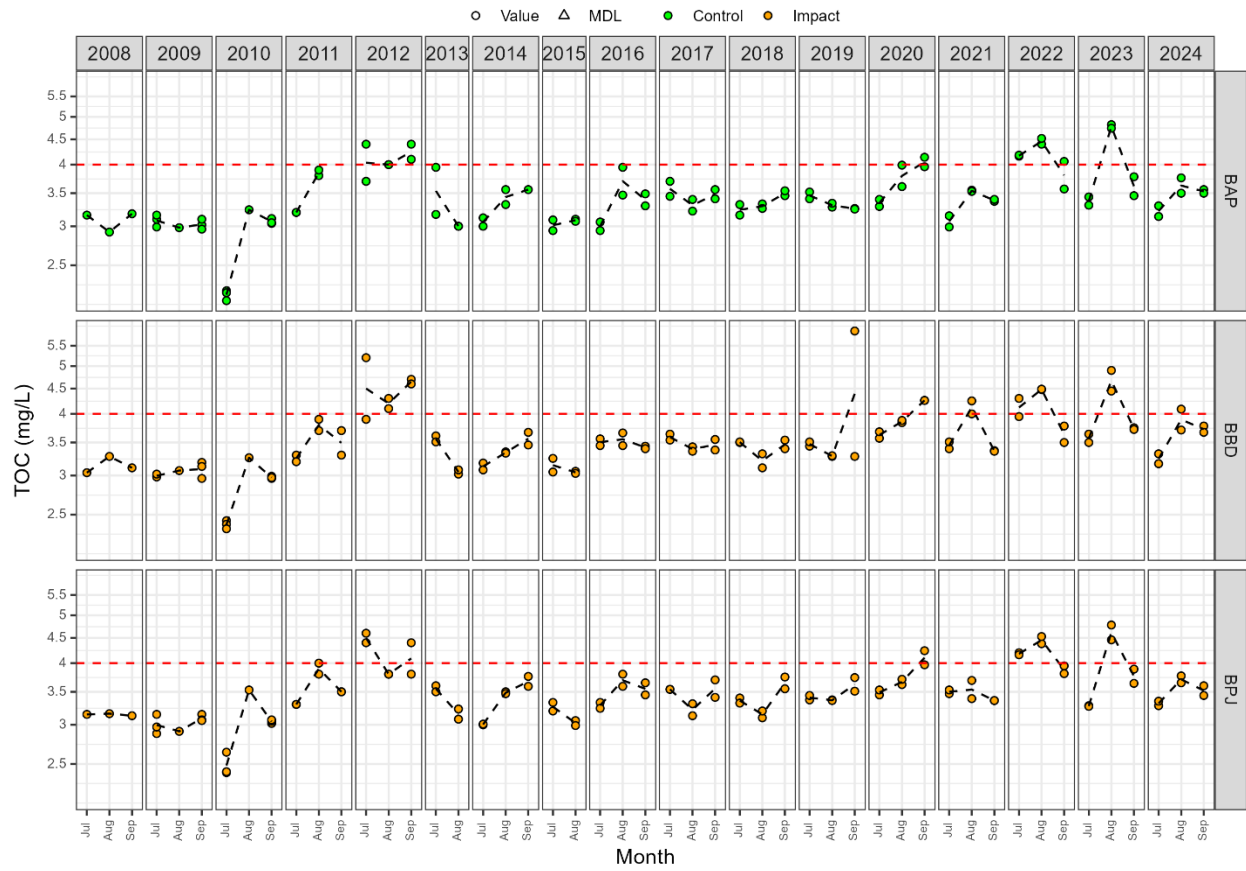


Figure C3-22. Total aluminum (mg/L).

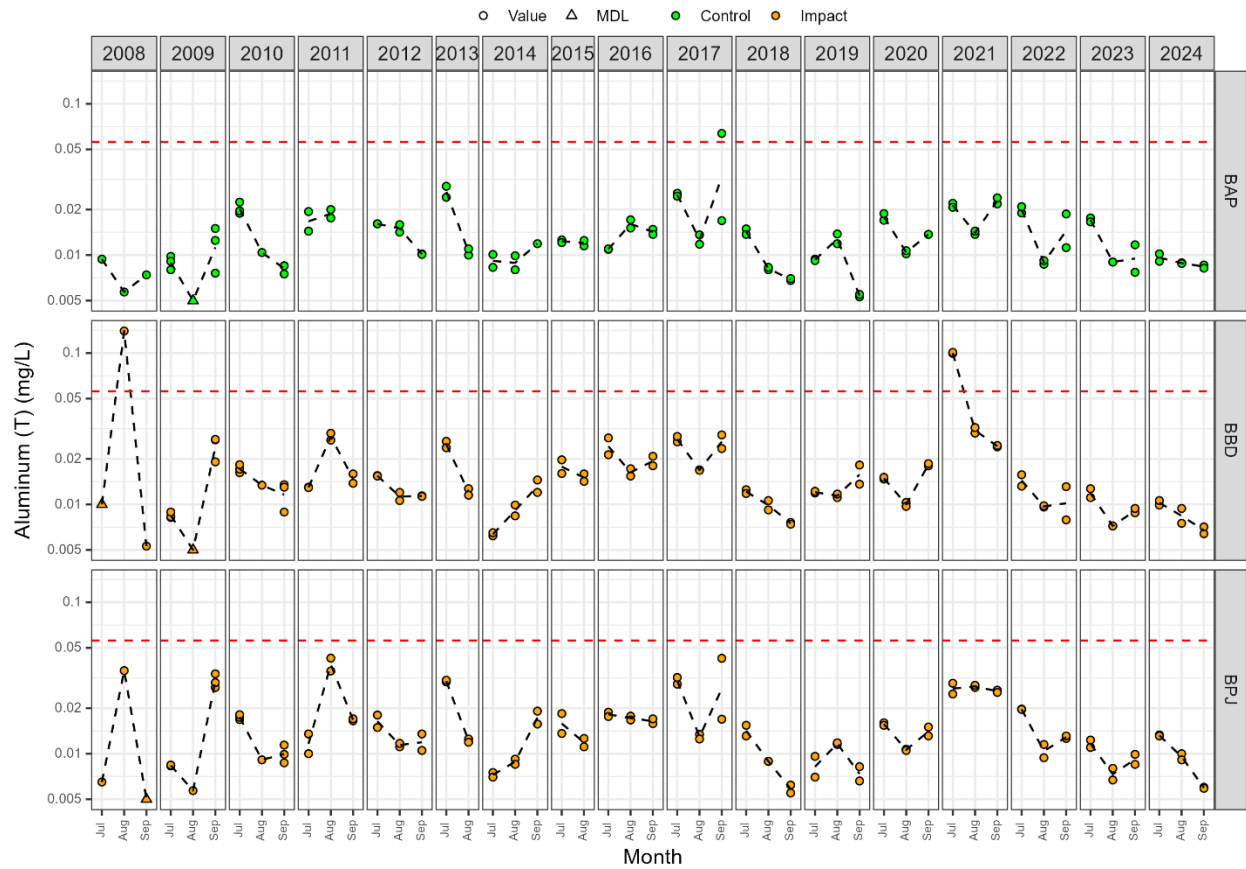


Figure C3-23. Total antimony (mg/L).

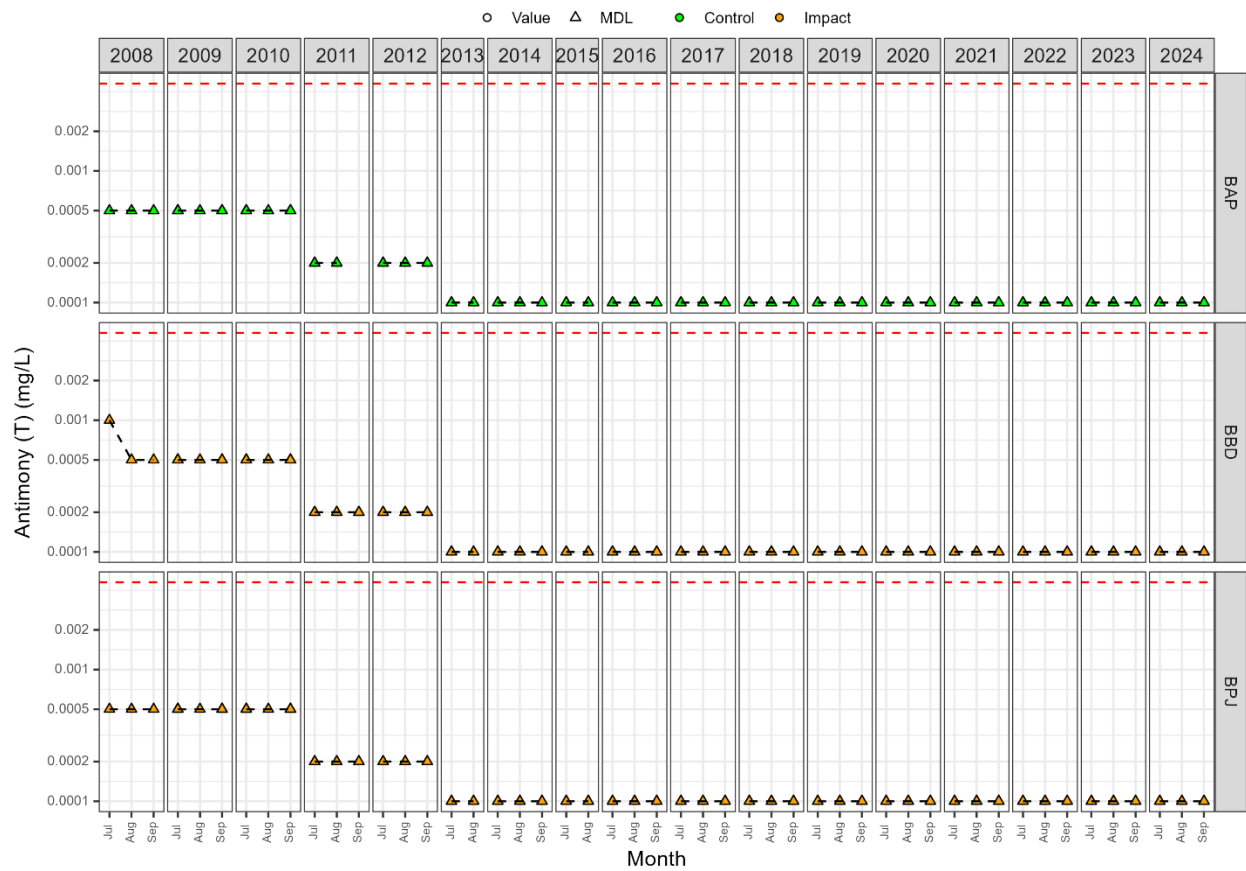


Figure C3-24. Total arsenic (mg/L).

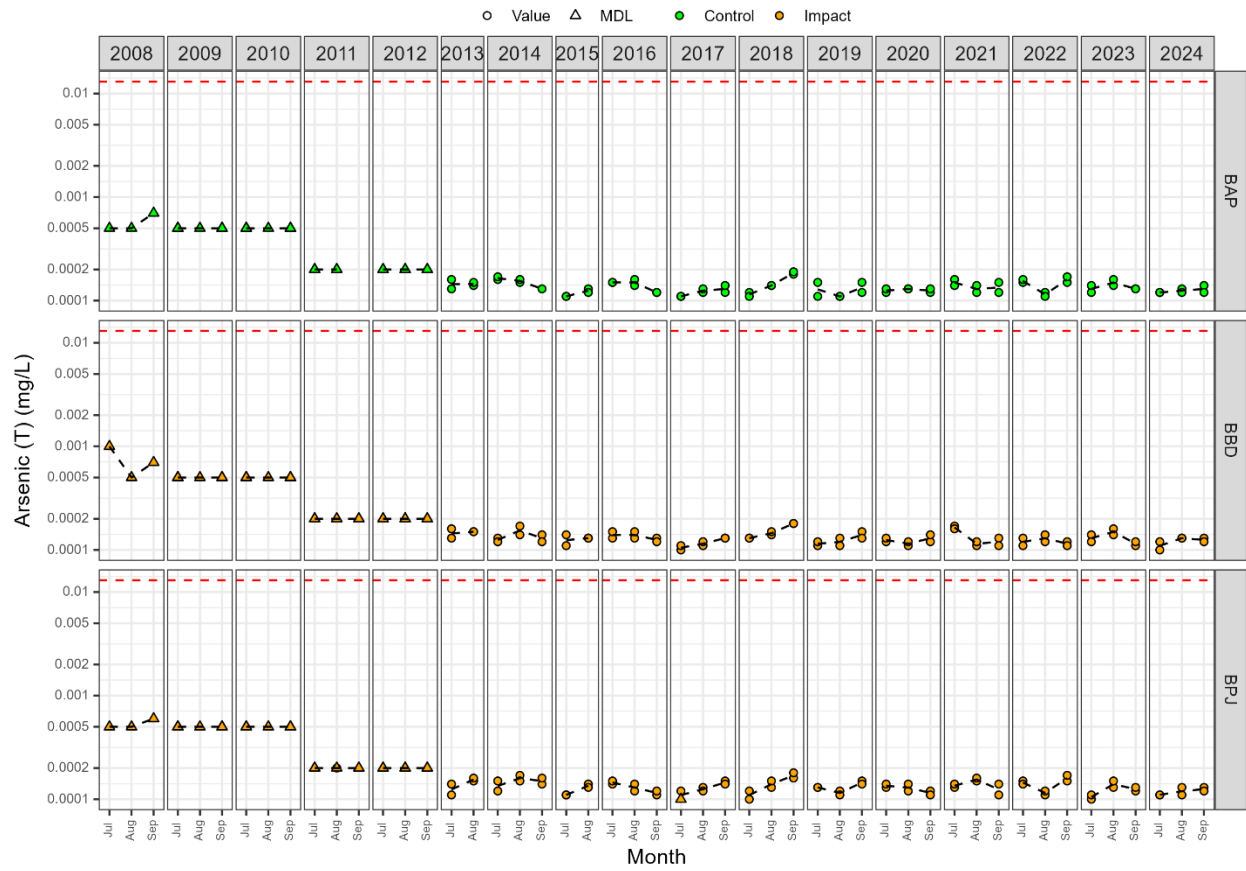


Figure C3-25. Total barium (mg/L).

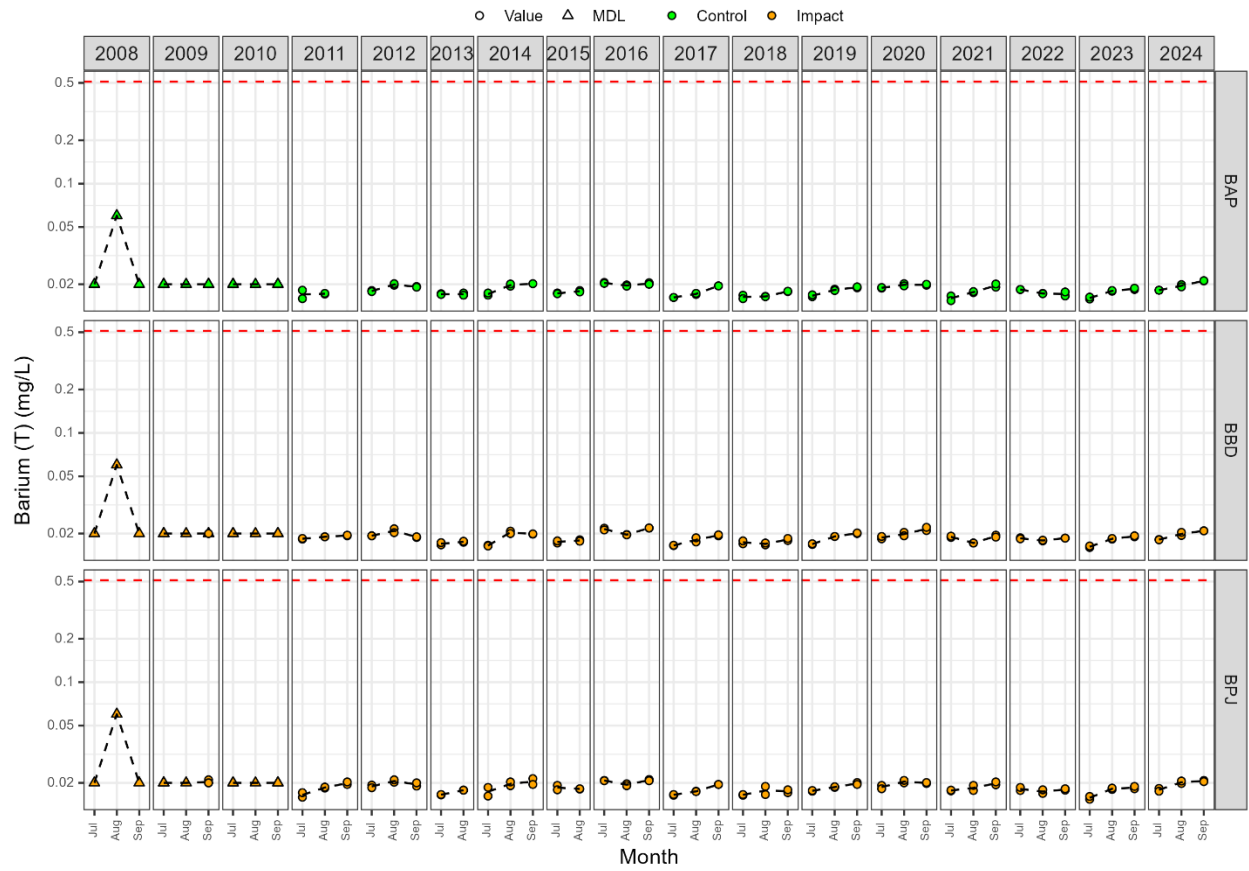


Figure C3-26. Total beryllium (mg/L).

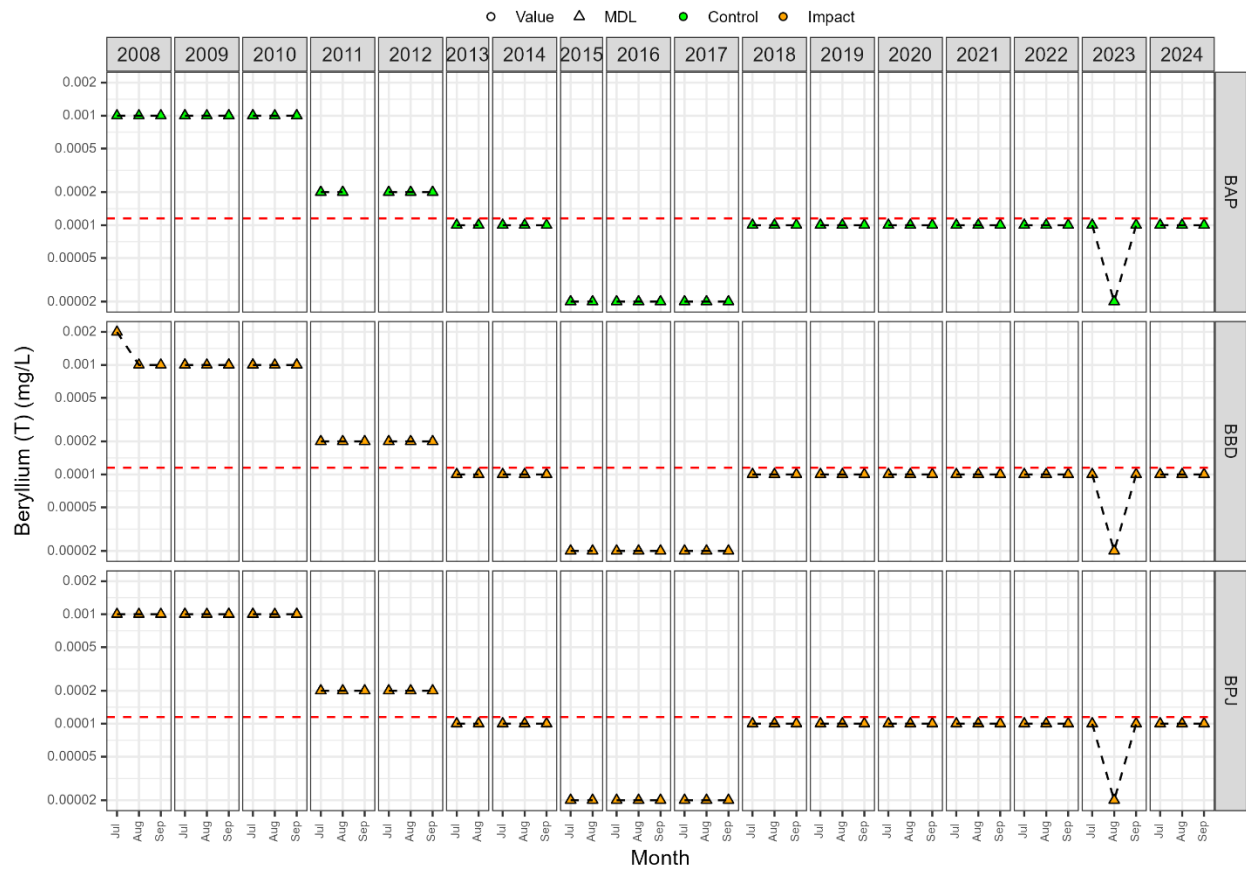


Figure C3-27. Total boron (mg/L).

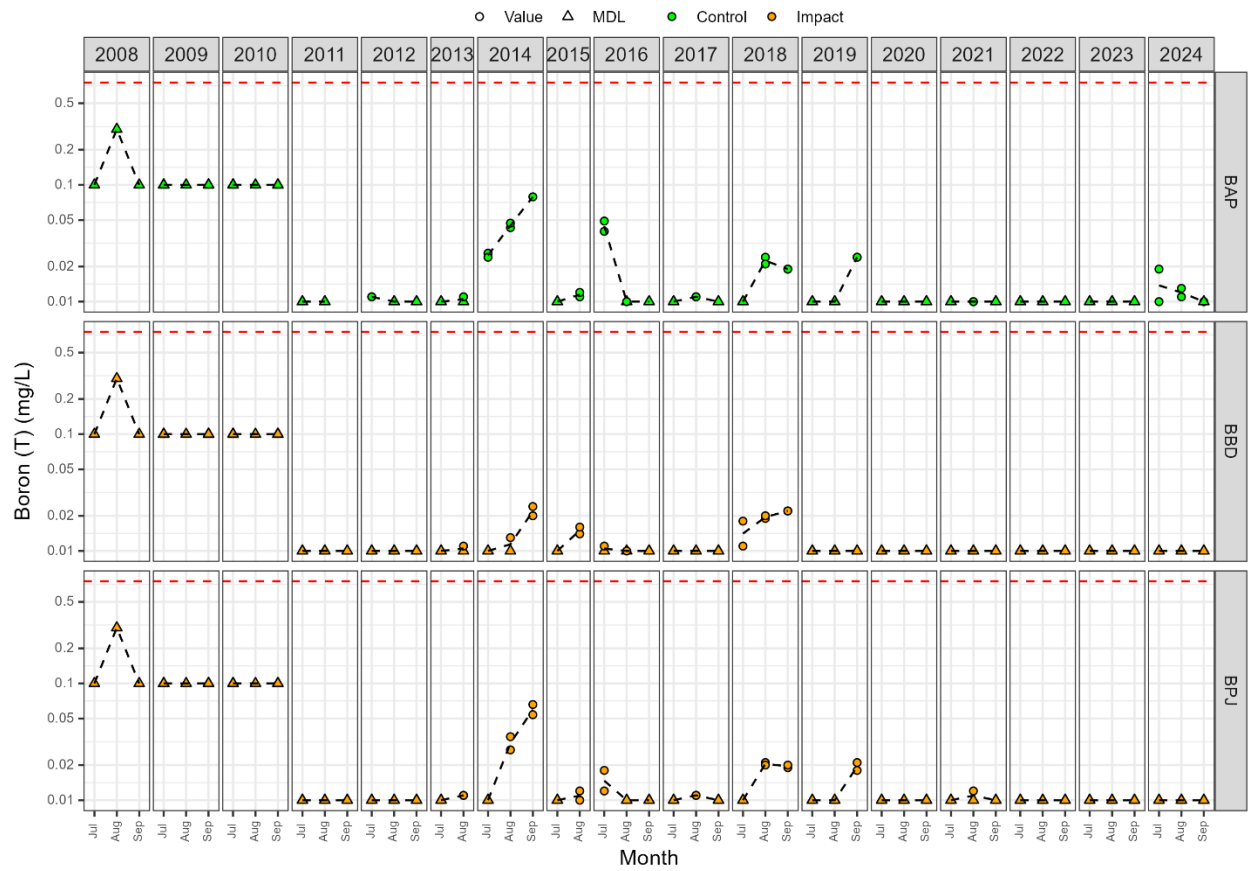


Figure 1 displays a 3x12 grid of plots showing Cadium (T) (mg/L) for three different locations: BAP, BBD, and BPJ. The rows represent the locations, and the columns represent the years from 2008 to 2024. The x-axis for each plot shows the months of the year (Jul, Aug, Sep). The y-axis represents Cadium (T) (mg/L), ranging from 0.000005 to 0.000035. A red dashed line is present in each plot at 0.000025 mg/L. The legend indicates four data series: Value (open circle), MDL (open triangle), Control (green circle), and Impact (orange circle). The plots show that Cadium (T) levels are generally low and stable across all locations and years, with some minor fluctuations observed in the early years (2008-2010) for BBD and BPJ.

Figure C3-29. Total calcium (mg/L).

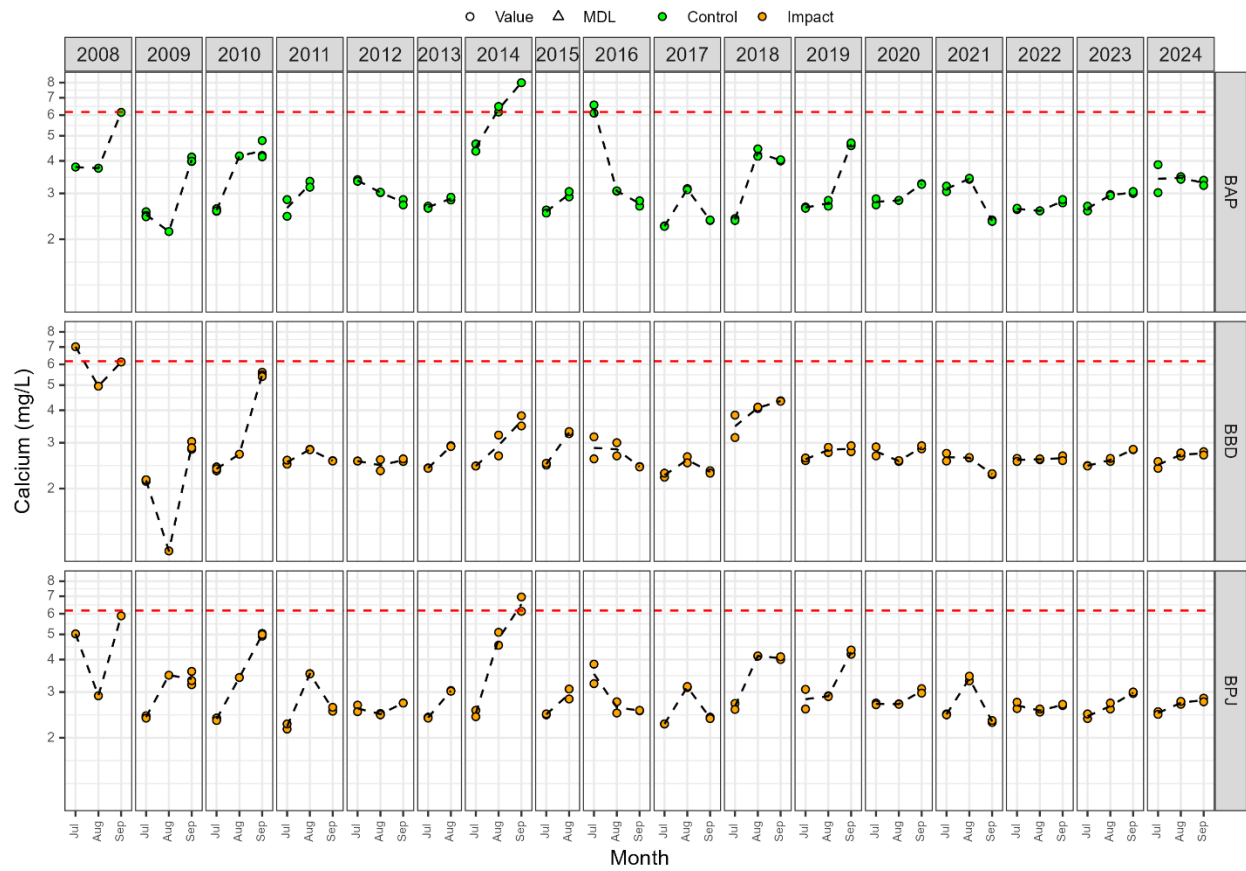


Figure C3-30. Total chromium (mg/L).

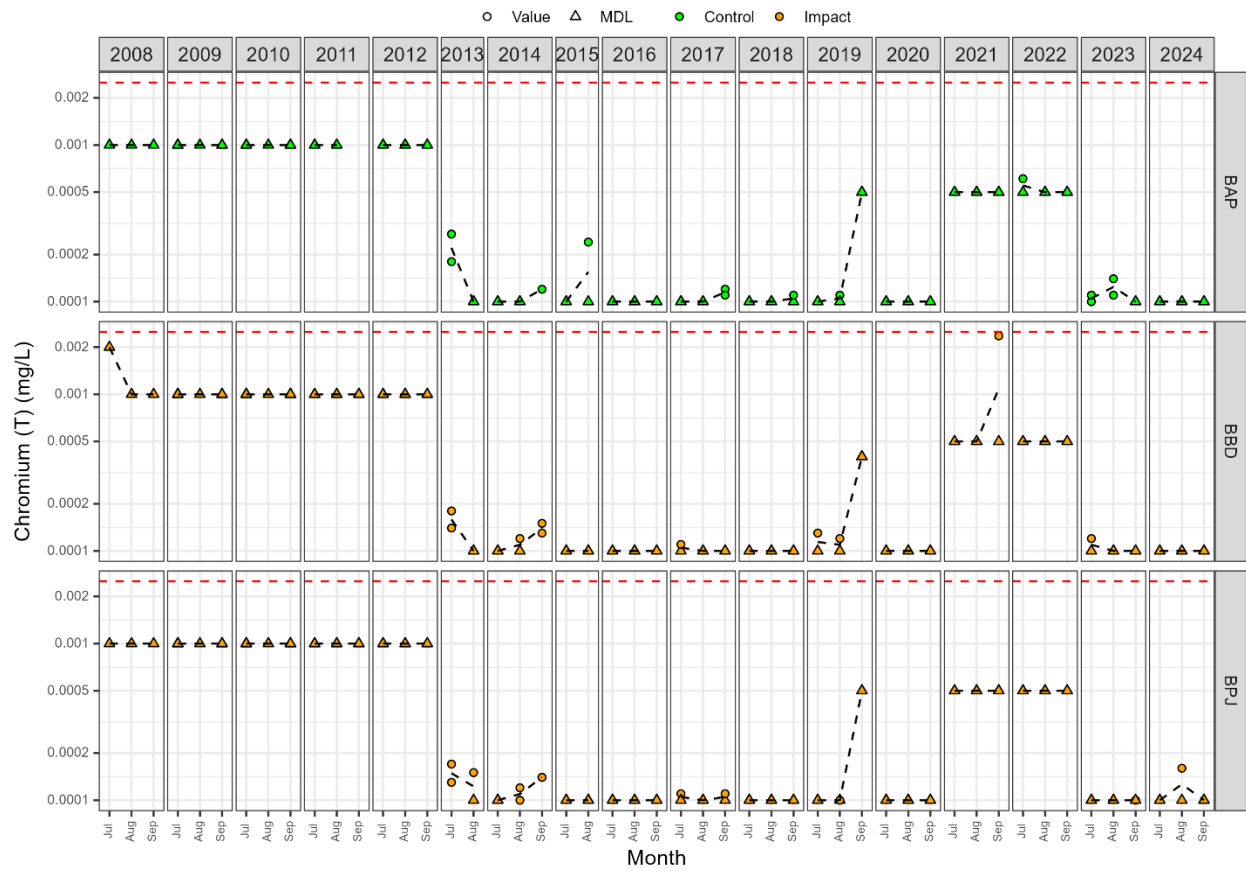


Figure C3-31. Total copper (mg/L).

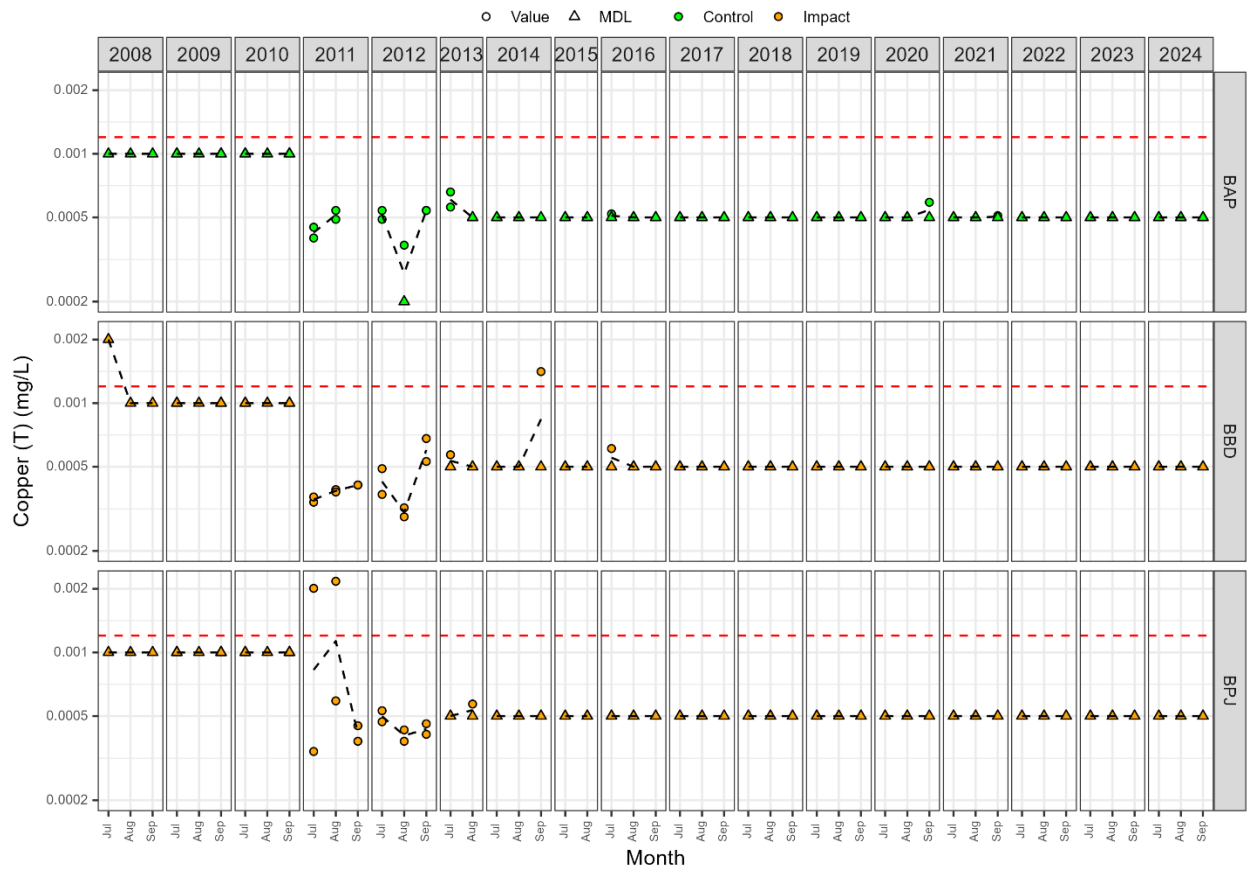


Figure C3-32. Total iron (mg/L).

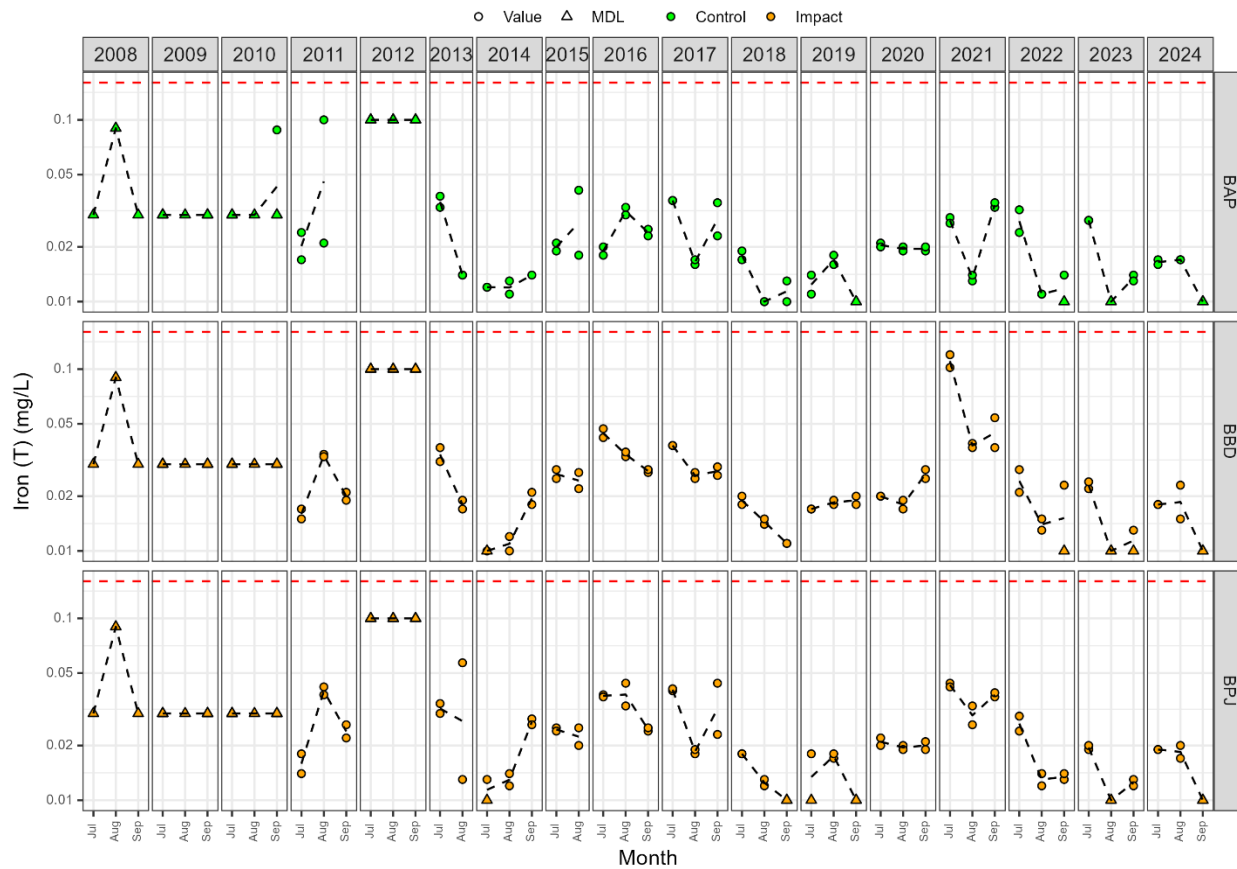


Figure C3-33. Total lead (mg/L).

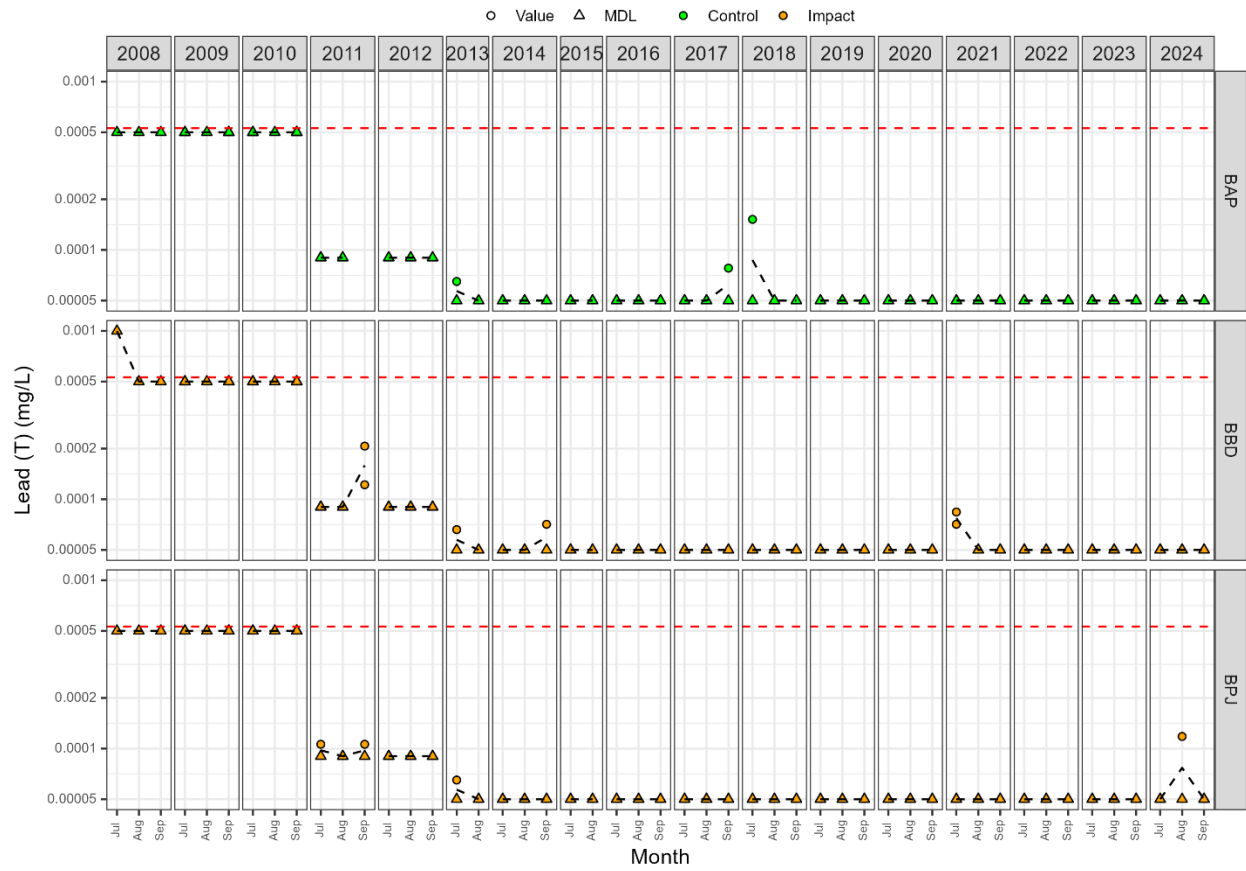


Figure C3-34. Total lithium (mg/L).

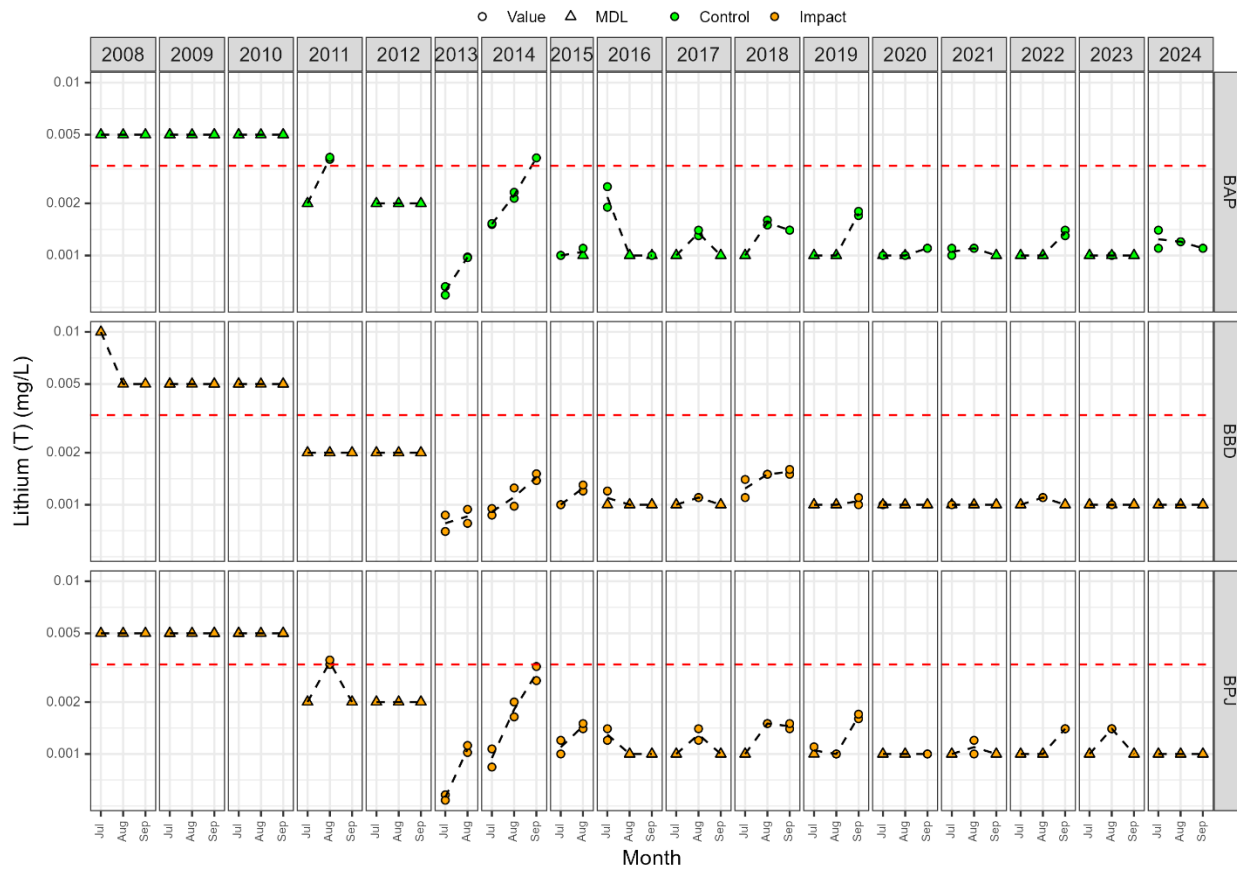


Figure C3-35. Total magnesium (mg/L).

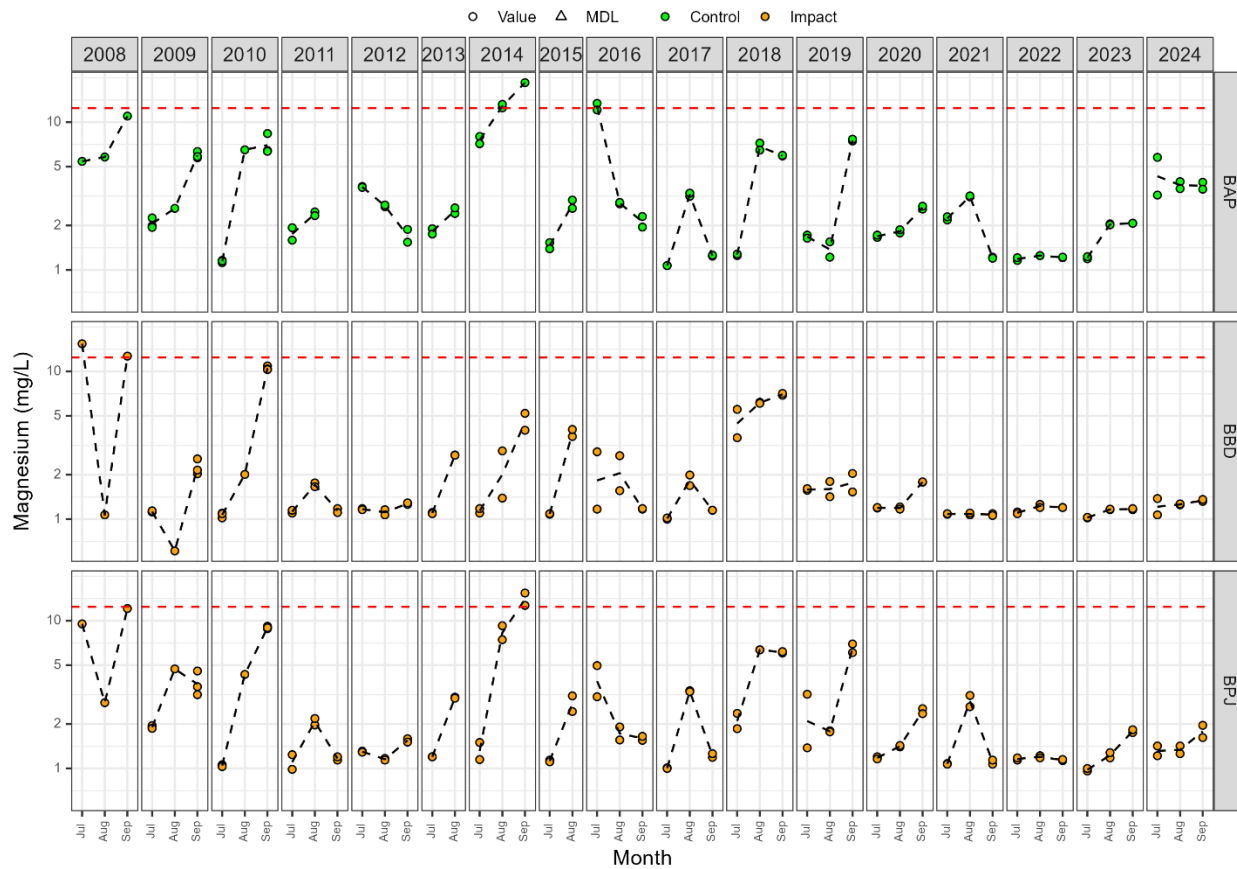


Figure C3-36. Total manganese (mg/L).

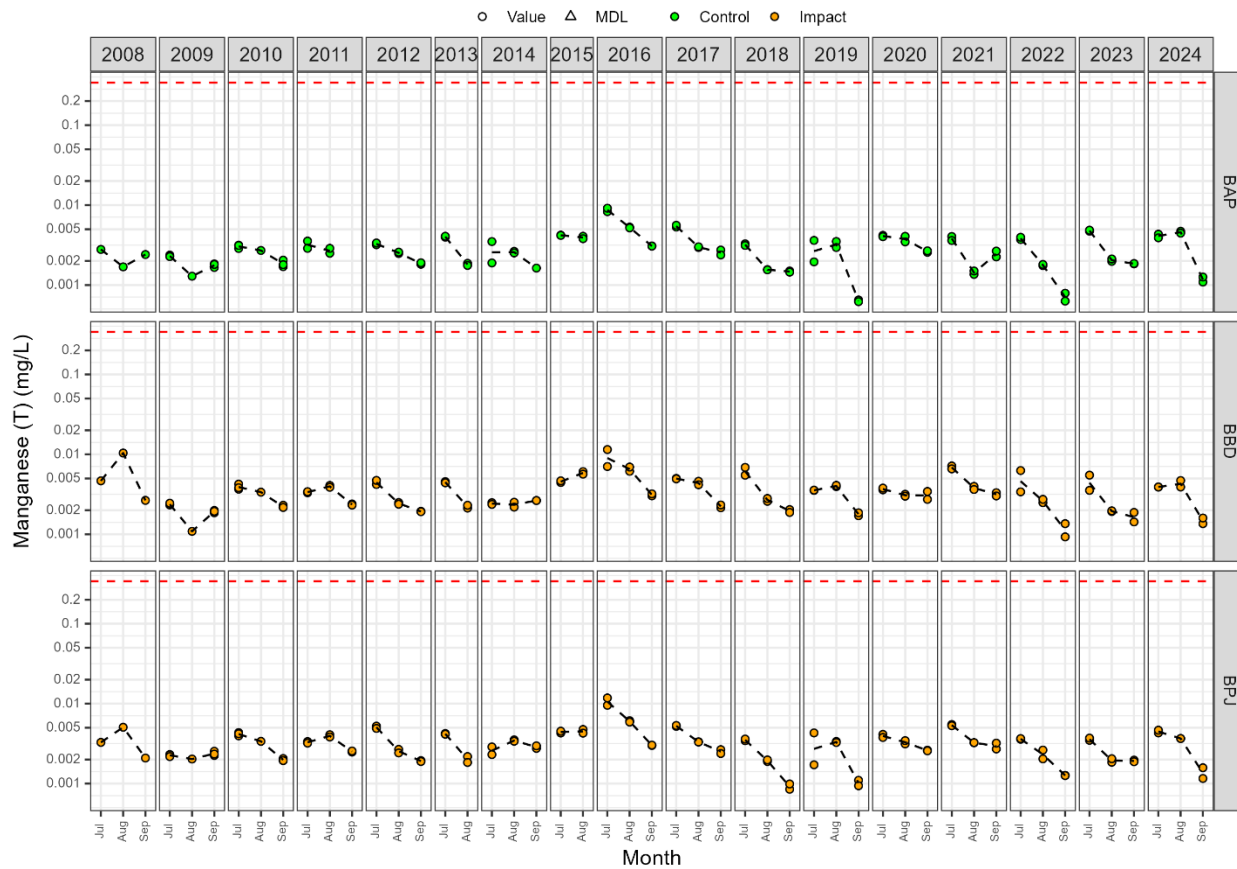


Figure C3-37. Total mercury (mg/L).

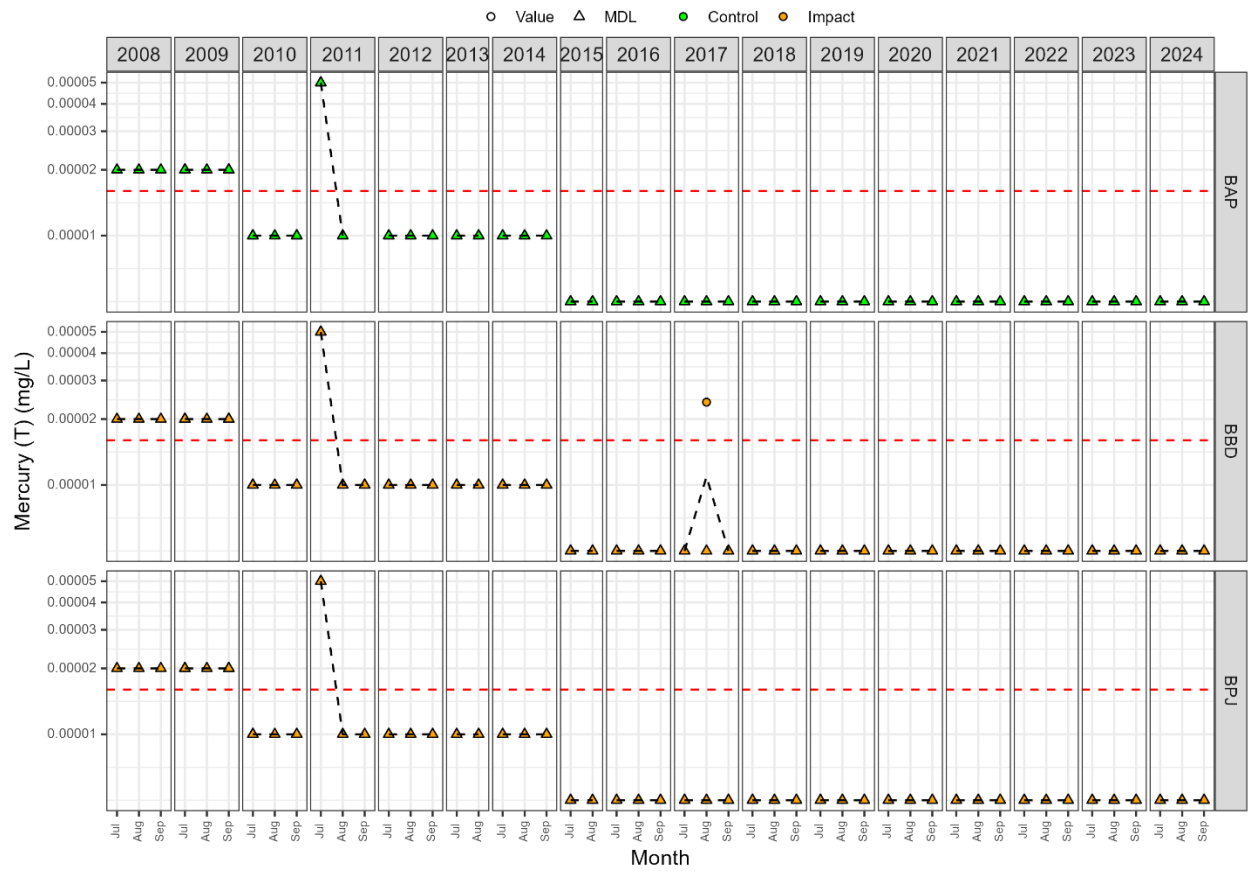


Figure C3-38. Total molybdenum (mg/L).

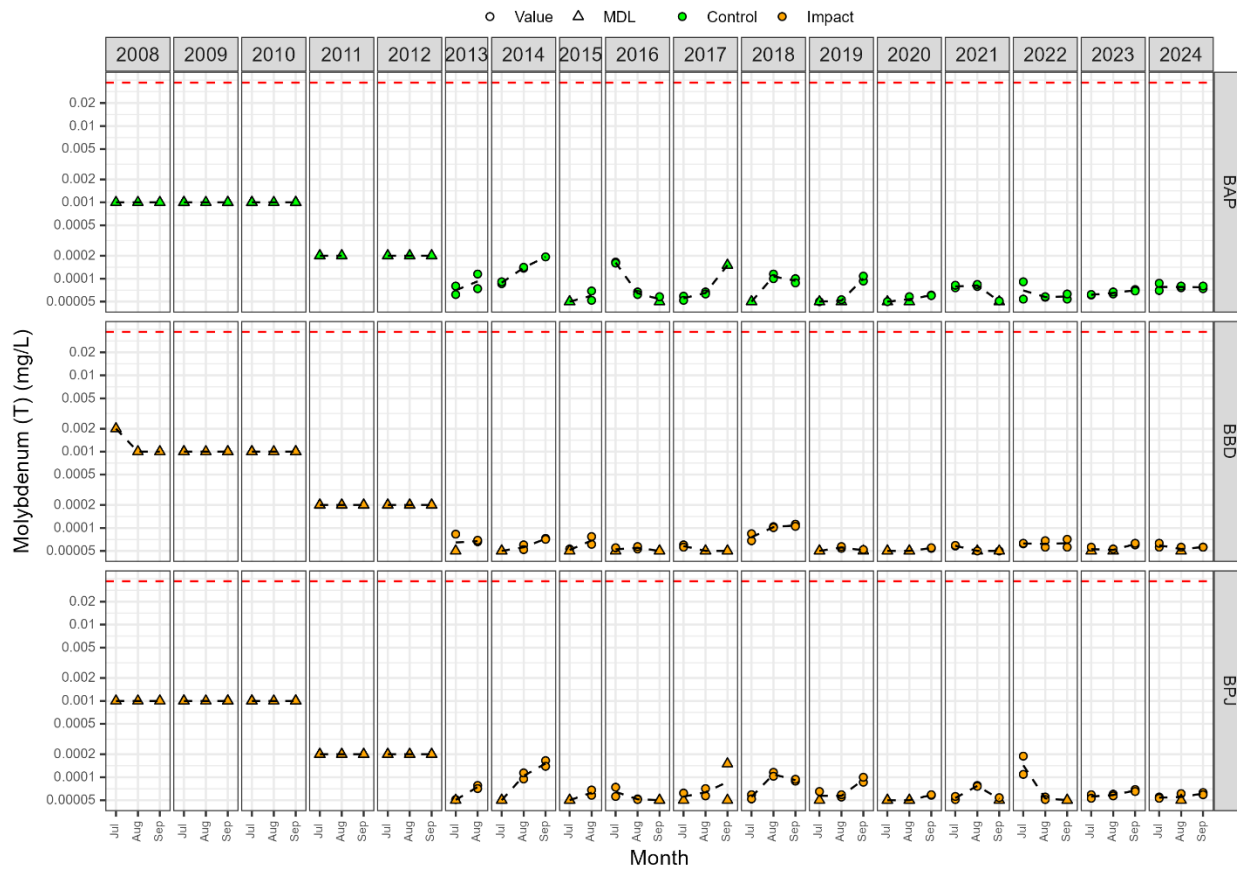


Figure C3-39. Total nickel (mg/L).

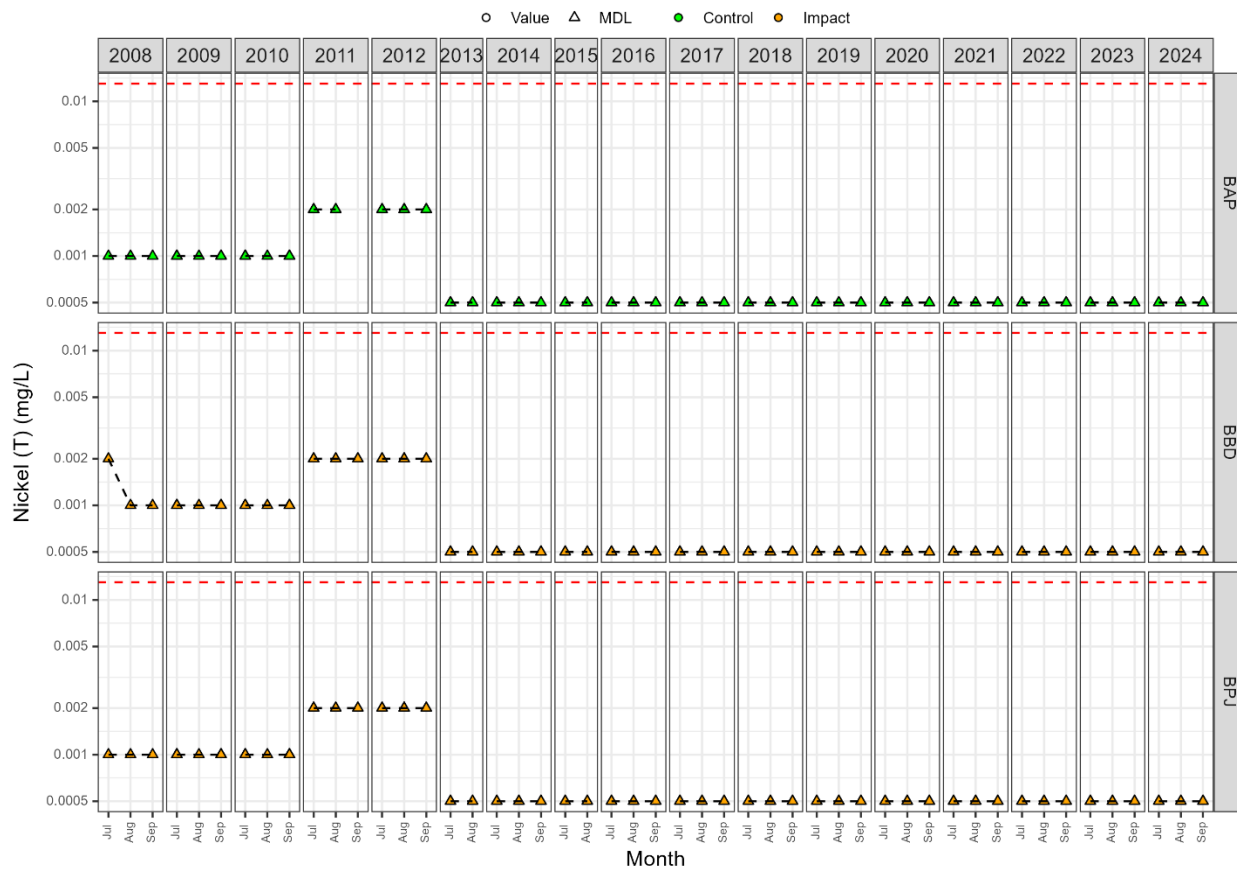


Figure C3-40. Total potassium (mg/L).

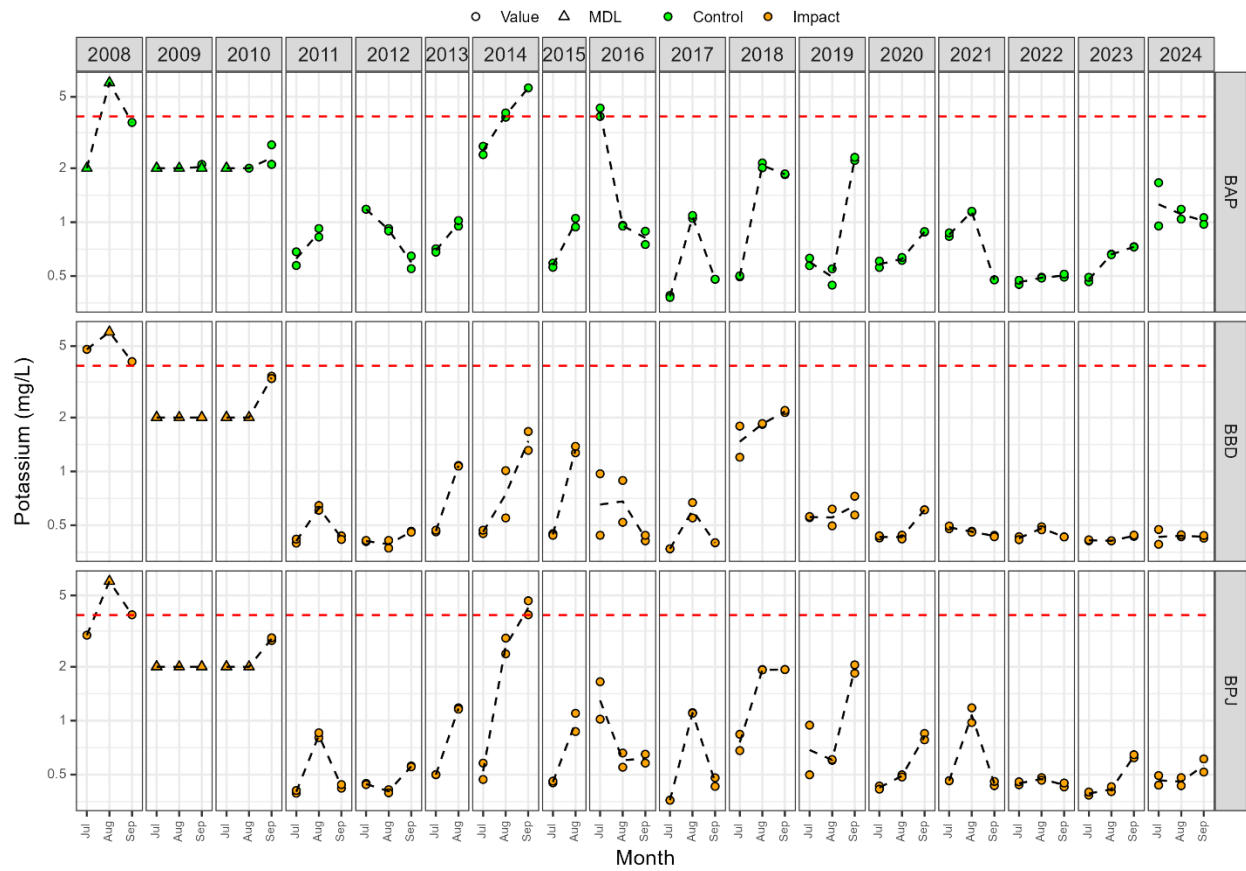


Figure C3-41. Total selenium (mg/L).

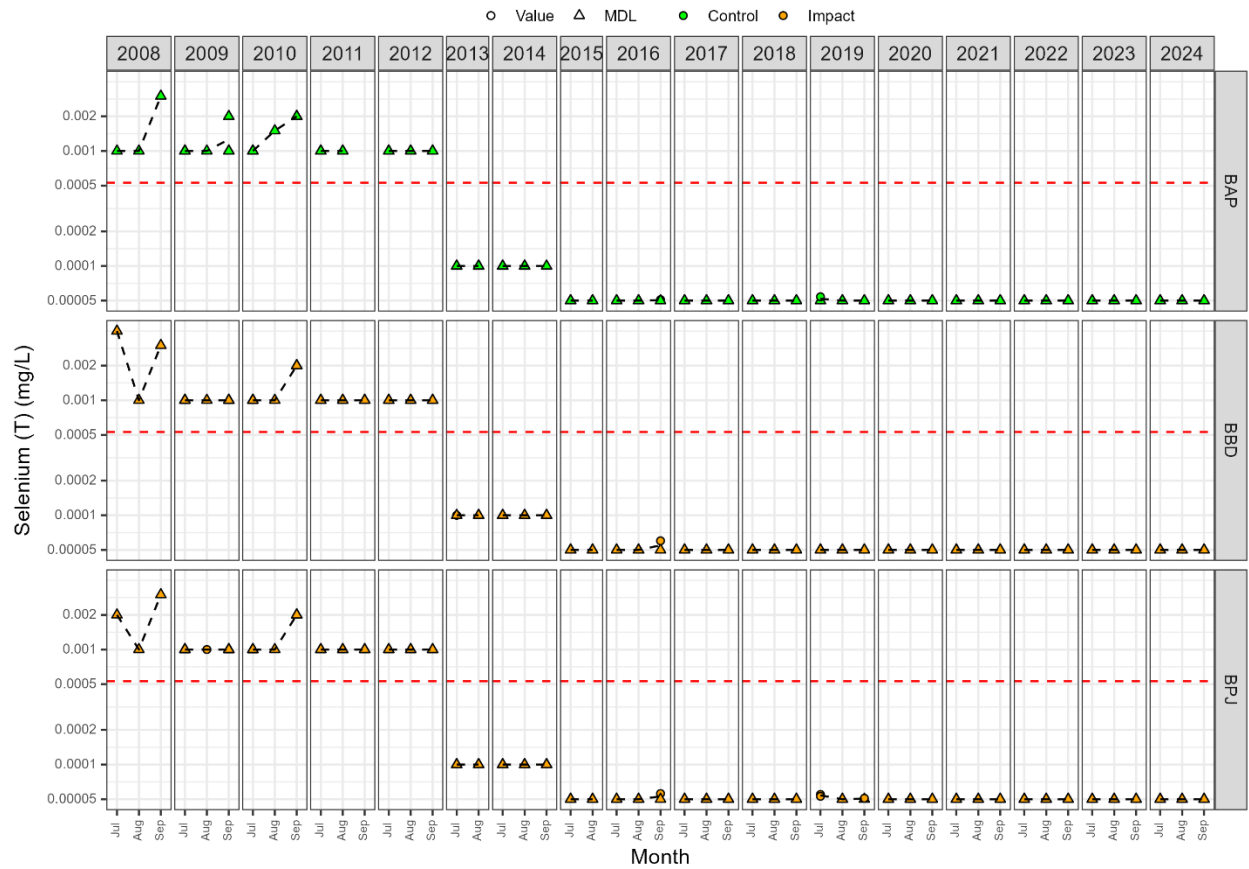


Figure C3-42. Total silicon (mg/L).



Figure C3-43. Total silver (mg/L).

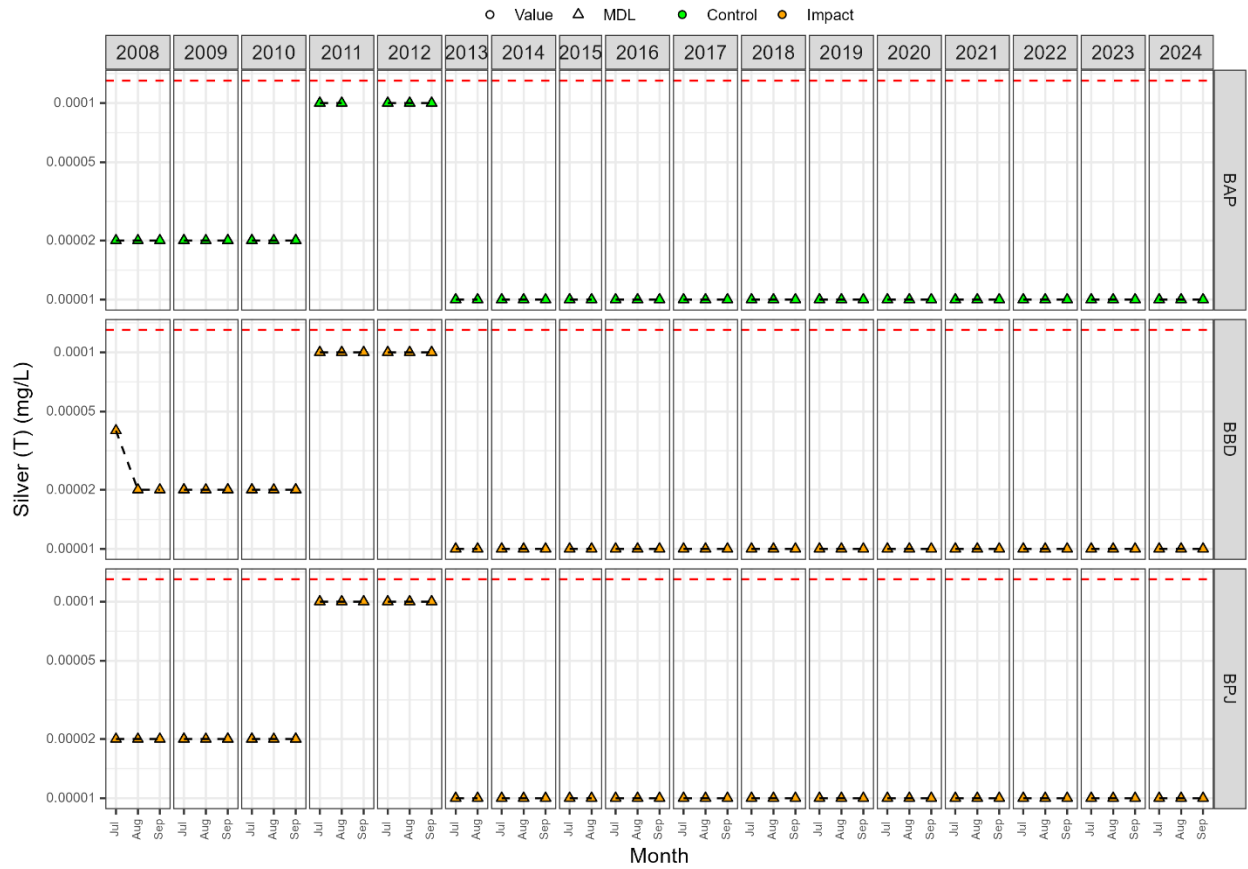


Figure C3-44. Total sodium (mg/L).

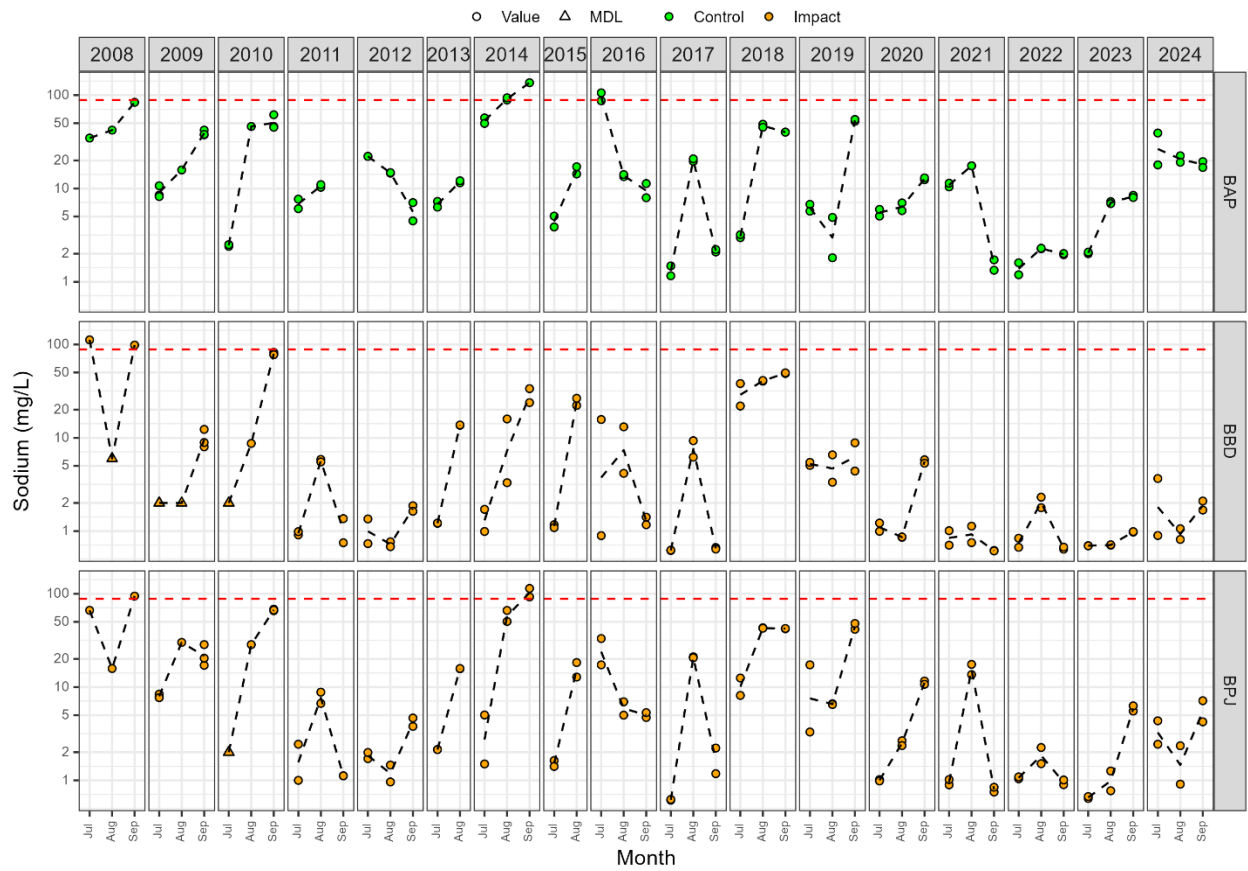


Figure C3-45. Total strontium (mg/L).

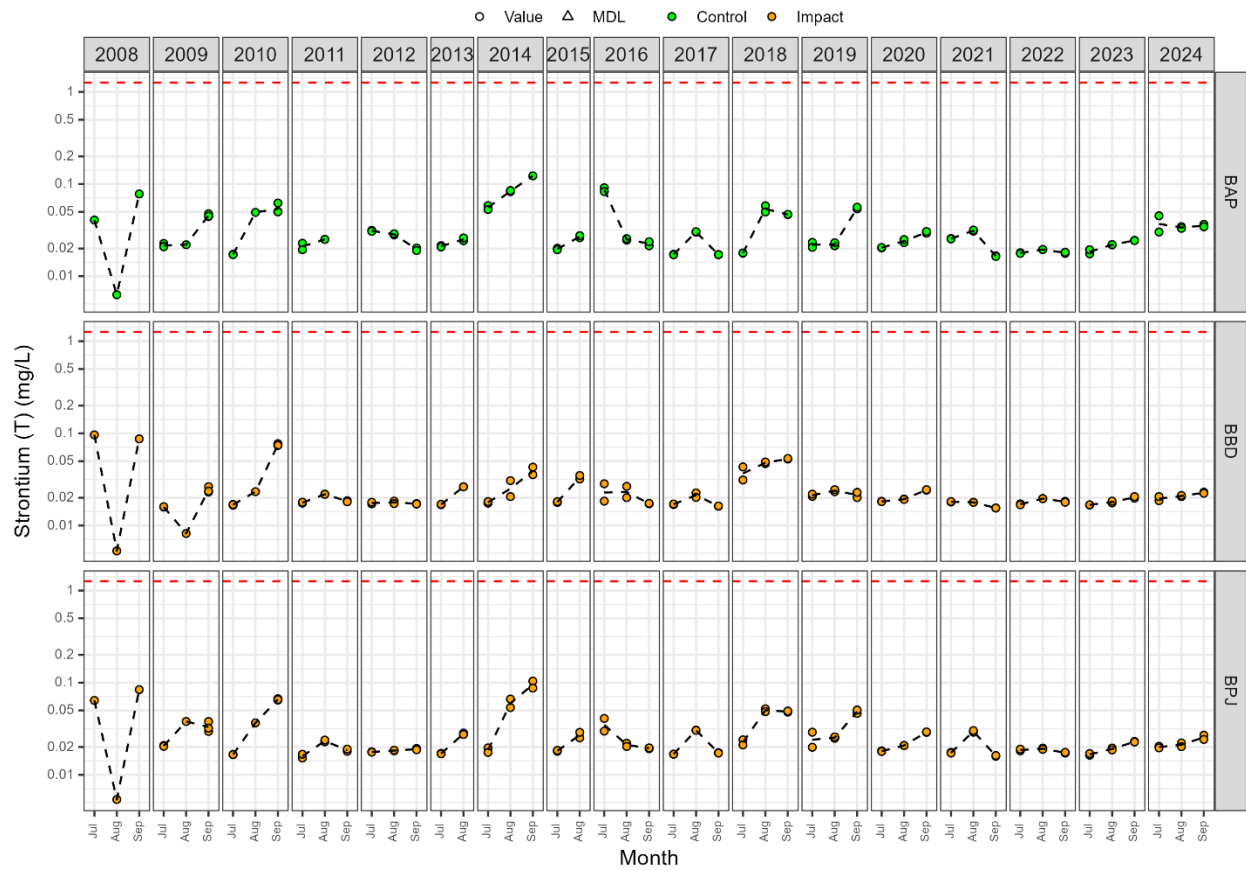


Figure C3-46. Total thallium (mg/L).

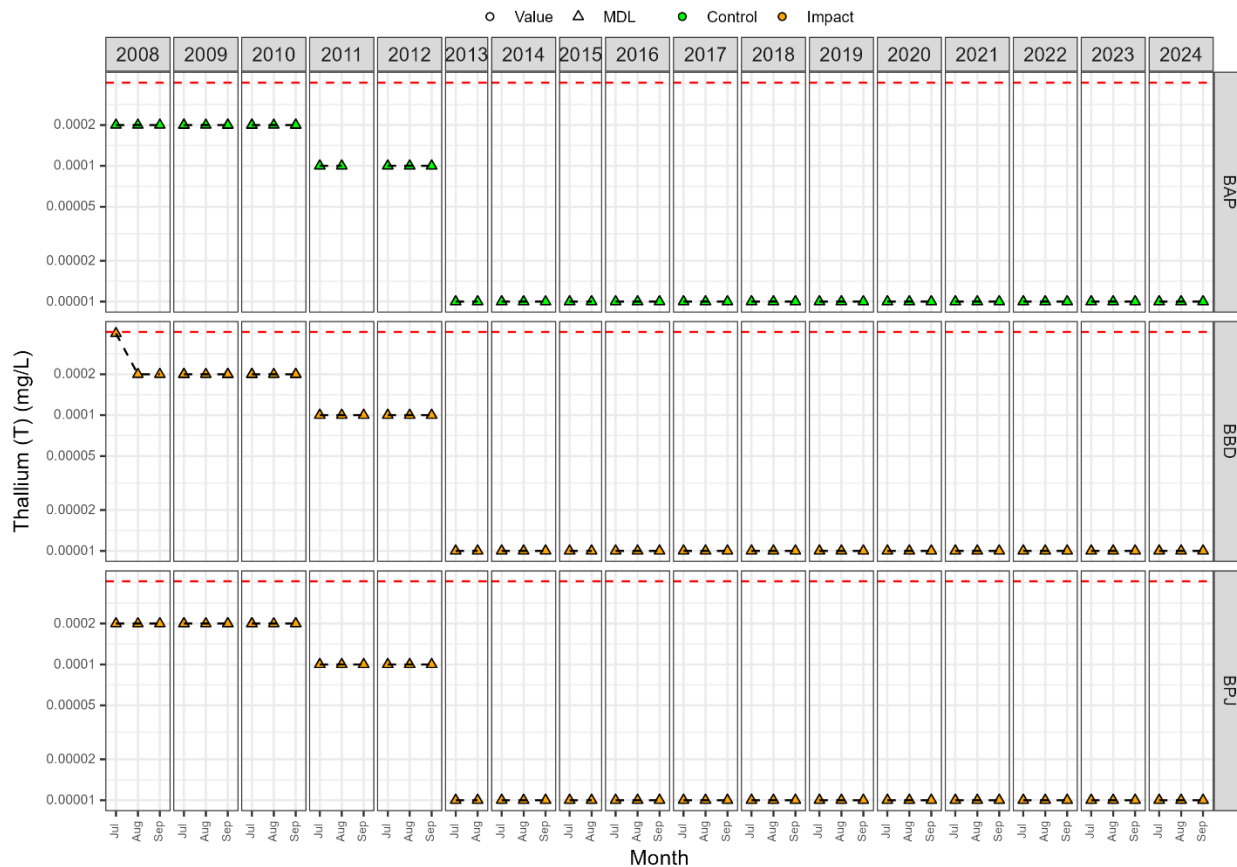


Figure C3-47. Total tin (mg/L).

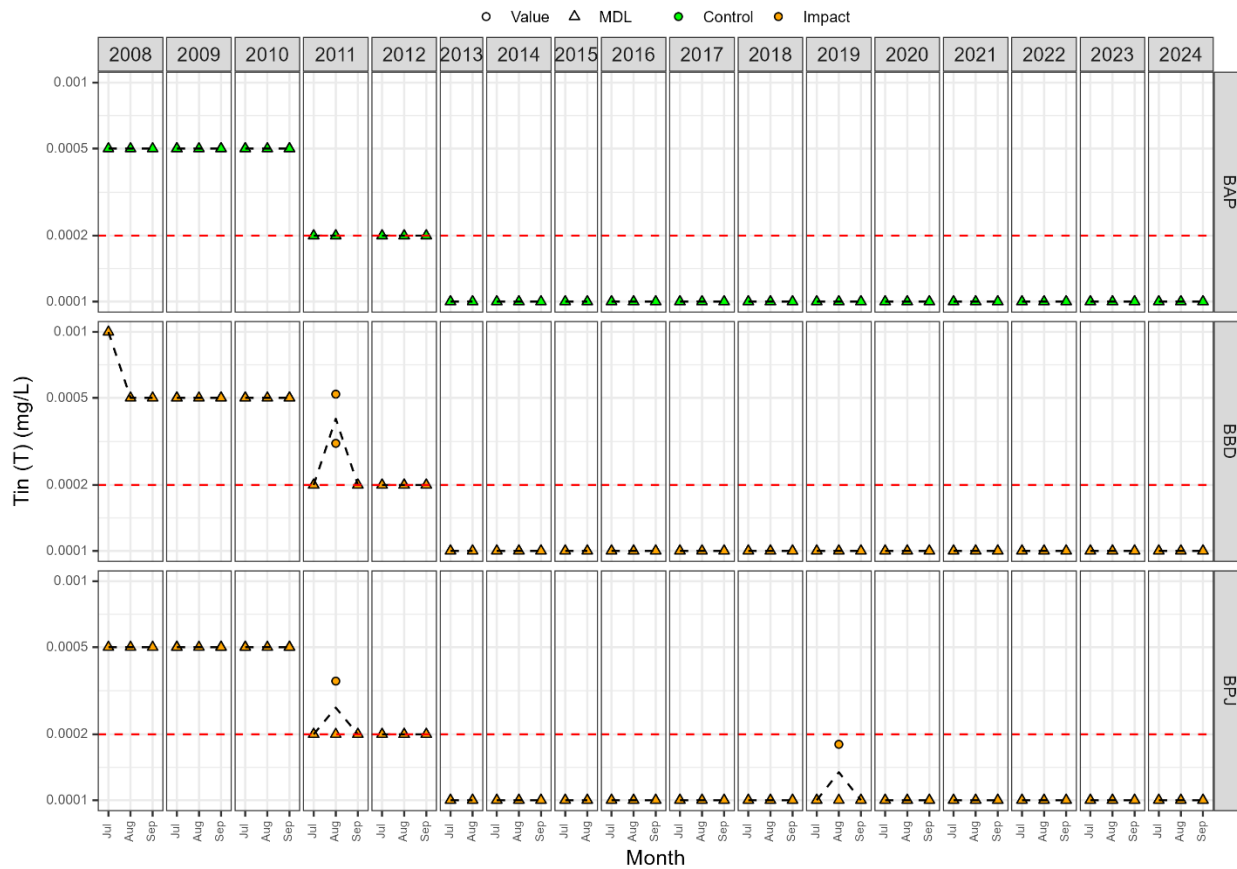


Figure C3-48. Total titanium (mg/L).

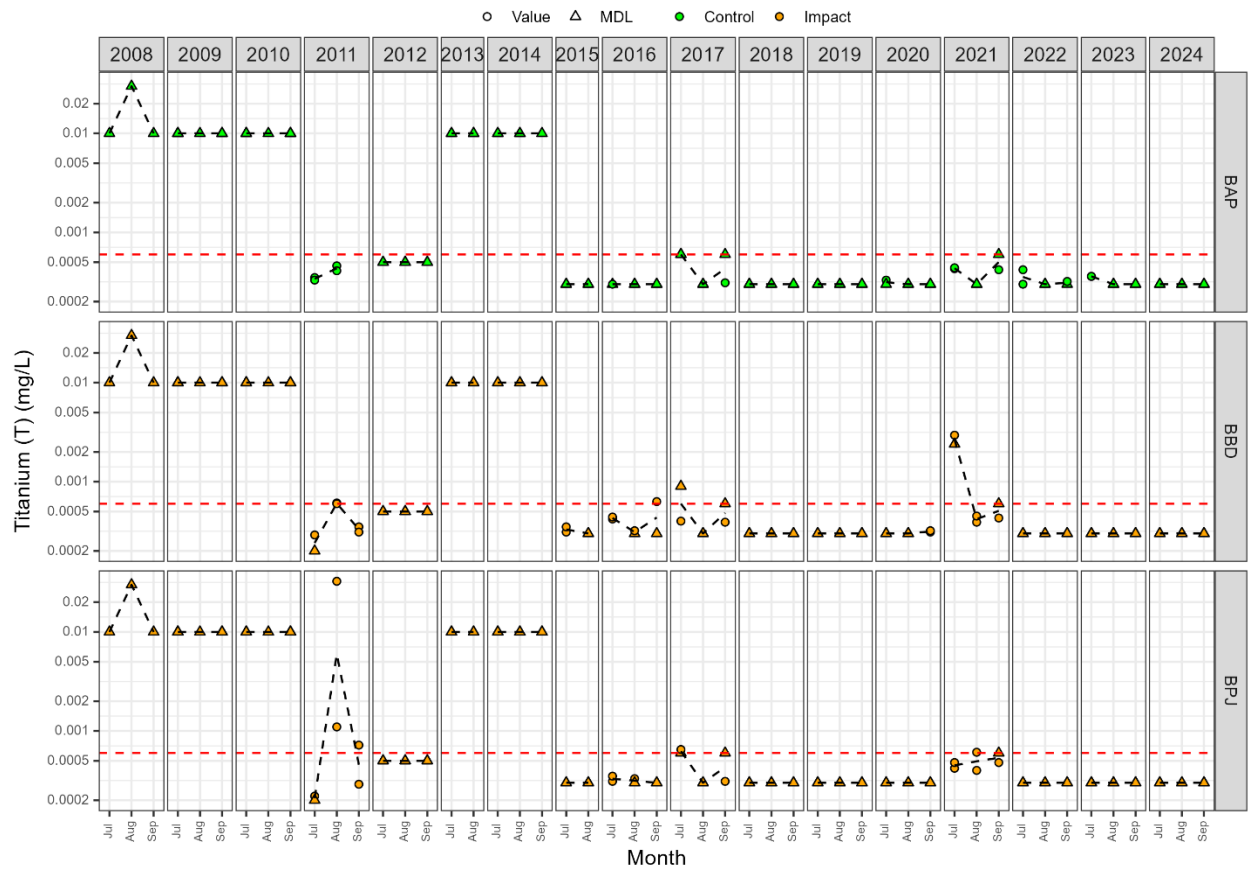


Figure C3-49. Total uranium (mg/L).

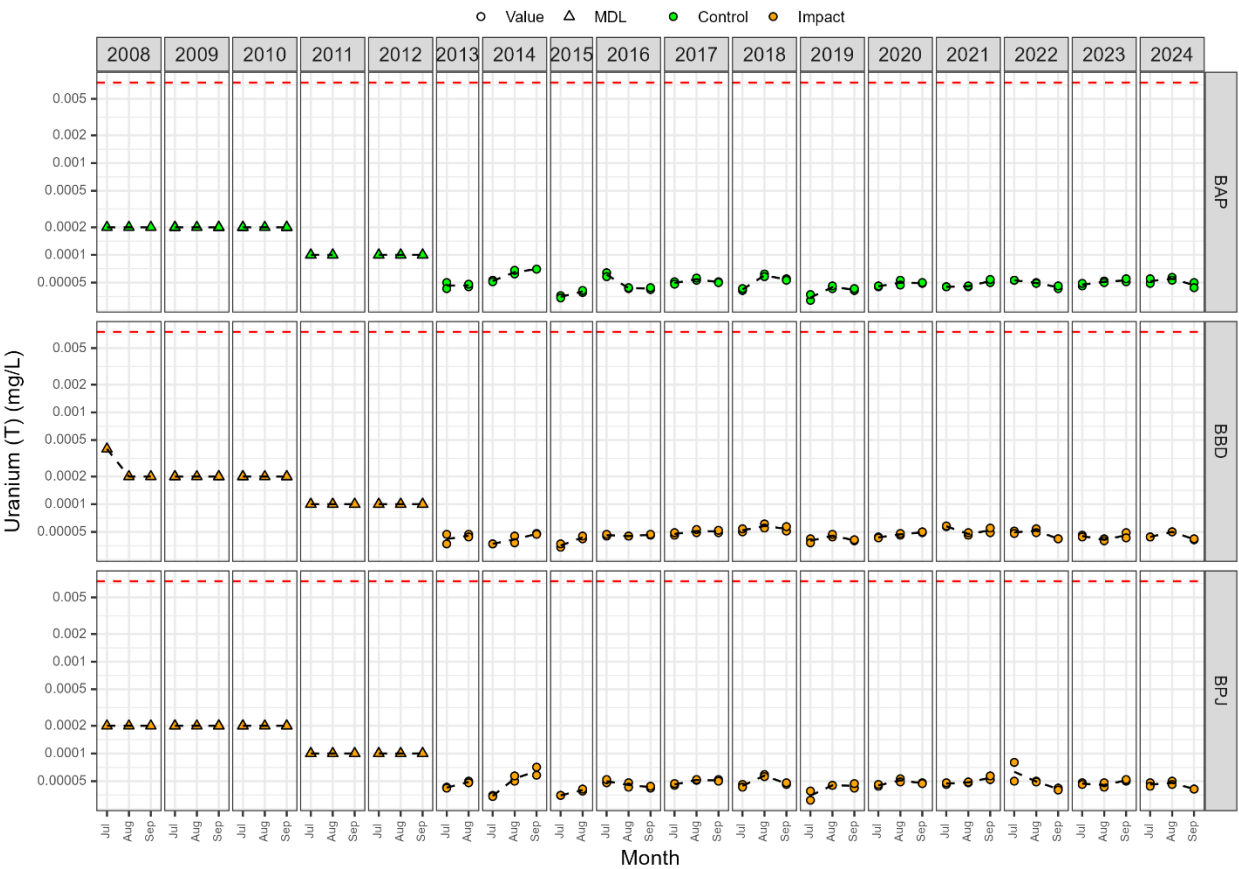


Figure C3-50. Total vanadium (mg/L).

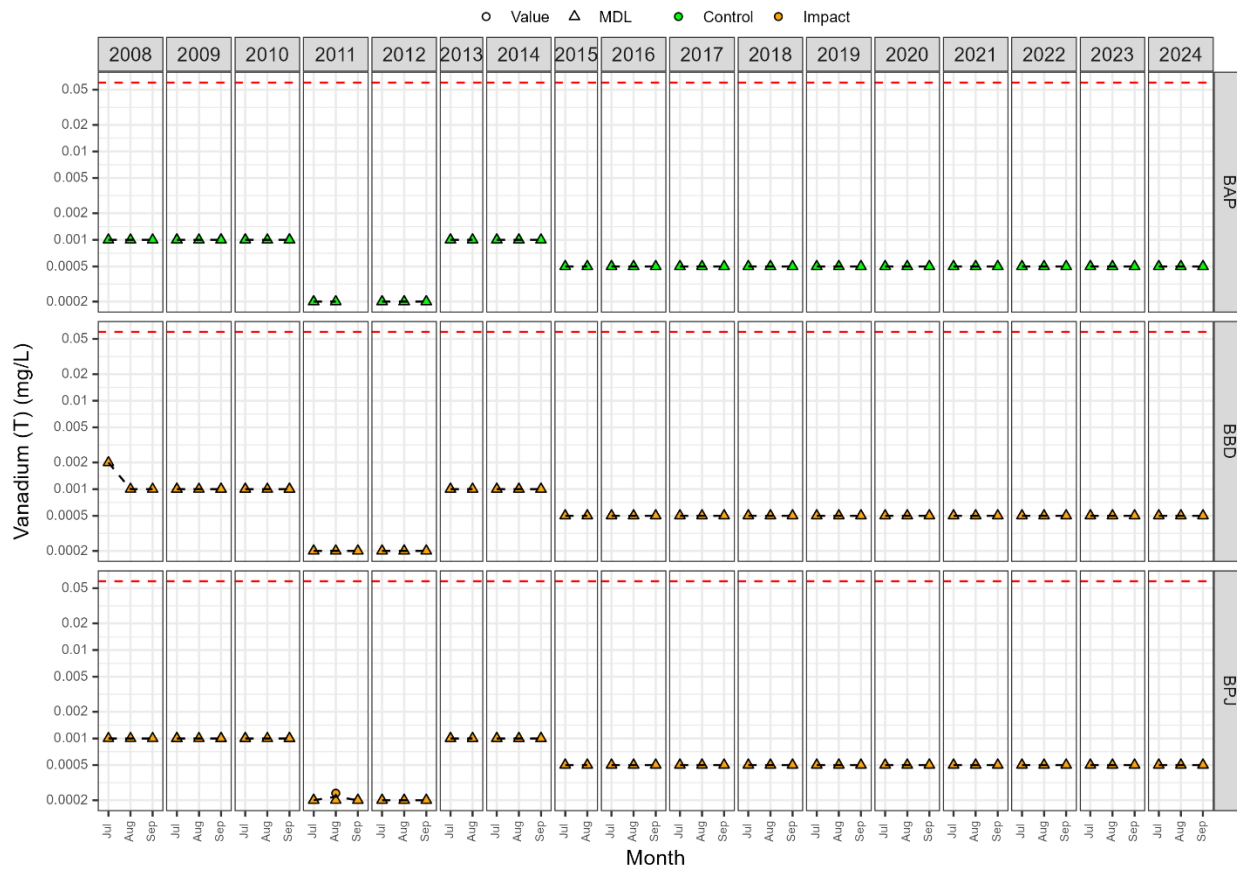


Figure C3-51. Total zinc (mg/L).

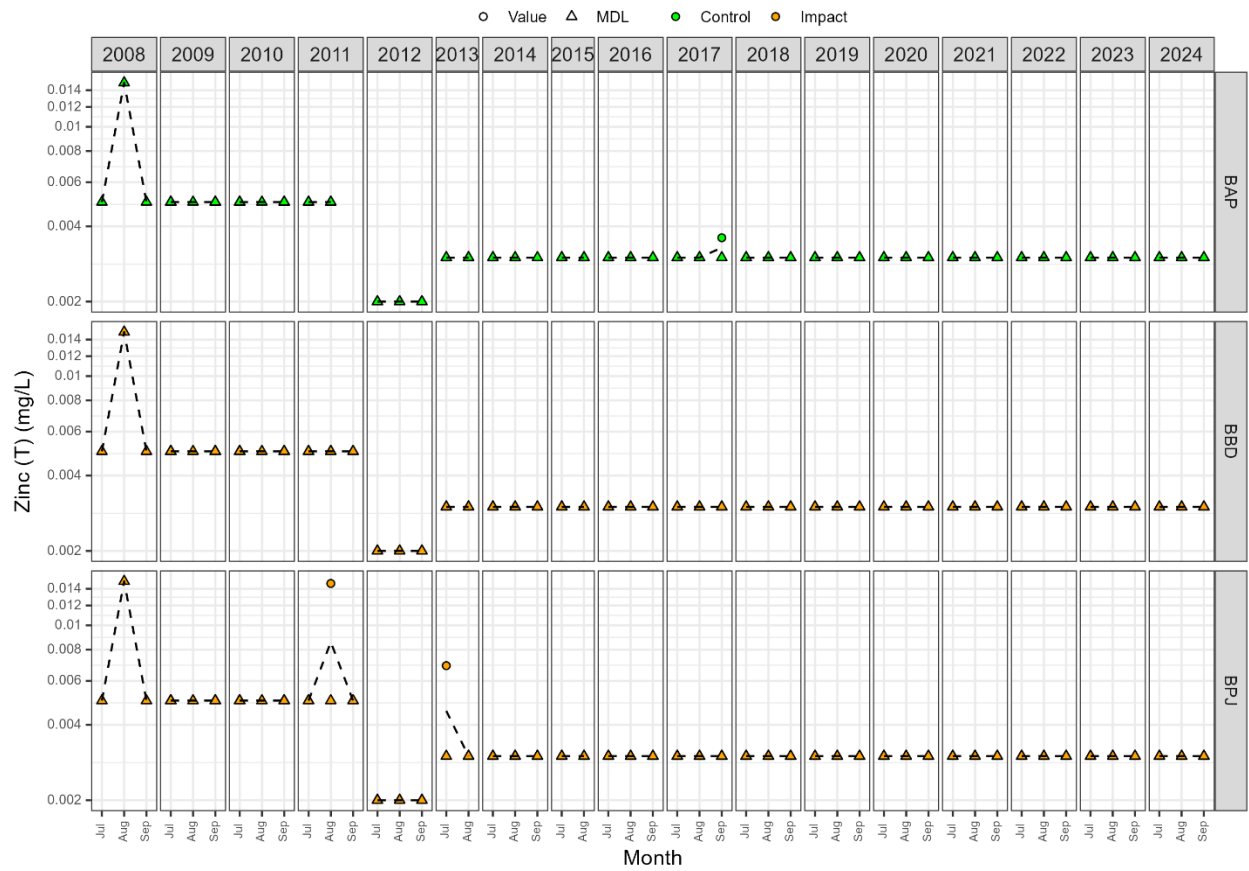


Figure C3-52. Dissolved aluminum (mg/L).

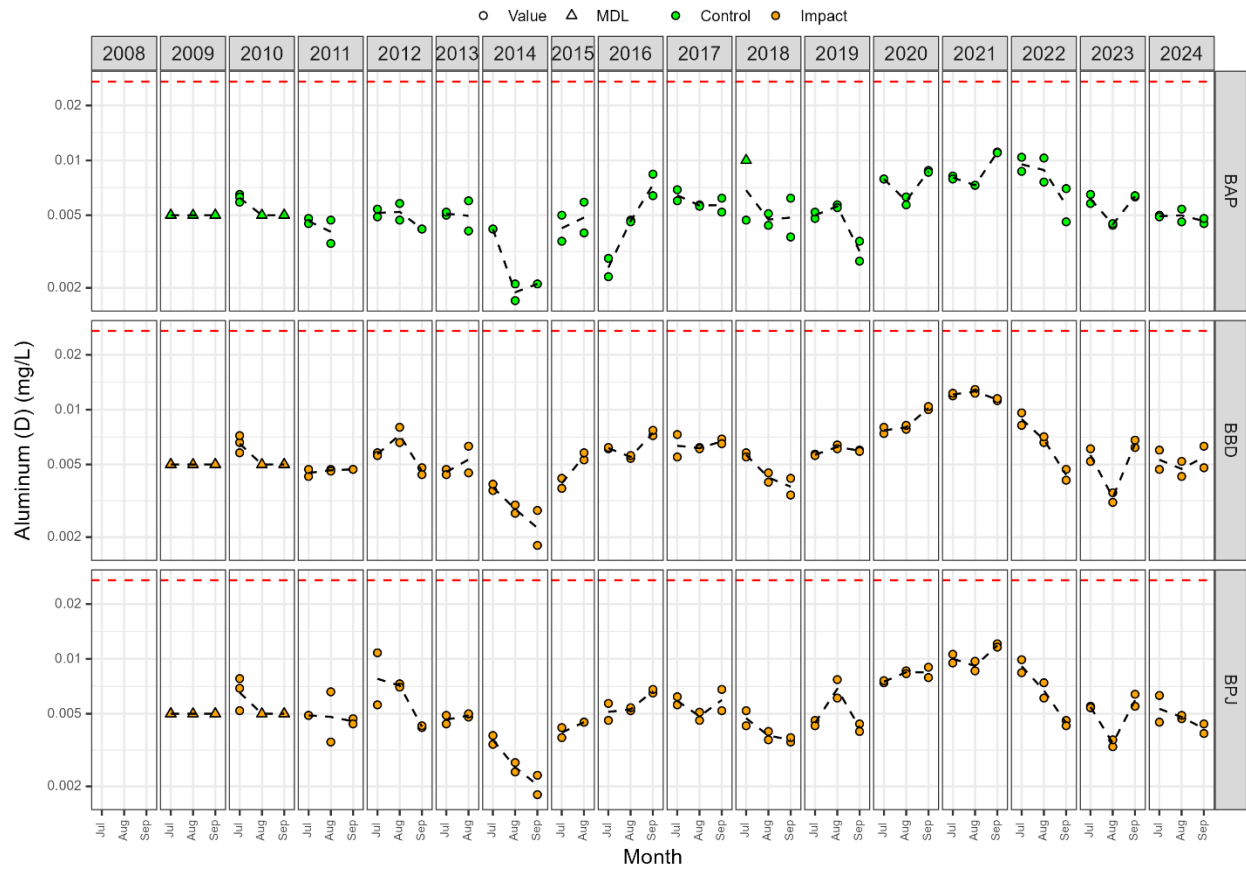


Figure C3-53. Dissolved antimony (mg/L).

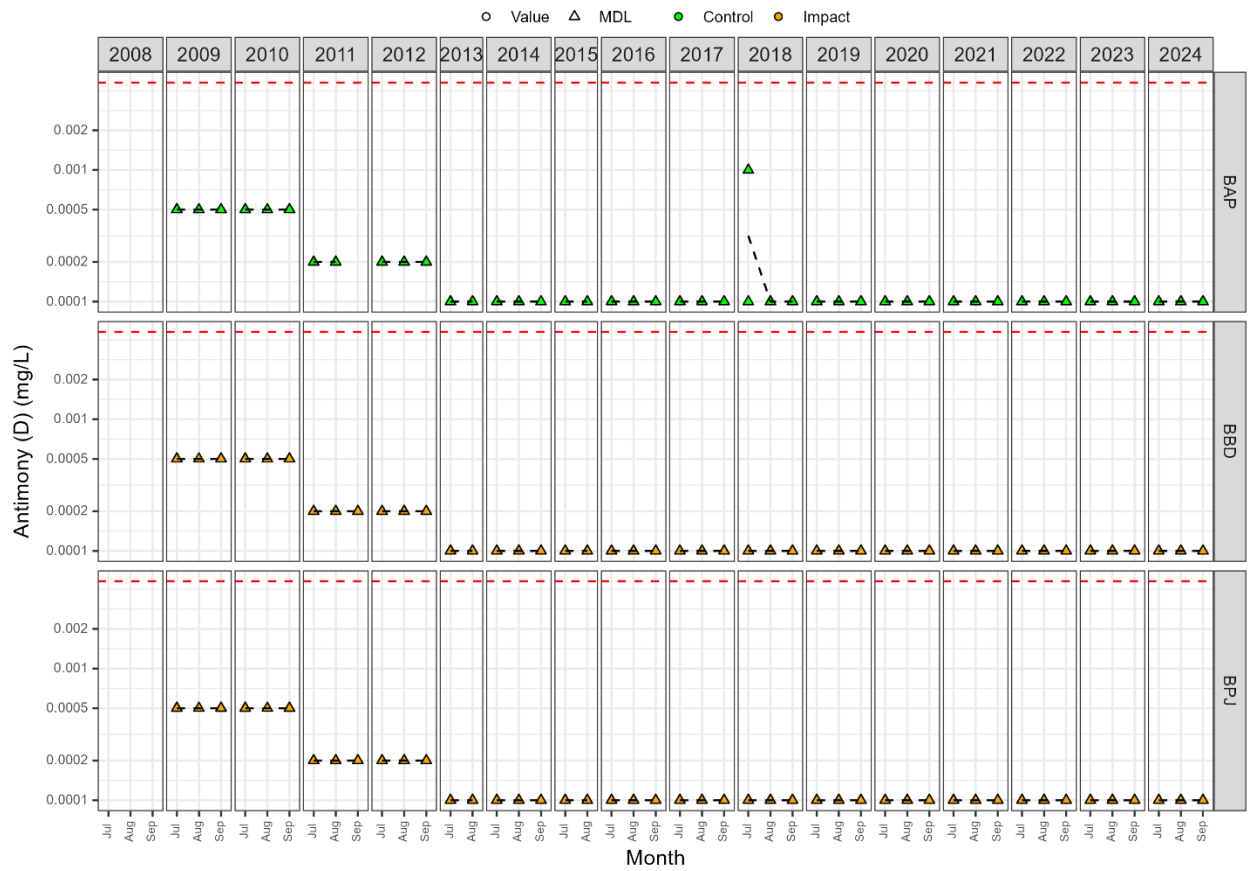


Figure C3-54. Dissolved arsenic (mg/L).

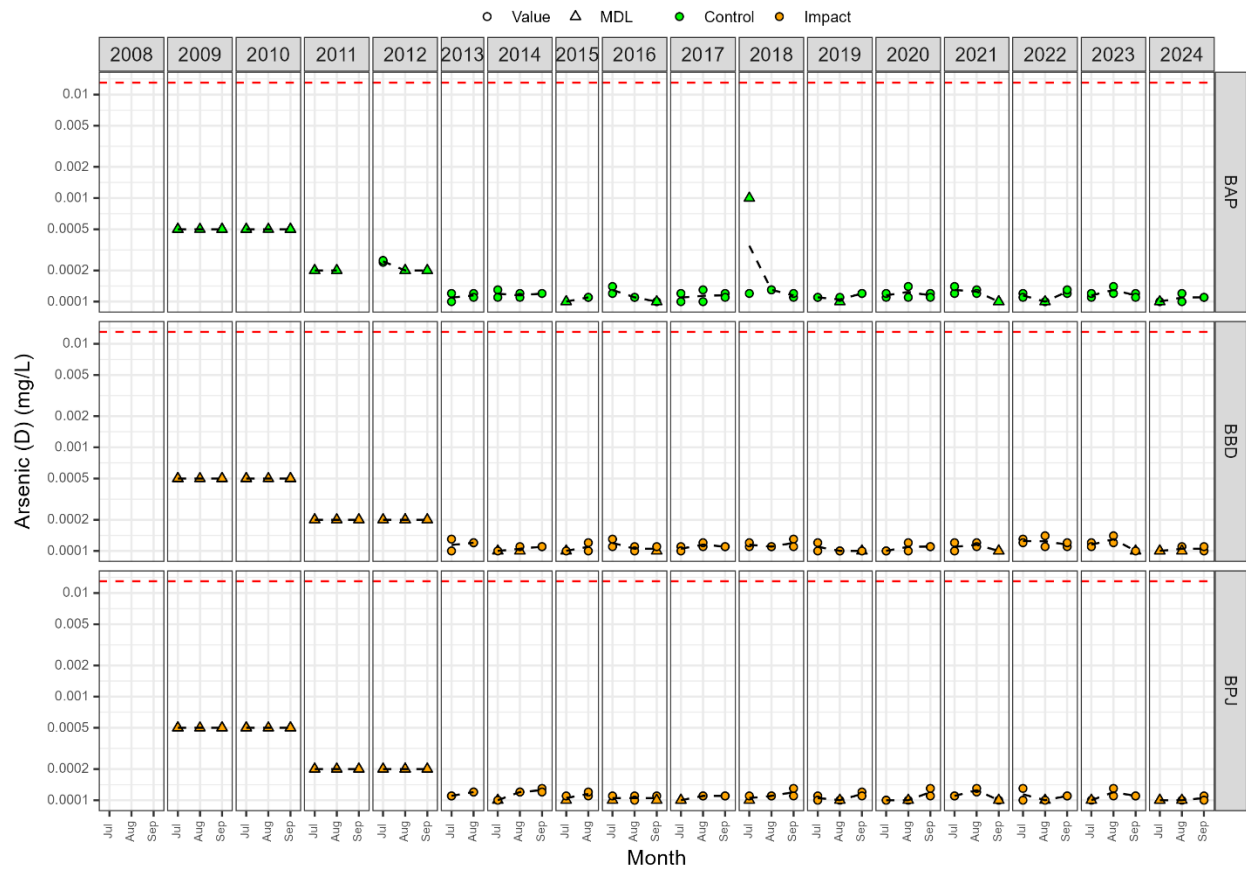


Figure C3-55. Dissolved barium (mg/L).

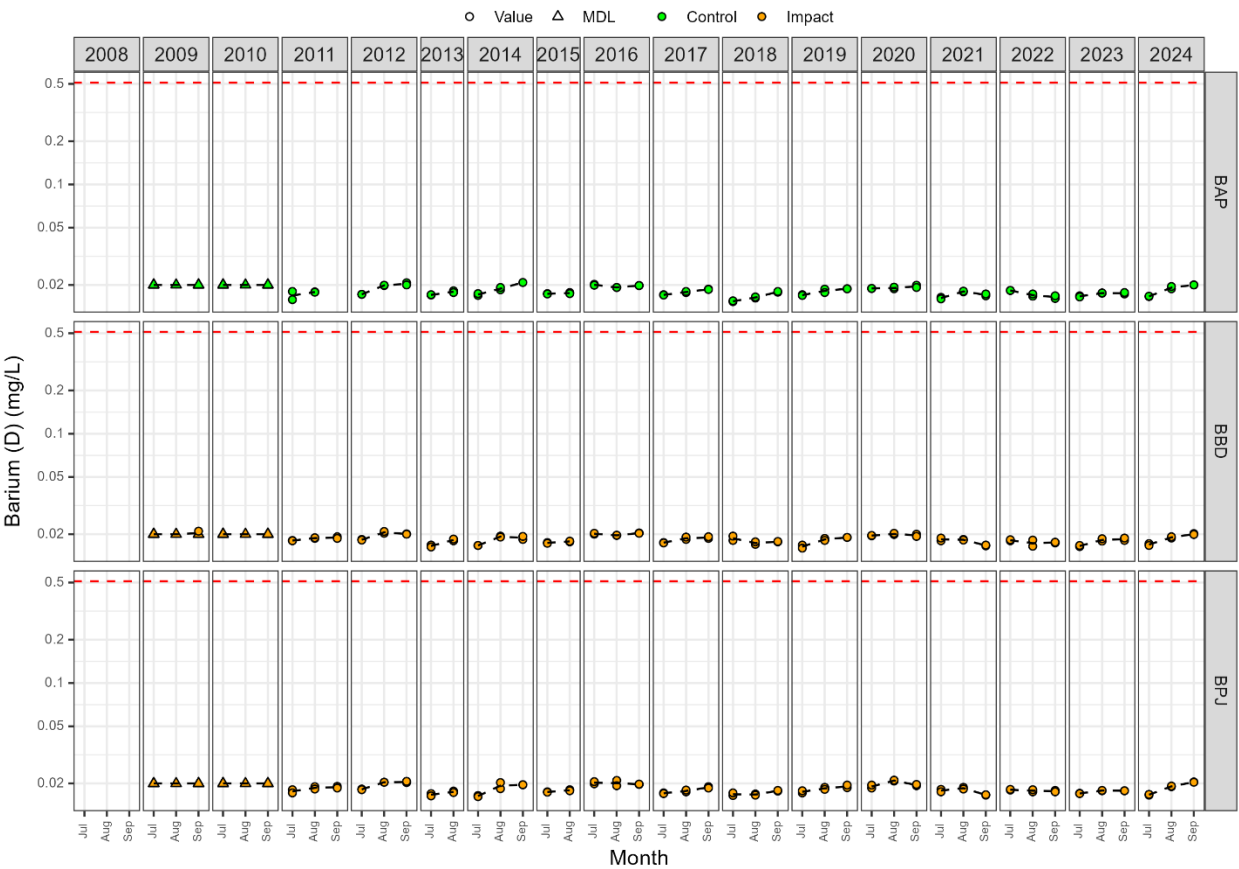


Figure C3-56. Dissolved beryllium (mg/L).



Figure C3-57. Dissolved boron (mg/L).

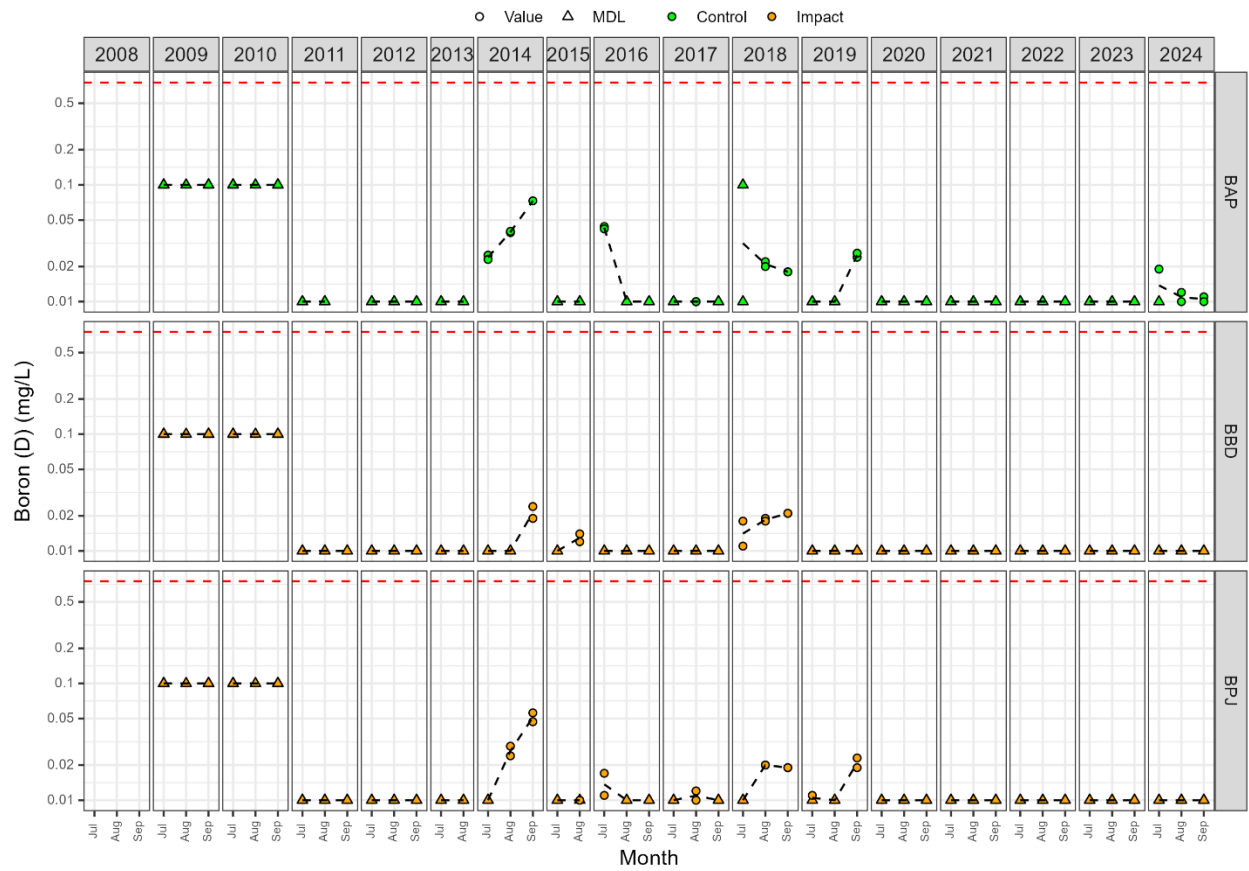


Figure C3-58. Dissolved cadmium (mg/L).

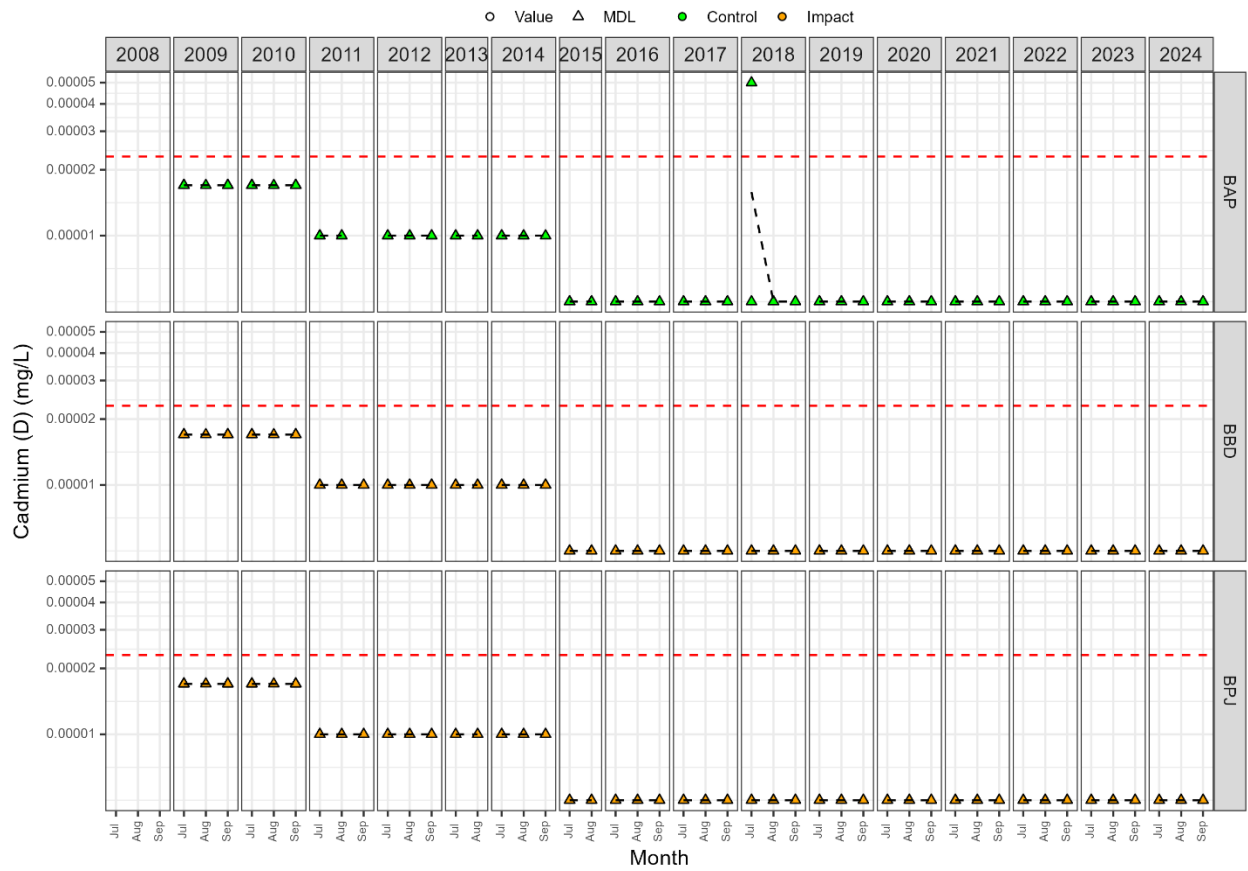


Figure C3-60. Dissolved copper (mg/L).

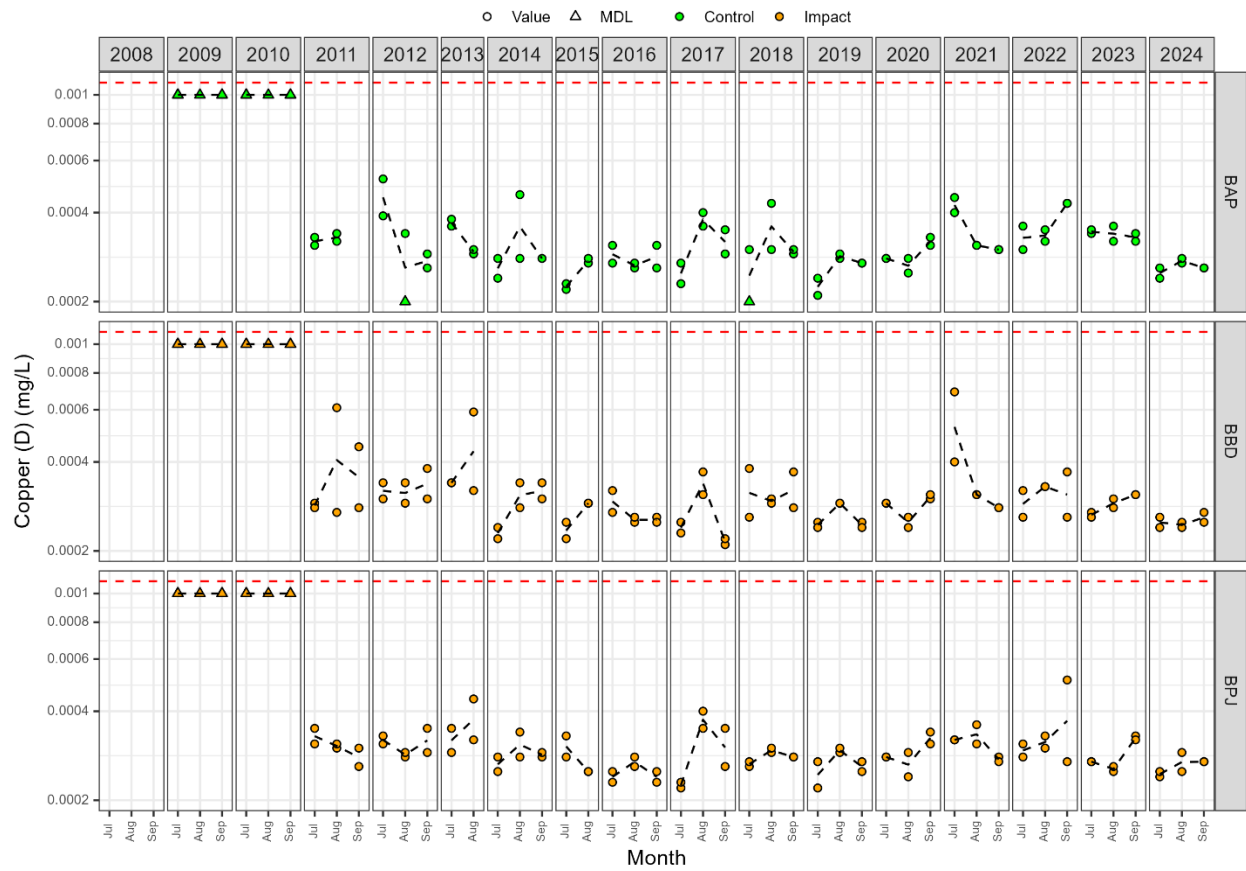


Figure C3-61. Dissolved iron (mg/L).

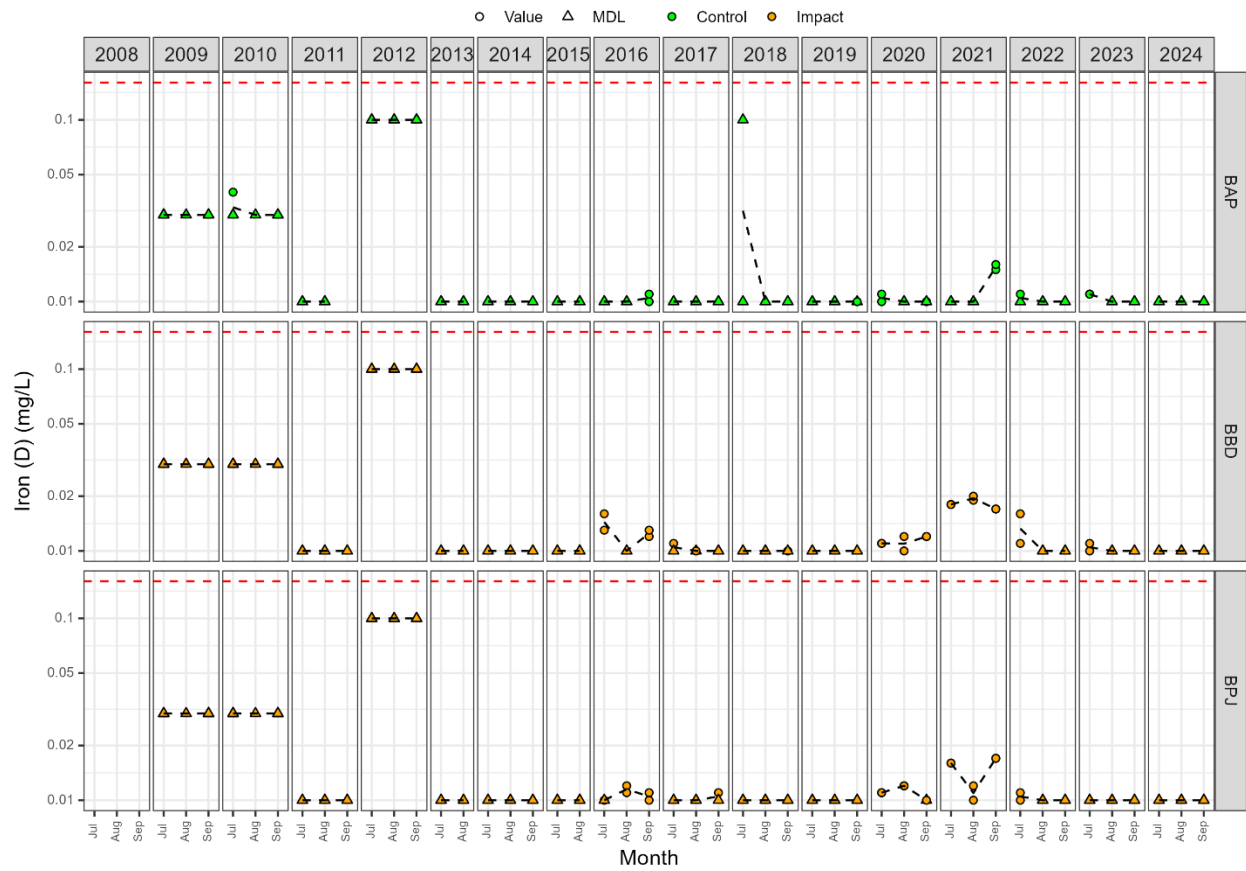


Figure C3-62. Dissolved lead (mg/L).

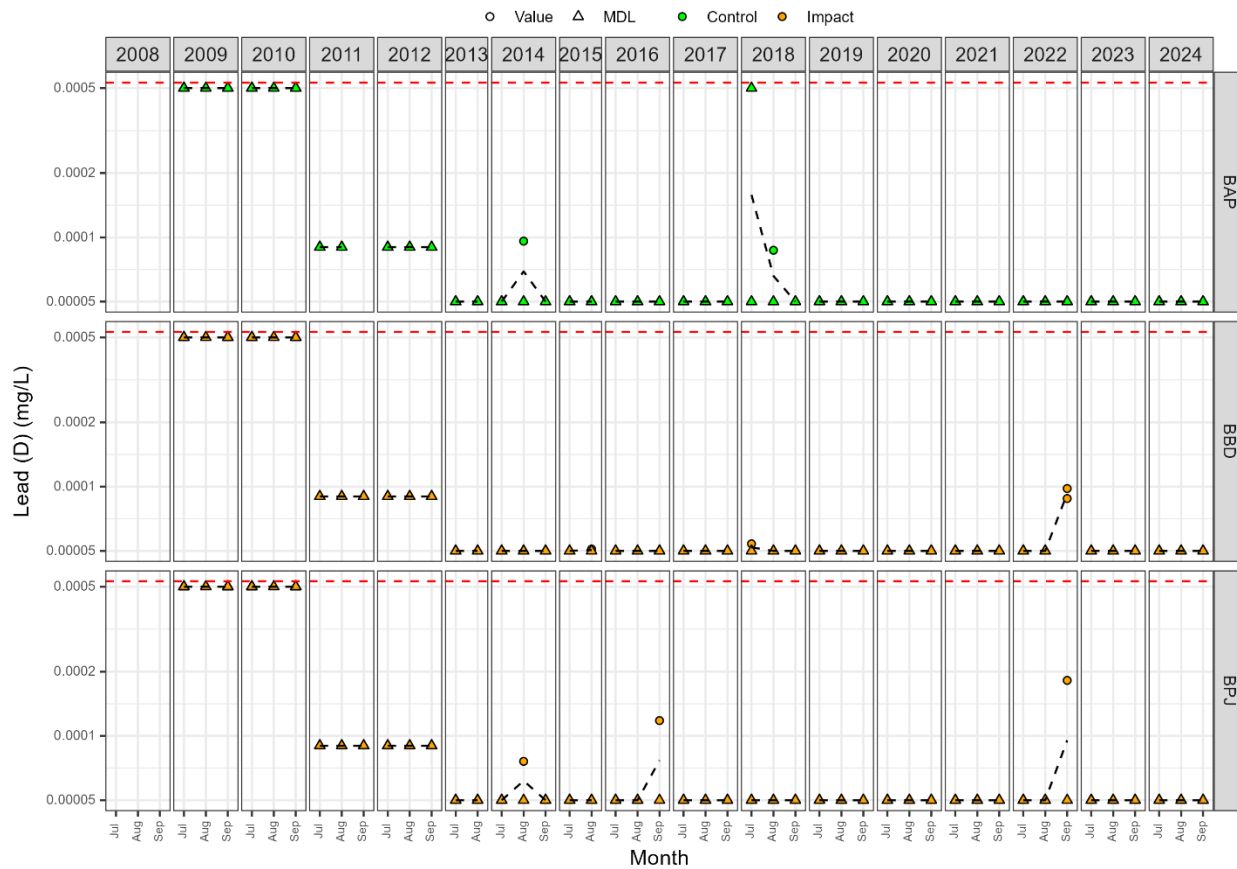


Figure C3-63. Dissolved lithium (mg/L).

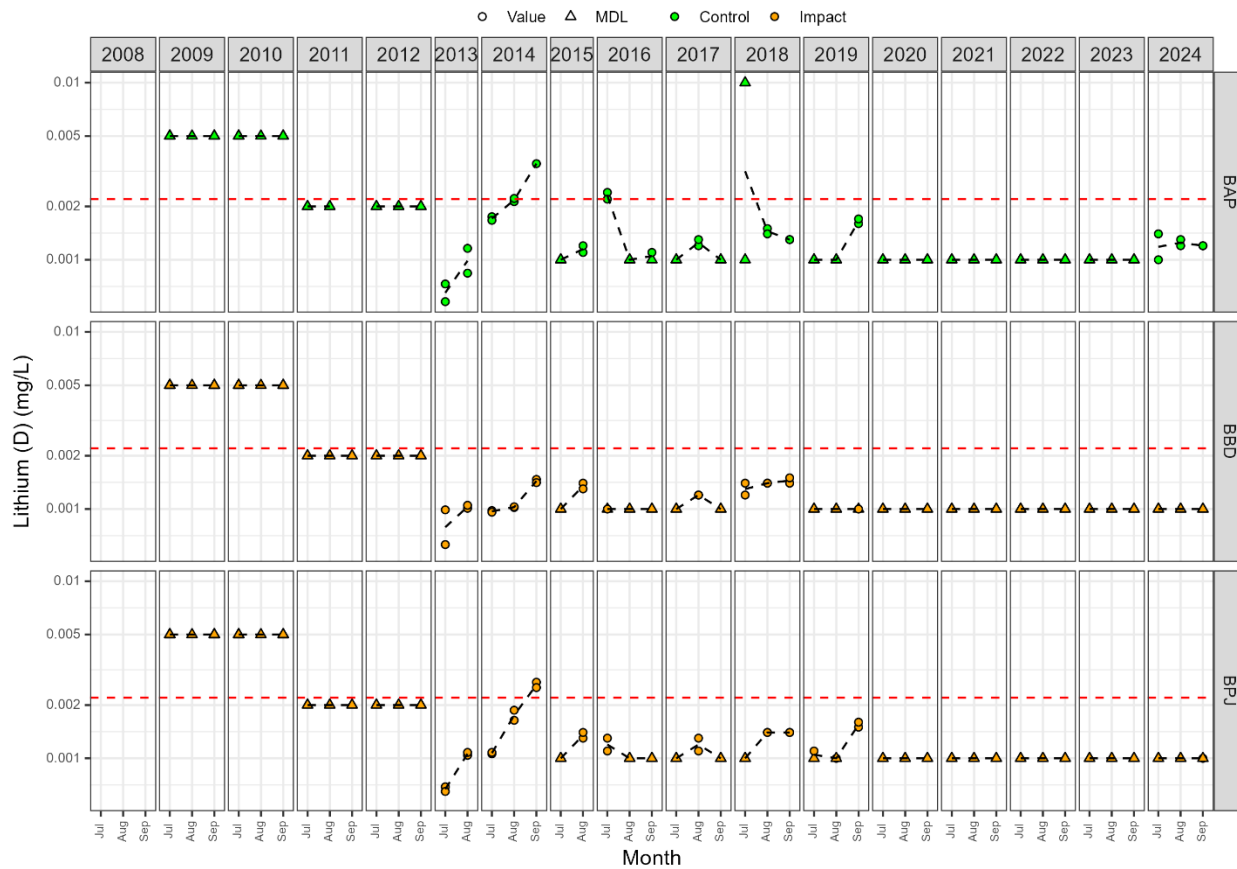


Figure C3-64. Dissolved manganese (mg/L).

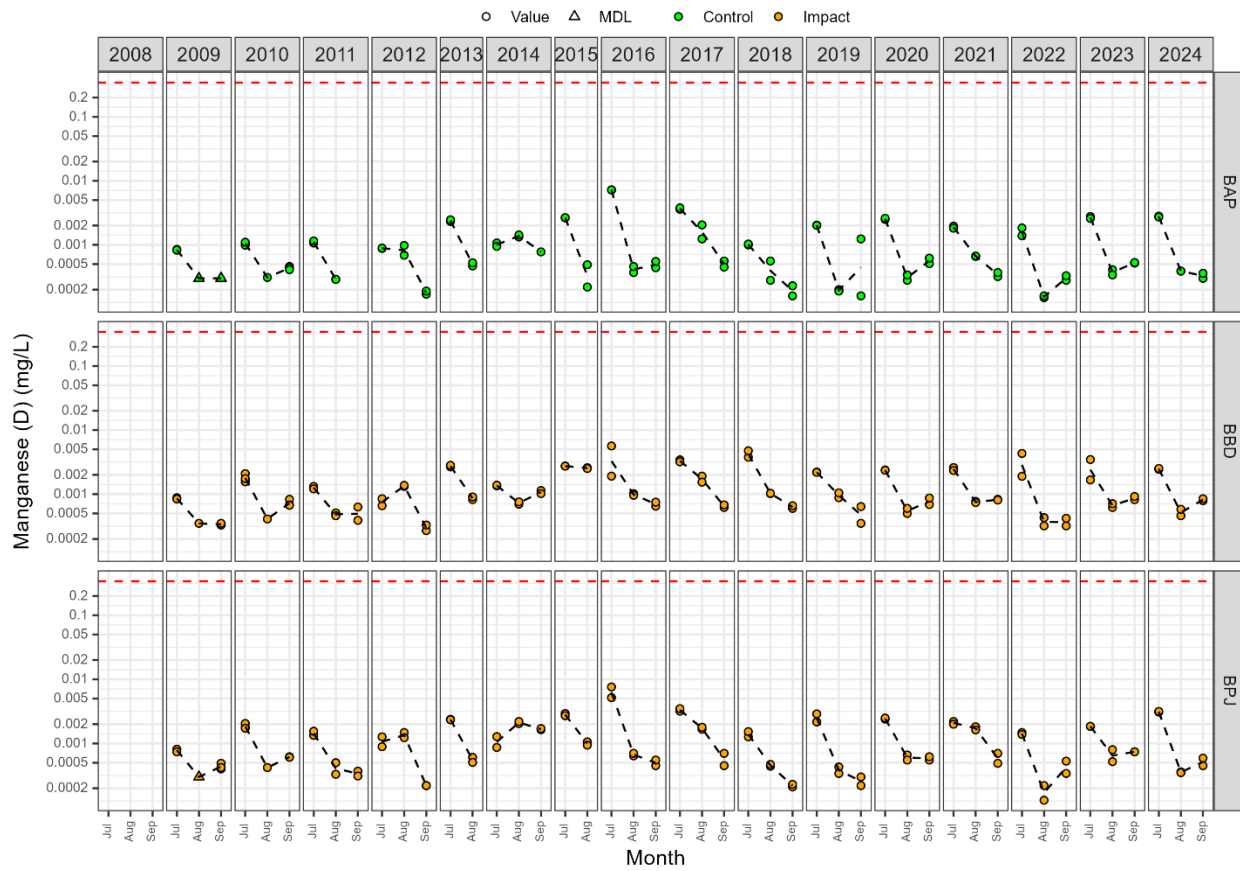


Figure C3-65. Dissolved mercury (mg/L).

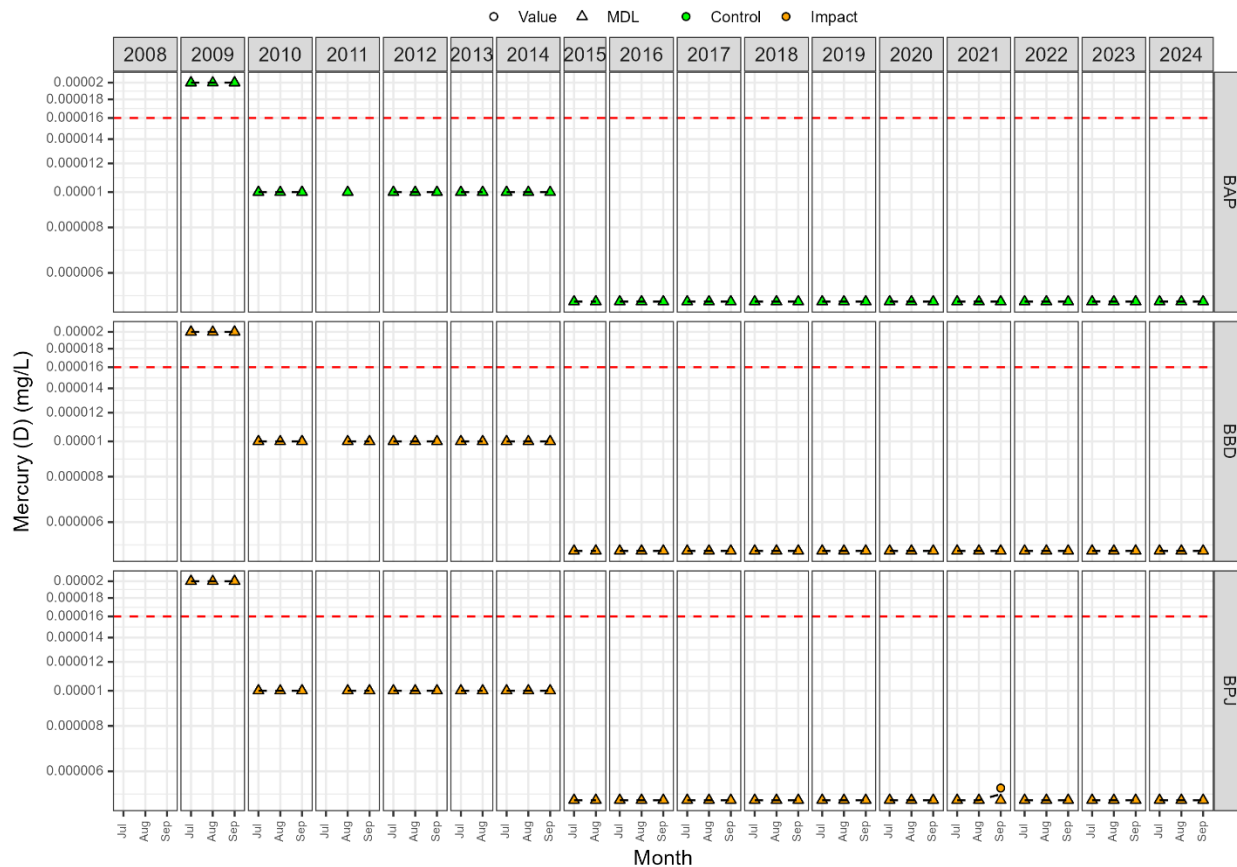


Figure C3-66. Dissolved molybdenum (mg/L).

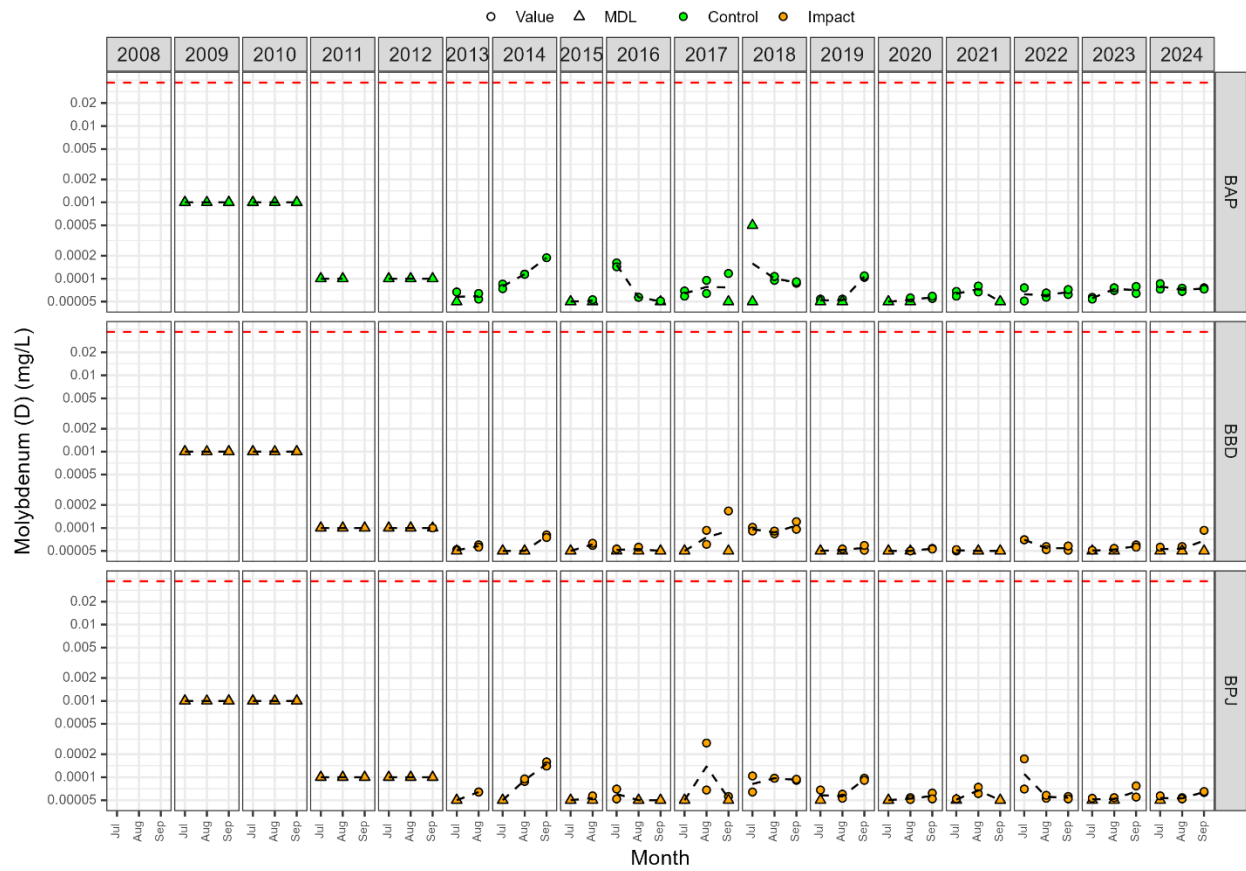


Figure C3-67. Dissolved nickel (mg/L).

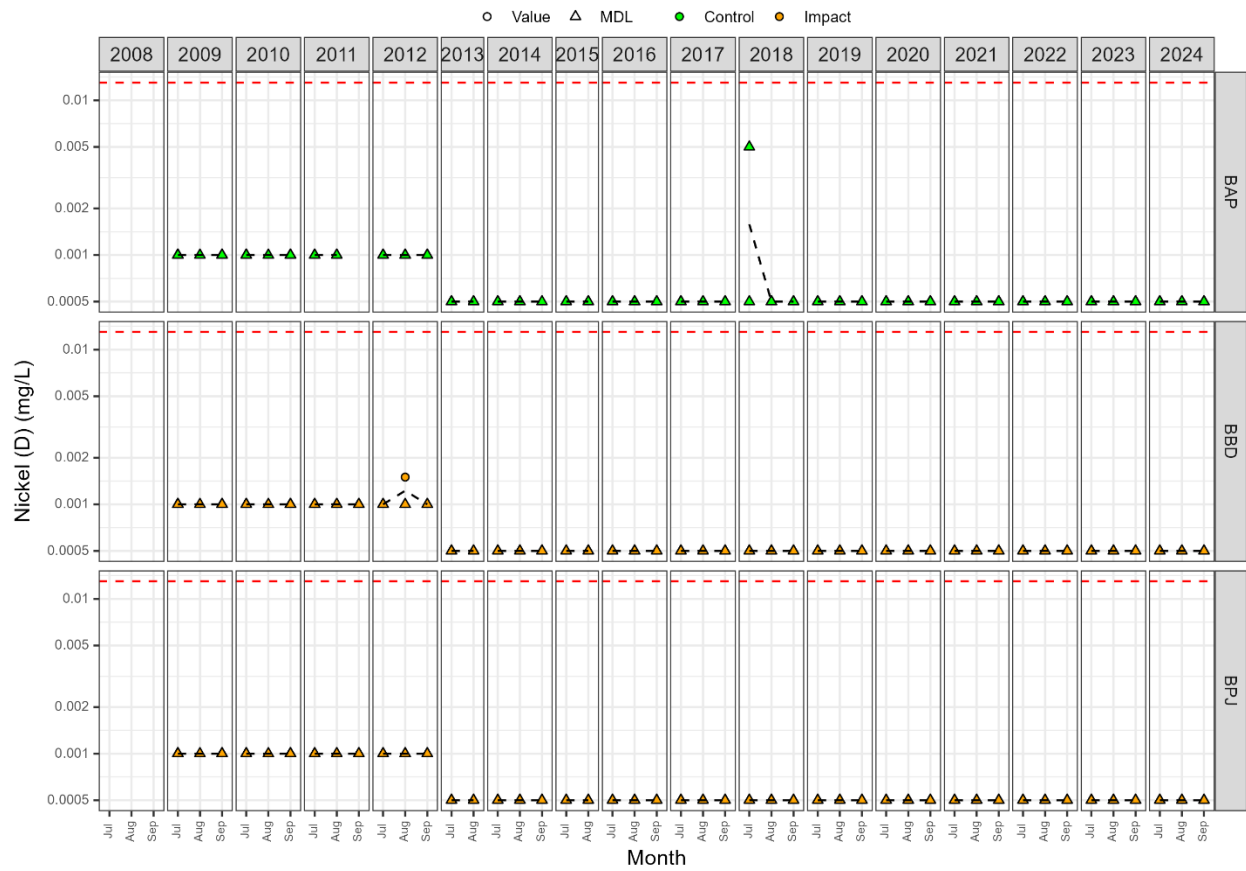


Figure C3-68. Dissolved selenium (mg/L).

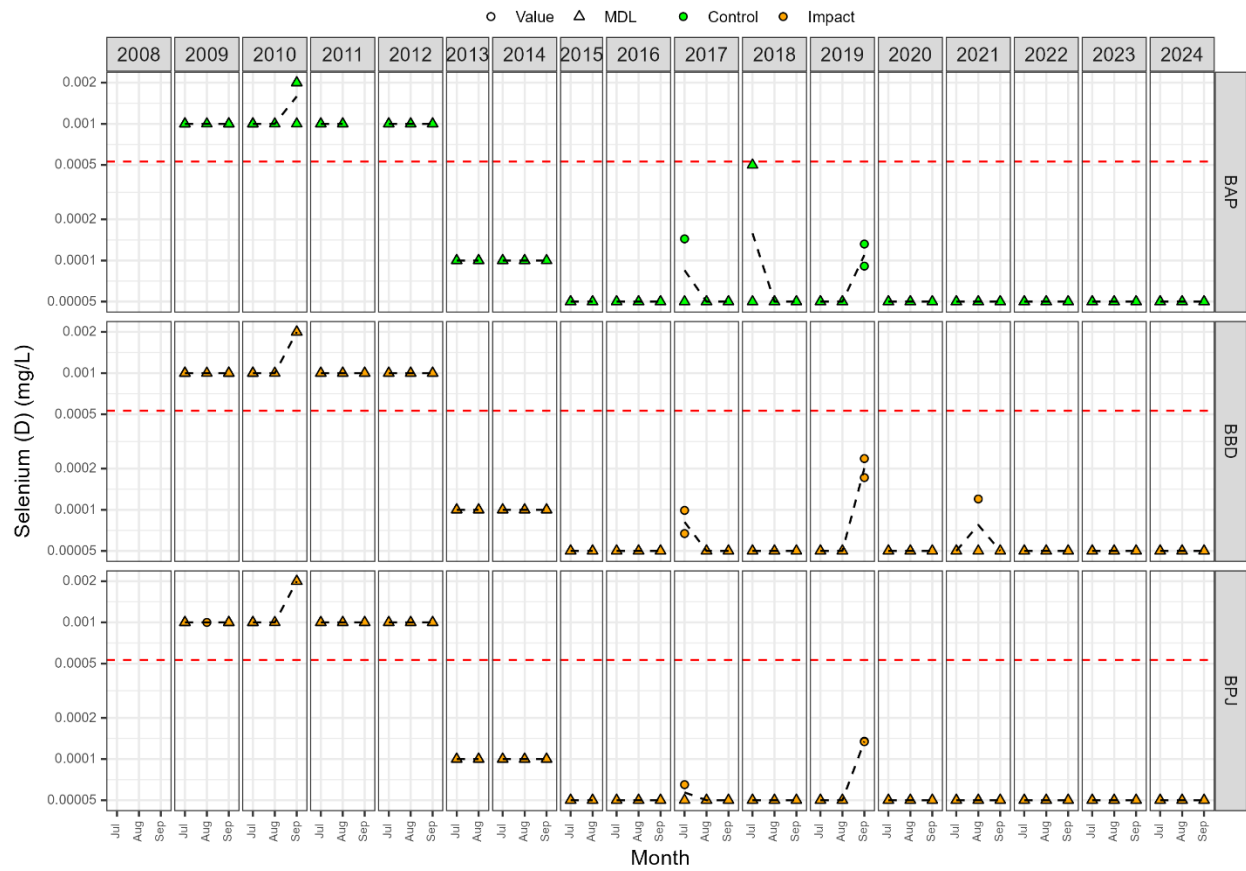


Figure C3-69. Dissolved silicon (mg/L).

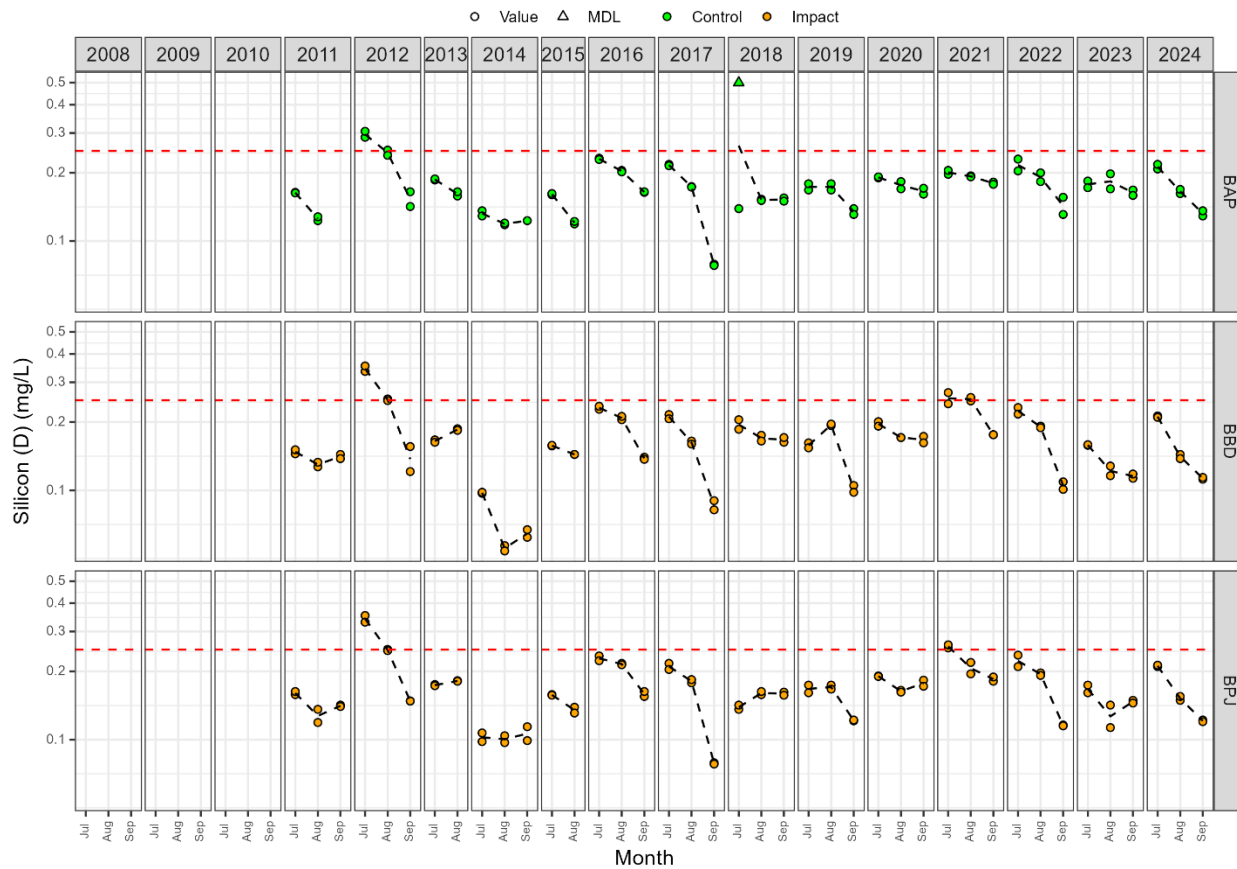


Figure C3-70. Dissolved silver (mg/L).

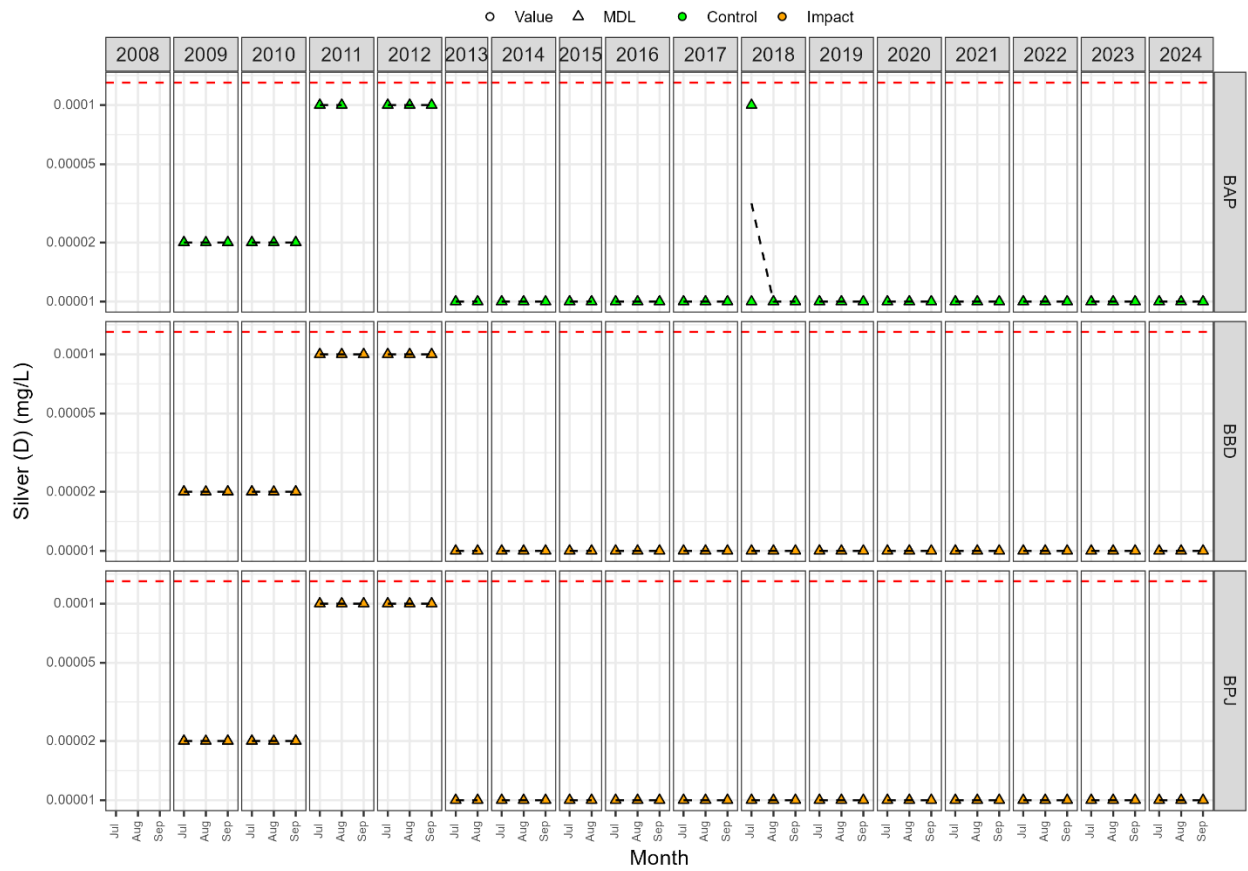


Figure C3-71. Dissolved strontium (mg/L).

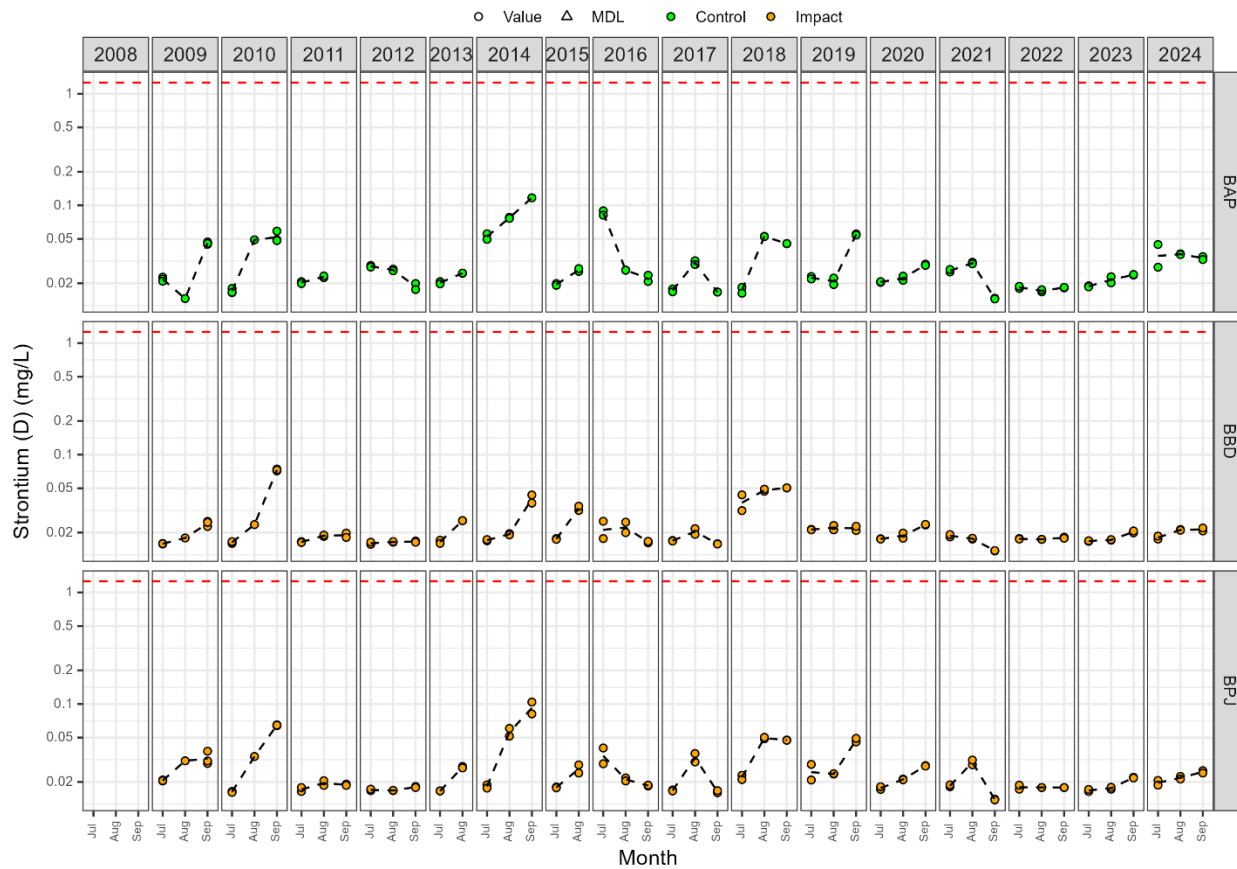


Figure C3-72. Dissolved thallium (mg/L).

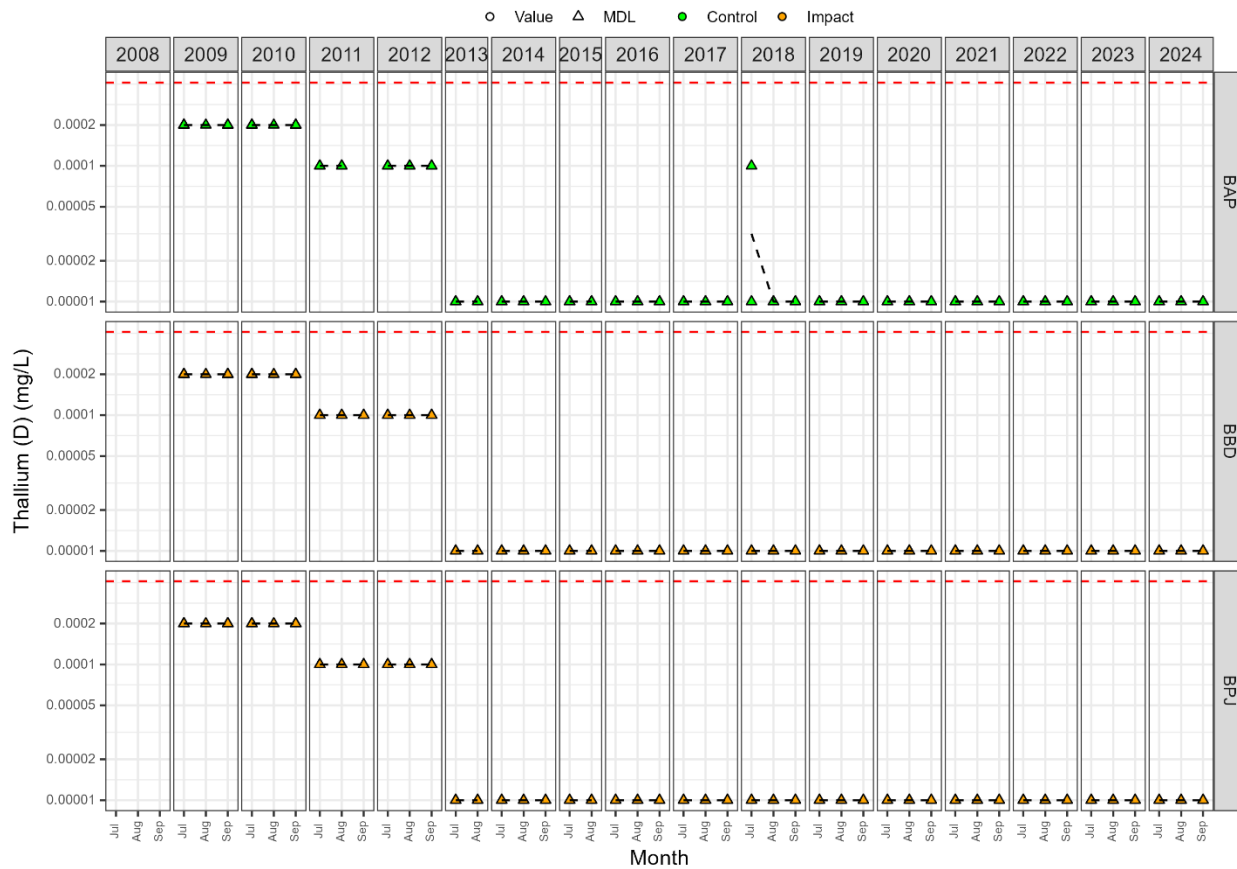


Figure C3-73. Dissolved tin (mg/L).

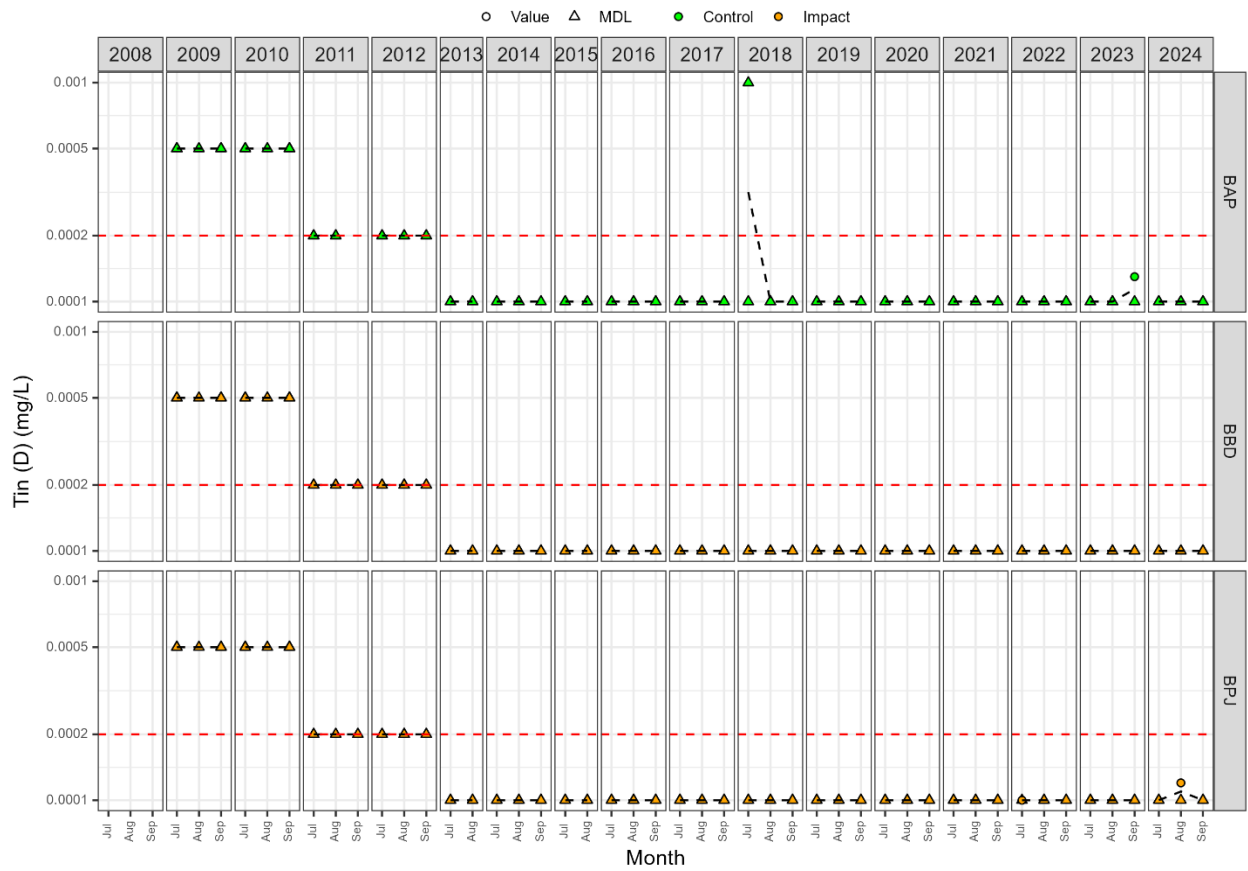


Figure C3-74. Dissolved titanium (mg/L).

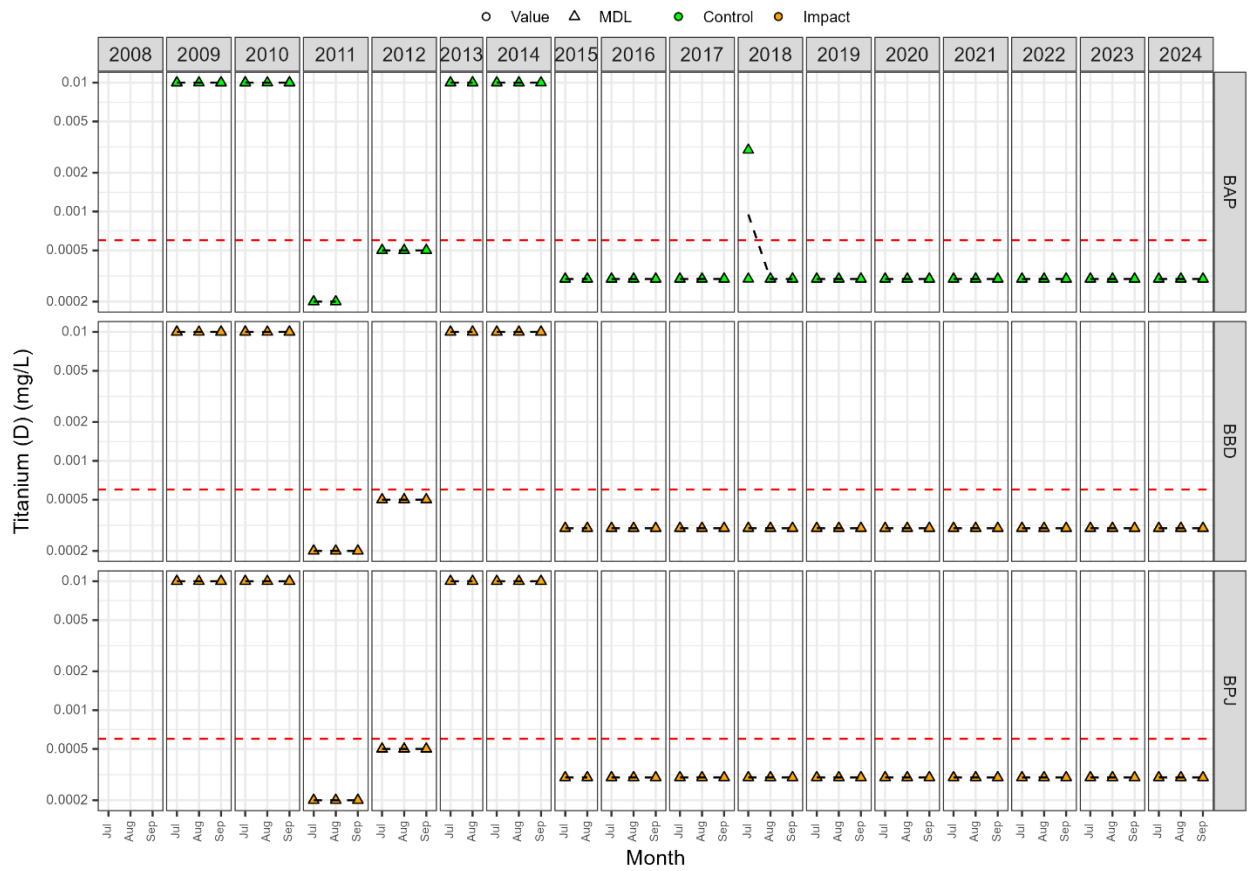


Figure C3-75. Dissolved uranium (mg/L).

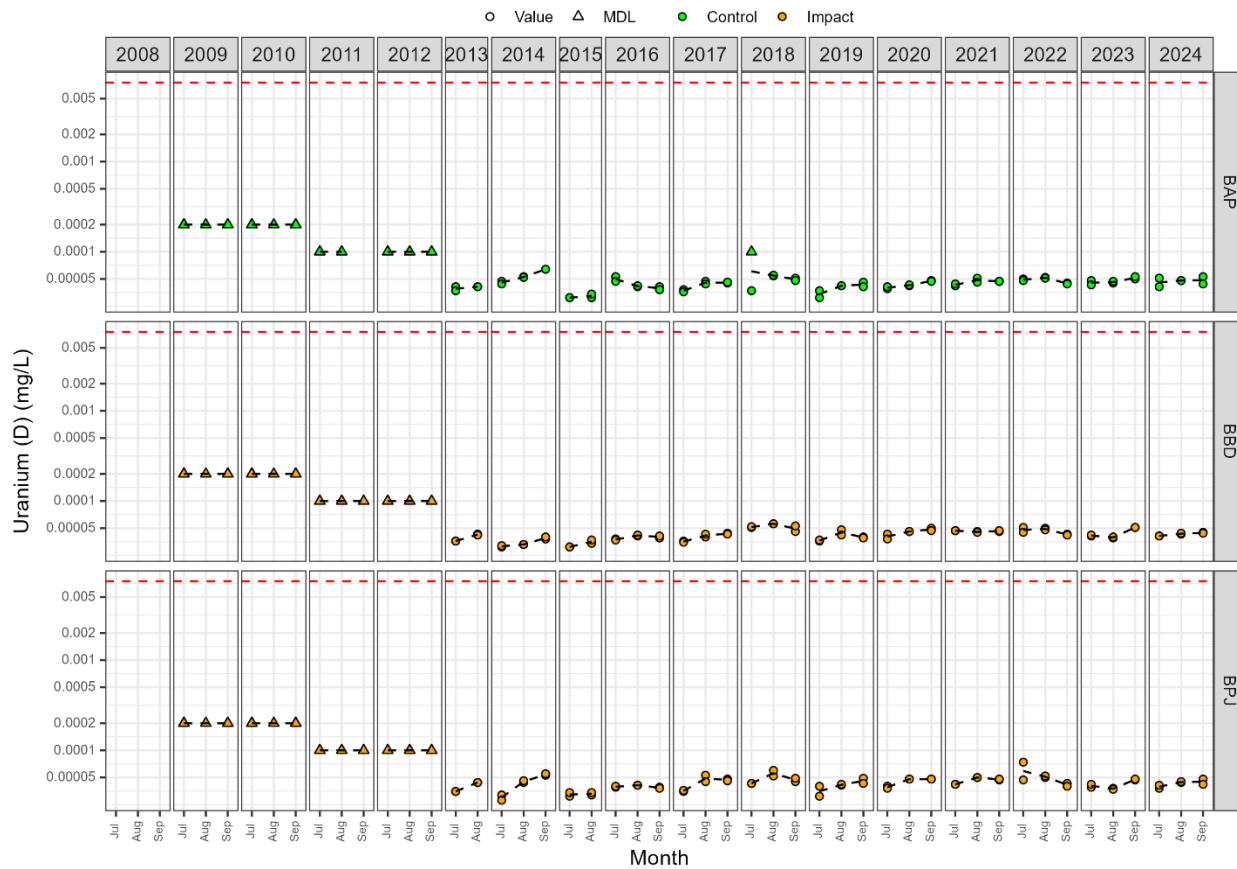


Figure C3-76. Dissolved vanadium (mg/L).

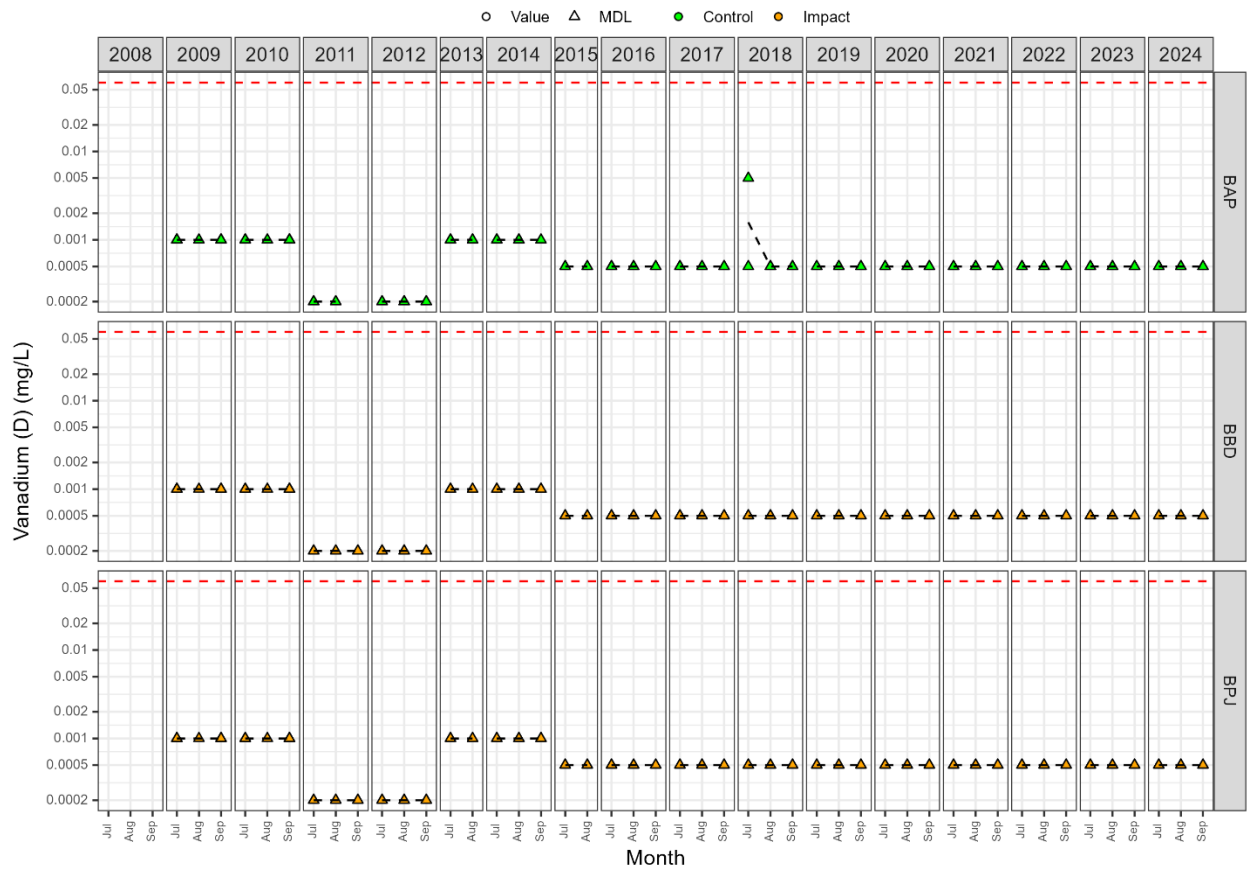
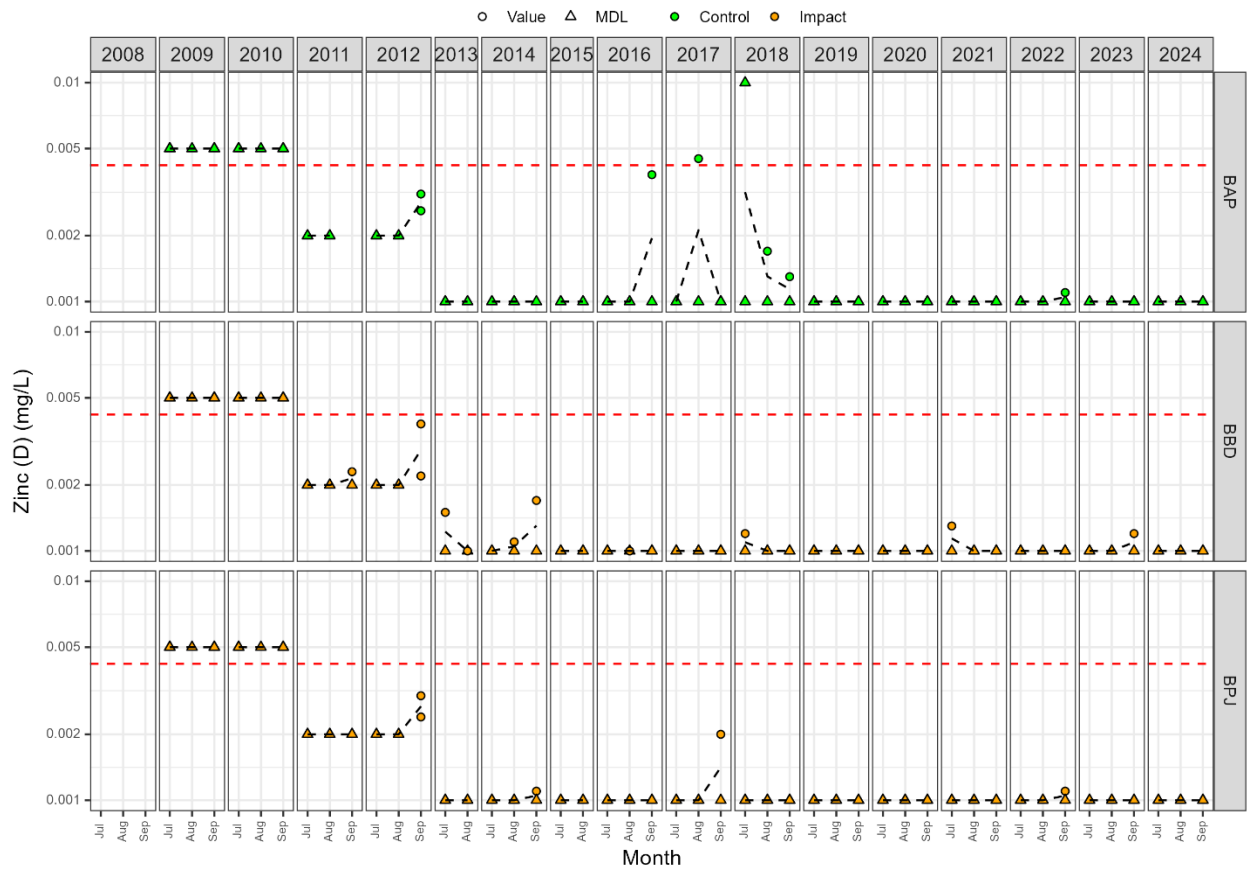


Figure C3-77. Dissolved zinc (mg/L).



APPENDIX D

SEDIMENT CHEMISTRY DATA

Appendix D1

Sediment Chemistry – Meadowbank Study Area Lakes

LIST OF TABLES

Table D1-1. Sediment grab results, Meadowbank study lakes, 2024.	5
Table D1-2. Hydrocarbon and PAH results for composite sediment grabs at Meadowbank study area lakes, 2024.	7

SEDIMENT PROGRAM OVERVIEW

Below is an overview of the various sediment sampling programs at Meadowbank dating back to baseline sampling in 2008:

- **2008** – Baseline coring was conducted in July 2008 prior to onset of East Dike construction to characterize baseline surface metals concentrations at all monitoring areas.
- **2009** – The 2009 coring program was implemented to monitor potential changes to surface sediment chemistry that may have occurred as a result of the East Dike sedimentation event in August 2008. The 2009 study was conducted only at SP, TE, TPE, and INUG. TPE and INUG were used as the reference areas for SP and TE.
- **2010 to 2013** – The 2010 to 2013 sediment grab sampling programs covered all NF, MF, and FF Meadowbank study lakes as well as the reference areas INUG and PDL. Sediment coring was completed as part of the 2012 program.
- **2014** – The 2014 program was advanced a year ahead to align with EEM program. It covered all Meadowbank study lakes, sampling areas, and reference areas. Additional sampling was completed at TPE in 2014 to help assess whether the apparent changes in sediment chromium concentrations were related to spatially biased sampling or were a real temporal trend. Two zones in TPE were targeted for coring: the zone sampled initially in 2008 and 2009 (prior to dike construction; TPE-B) and the zone sampled in 2010 (TPE). Results from this analysis helped inform the design of the targeted chromium bioavailability study conducted at TPE in 2015.
- **2015** – The routine 2015 sediment sampling program was limited to the NF study lakes in accordance with the new approach outlined in the *CREMP Plan* (Azimuth, 2015b). In addition to routine sampling, a targeted bioavailability and toxicity testing program was completed on TPE sediments to help determine whether the apparent increase in chromium concentrations adversely affects the benthic invertebrate community. Sediment grab samples were collected from two zones in TPE and from the reference areas. Samples were analyzed for total metals and other conventional parameters, as per the routine CREMP program, and sequential extraction testing was performed to determine the bioavailability of sediment chromium. Bulk sediment was sent to a toxicity testing laboratory where two tests were run using *Chironomus dilutus* and *Hyalella azteca*.
- **2016** – Sediment sampling in 2016 was limited to grab sampling at the Meadowbank study lakes.
- **2017** – Sediment grab and core sampling was completed at all Meadowbank study area lakes. Samples were spaced throughout each basin. Grabs for chemistry and benthic invertebrates were collected at the same location. Core samples were opportunistically collected from some

of the grab sampling locations. The remaining replicates were spaced throughout the basin in areas with the targeted depth and substrate composition.

- **2018** – Sediment grab sampling at the Meadowbank study lakes was conducted concurrently with the benthic invertebrate community sampling locations. Targeted studies were conducted at TPE and WAL to follow up on recommendations in the 2017 CREMP (Azimuth, 2018c). The 2017 CREMP study found that chromium concentrations in the sediments at TPE and the arsenic concentrations at WAL appeared elevated compared to pre-development baseline concentrations. Sediment coring (10 replicates per location¹) was conducted to verify the 2017 results, and toxicity testing was conducted following the method used in 2015.
- **2019** – Sediment grab sampling was completed at the Meadowbank study lakes concurrently with benthic invertebrate community sampling. The targeted bioavailability study completed in 2018 indicated lower mean chromium concentrations at TPE than were observed in 2017 but appeared to confirm that concentrations were higher than before-impact concentrations. Another year of coring was completed at TPE to provide three consecutive years of chemistry data to evaluate temporal changes in sediment chromium concentrations. Sediment coring at WAL in 2018 confirmed there are no temporal changes in sediment metals at WAL attributable to activities at the mine; no follow-up was completed in 2019.
- **2020** – Sediment grab and core sampling was completed at the NF and reference areas only. Samples were spaced throughout each basin. Grabs for chemistry and benthic invertebrates were collected at the same location. Core samples were opportunistically collected from some of the grab sampling locations. The remaining replicates were spaced throughout the basin in areas with the targeted depth and substrate composition. Targeted studies focusing on chromium in sediment at TPE were completed in 2019 and concluded that, while concentrations of chromium have increased relative to the baseline period and are most likely mining-related, current concentrations of chromium in sediment and porewater do not pose risks to the benthos at TPE.
- **2021** – Sediment grab sampling was completed at the NF and reference areas only. Samples were spaced throughout each basin. Grabs for chemistry and benthic invertebrates were collected at the same location. In 2021, due to a laboratory error, some of the sediment samples were discarded prior finalizing the request for analysis. As such, only one batch of sediment samples was analyzed which included the NF areas at Meadowbank (SP, TPE, and TPN [only

¹ A “replicate” is a discrete core sample following the standard operating procedure (SOP) in Azimuth 2015b.

grain size]). Samples from reference areas INUG and PDL, and from NF area WAL were accidentally discarded by the laboratory prior to analysis (See [Appendix A](#) and [Appendix C2](#) in the 2021 CREMP report for details, Azimuth 2022a).

- **2022** – Sediment grab sampling was conducted at the NF and reference areas. The NF study lake sediment was analyzed for grain size and total organic carbon (TOC) with the remaining sediment archived for chemistry. Full chemistry analysis was performed for the reference lakes (INUG and PDL), however due to elevated moisture content, grain size analysis could not be performed.
- **2023** – Sediment core and grab sampling were conducted at the NF and reference areas. Sediment grab samples for habitat characteristics were analyzed for moisture, TOC and grain size; composite grab samples for chemistry were analyzed for aggregate organics, hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs). Sediment core samples were analyzed for moisture, pH, and total metals.
- **2024** – Sediment grabs were collected at the NF and reference areas. Sediment was analyzed for grain size and TOC; composite grab samples for chemistry were analyzed for aggregate organics, hydrocarbons, and PAHs. The remaining sediment was archived for chemistry as per the *CREMP Plan Update* (Azimuth, 2022b).

TABLES

Table D1-1. Sediment grab results, Meadowbank study lakes, 2024.

Lake & Basin	Inuggugayualik Lake (INUG)					Pipedream Lake (PDL)					Third Portage Lake - East Basin (TPE)				
Area-Replicate ID	INUG-1	INUG-2	INUG-3	INUG-4	INUG-5	PDL-1	PDL-2	PDL-3	PDL-4	PDL-5	TPE-1	TPE-2	TPE-3	TPE-4	TPE-5
Date	10-Aug-24	10-Aug-24	10-Aug-24	10-Aug-24	10-Aug-24	11-Aug-24	11-Aug-24	11-Aug-24	11-Aug-24	11-Aug-24	12-Aug-24	12-Aug-24	12-Aug-24	12-Aug-24	12-Aug-24
ALS Sample ID	VA24C2443-031	VA24C2443-032	VA24C2443-033	VA24C2443-034	VA24C2443-035	VA24C2443-025	VA24C2443-026	VA24C2443-027	VA24C2443-028	VA24C2443-029	VA24C2443-013	VA24C2443-014	VA24C2443-015	VA24C2443-016	VA24C2443-017
Physical Tests															
Moisture (%)	83	81	82	77	78	73	75	74	75	73	80	83	83	65	80
pH	5.3	5.4	5.3	5.1	5.4	6.2	5.9	6.0	5.9	5.8	5.7	5.7	6.1	5.9	5.7
Particle Size (%)															
clay (<0.004mm)	16	21	18	15	20	19	20	18	18	15	33	33	32	37	26
silt (0.063mm - 0.004mm)	83	77	81	84	75	79	77	80	78	80	66	66	67	55	69
sand (2.0mm - 0.063mm)	<1.0	2.0	1.5	<1.0	5.5	2.7	2.9	2.0	3.9	4.4	1.3	1.2	1.1	8.5	5.1
gravel (>2mm)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Organic Carbon															
TOC (% dw)	3.8	3.5	3.7	3.7	3.2	2.4	2.2	2.0	2.1	2.3	2.6	3.0	2.9	1.3	2.9

Notes:
Italicized numbers are below detection limits.



Table D1-1. Sediment grab results, Meadowbank study lakes, 2024.

Lake & Basin	Third Portage Lake - North Basin (TPN)					Second Portage Lake (SP)					Wally Lake (WAL)				
Area-Replicate ID	TPN-1	TPN-2	TPN-3	TPN-4	TPN-5	SP-1	SP-2	SP-3	SP-4	SP-5	WAL-1	WAL-2	WAL-3	WAL-4	WAL-5
Date	9-Aug-24	9-Aug-24	9-Aug-24	9-Aug-24	9-Aug-24	19-Aug-24	19-Aug-24	19-Aug-24	19-Aug-24	19-Aug-24	9-Aug-24	9-Aug-24	9-Aug-24	9-Aug-24	9-Aug-24
ALS Sample ID	VA24C2443-019	VA24C2443-020	VA24C2443-021	VA24C2443-022	VA24C2443-023	VA24C2443-001	VA24C2443-002	VA24C2443-003	VA24C2443-004	VA24C2443-005	VA24C2443-007	VA24C2443-008	VA24C2443-009	VA24C2443-010	VA24C2443-011
Physical Tests															
Moisture (%)	27	72	53	79	26	82	82	83	70	82	92	88	89	91	91
pH	5.9	5.3	5.8	5.7	6.3	5.4	5.2	5.4	6.0	5.3	6.2	6.4	6.2	6.6	6.3
Particle Size (%)															
clay (<0.004mm)	34	16	7.6	19	29	23	27	31	40	26	13	16	17	16	19
silt (0.063mm - 0.004mm)	38	58	33	61	37	74	72	68	56	73	86	83	83	81	80
sand (2.0mm - 0.063mm)	18	26	59	20	35	2.6	1.1	1.6	3.6	1.4	1.0	1.2	<1.0	3.7	<1.0
gravel (>2mm)	11	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Organic Carbon															
TOC (% dw)	0.22	2.1	0.90	2.6	0.32	3.6	3.7	3.4	1.6	3.2	10.0	8.7	9.0	7.8	8.9

Notes:
Italicized numbers are below detection limits.



Table D1-2. Hydrocarbon and PAH results for composite sediment grabs at Meadowbank study area lakes, 2024.

Area-Replicate ID	CCME Sediment Quality Guidelines ¹		INUG-COMP	PDL-COMP	TPE-COMP	TPN-COMP	SP-COMP	WAL-COMP
Date			10-Aug-2024	11-Aug-2024	12-Aug-2024	09-Aug-2024	18-Aug-2024	09-Aug-2024
ALS Sample ID	ISQG	PEL	VA24C2443-036	VA24C2443-030	VA24C2443-018	VA24C2443-024	VA24C2443-006	VA24C2443-012
Physical Parameters								
Moisture (%)	-	-	82	79	81	49	82	91
Aggregate Organics (mg/kg)								
Mineral Oil and Grease	-	-	<500	720	<500	<500	600	1270
Hydrocarbons (mg/kg)								
EPH10-19	-	-	<330	<290	<320	<200	<320	<640
EPH19-32	-	-	<330	<290	<320	<200	<320	<640
LEPH	-	-	<330	<290	<320	<200	<320	<640
HEPH	-	-	<330	<290	<320	<200	<320	<640
Polycyclic Aromatic Hydrocarbons (mg/kg)								
Acenaphthene	0.0067	0.089	<0.0185	<0.0142	<0.0162	<0.0058	<0.0160	<0.0356
Acenaphthylene	0.0059	0.13	<0.0185	<0.0142	<0.0162	<0.0058	<0.0160	<0.0356
Acridine	-	-	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Anthracene	0.047	0.25	<0.0185	<0.0142	<0.0162	<0.0058	<0.0160	<0.0356
Benz(a)anthracene	0.032	0.39	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Benzo(a)pyrene	0.032	0.78	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Benzo(b+j)fluoranthene	-	-	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Benzo(b+j+k)fluoranthene	-	-	<0.025	<0.020	<0.023	<0.015	<0.023	<0.051
Benzo(g,h,i)perylene	-	-	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Benzo(k)fluoranthene	-	-	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Chrysene	0.057	0.86	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Dibenz(a,h)anthracene	0.0062	0.14	<0.0185	<0.0142	<0.0162	<0.0058	<0.0160	<0.0356
Fluoranthene	0.11	2.36	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Fluorene	0.021	0.144	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Indeno(1,2,3-c,d)pyrene	-	-	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Methylnaphthalene, 1-	-	-	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Methylnaphthalene, 2-	0.020	0.20	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Naphthalene	0.035	0.39	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Phenanthrene	0.042	0.52	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Pyrene	0.053	0.88	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
Quinoline	-	-	<0.018	<0.014	<0.016	<0.010	<0.016	<0.036
PAH Surrogates (%)								
Acridine-d9	-	-	90	84	87	114	86	89
Chrysene-d12	-	-	78	84	88	118	88	90
Naphthalene-d8	-	-	95	101	104	125	104	108
Phenanthrene-d10	-	-	96	97	99	125	101	104

Notes:

1. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.

ISQG = Interim freshwater Sediment Quality Guideline; PEL = probable effect level concentration

Bolded concentrations exceed the ISQG guideline.*Italicized numbers are below detection limits.*

Appendix D2

Sediment Chemistry – Whale Tail Study Area Lakes

LIST OF TABLES

Table D2-1. Sediment core chemistry results, Whale Tail study lakes, 2024.	1
Table D2-2. Sediment grab results, Whale Tail study lakes, 2024.	2
Table D2-3. Hydrocarbon and PAH results for composite sediment grabs at Whale Tail study area lakes, 2024.	5

SEDIMENT PROGRAM OVERVIEW

Below is an overview of the various sediment sampling programs at Whale Tail dating back to baseline sampling in 2015:

- **2015** – Baseline grab sampling was conducted at the NF lakes WTS, MAM, and NEM to characterize TOC, grain size, and baseline metals concentrations. A composite sample from each of the study lakes was also analyzed for hydrocarbons and PAHs. These analyses were conducted for each of the study lakes during each year of sampling to present.
- **2016** – Baseline grab sampling was expanded to include the MF lakes A20, A76, and DS1 along with the continued sampling at the NF lakes.
- **2017** – Baseline coring results in 2017 were used to establish trigger concentrations in each of the Whale Tail study lakes in anticipation of future mine developments. Unlike Meadowbank in which trigger values were applied over multiple lakes in the study area, at the Whale Tail lakes sediment chemistry was too heterogeneous to apply triggers over broad spatial scales. Instead, lake specific triggers were derived.
- **2018** – NF lake WTS moved to the “Impact” category following dike construction at Whale Tail Lake which began on July 27. All other Whale Tail lakes remained in the “Control” category. Sampling conducted via grab sampling.
- **2019** – All of the NF and MF Whale Tail study lakes were characterized as “Impact”. Sampling conducted via grab sampling.
- **2020** – Core sampling was conducted across the Whale Tail study lakes with results formally compared to lake specific triggers. Increases in mean concentrations of arsenic, chromium, and copper were found in some study lakes, however there was evidence that the observed concentrations may have been due to natural spatial heterogeneity. Findings were considered preliminary until further coring data is available during the 2023 coring cycle.
- **2021** – Grab sampling was conducted throughout the Whale Tail study lakes. In 2021, due to a laboratory error, some of the sediment samples were discarded prior finalizing the request for analysis. As such, results were missing for MAM, A20, and DS1.
- **2022** – Grab sampling was conducted throughout the Whale Tail study lakes. Concentrations of metals were generally similar to results from the baseline period and early operations.
- **2023** – Sediment core and grab sampling were conducted at the Whale Tail study lakes. Sediment grab samples for habitat characteristics were analyzed for moisture, total organic carbon (TOC), and grain size; composite grab samples for chemistry were analyzed for aggregate

organics, hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs). Sediment core samples were analyzed for moisture, pH, and total metals.

- **2024** – Grabs were collected throughout the Whale Tail study lakes, and 25 sediment cores were collected throughout the WTS basin. The focused coring program was done in response to concern that chromium concentrations were increasing within WTS. Sediment grab samples for habitat characteristics were analyzed for moisture, TOC, and grain size; composite grab samples for chemistry were analyzed for aggregate organics, hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs). Sediment core samples were analyzed for moisture, pH, and total metals.

TABLES

Table D2-1. Sediment core chemistry results, Whale Tail Lake - South Basin, 2024.

Lake & Basin	Screening Criteria			Whale Tail Lake - South Basin (WTS)										
Area-Replicate ID	CCME ¹		Thresholds ³ (All Lakes)	WTS Triggers	WTS-SC-1	WTS-SC-2	WTS-SC-3	WTS-SC-4	WTS-SC-5	WTS-SC-6	WTS-SC-7	WTS-SC-8	WTS-SC-9	WTS-SC-10
Date					15-Aug-2024 00:00	15-Aug-2024 00:00	15-Aug-2024 00:00	15-Aug-2024 00:00	15-Aug-2024 00:00	15-Aug-2024 00:00	15-Aug-2024 00:00	15-Aug-2024 00:00	17-Aug-2024 00:00	17-Aug-2024 00:00
Time					VA24C2443-081	VA24C2443-082	VA24C2443-083	VA24C2443-084	VA24C2443-085	VA24C2443-086	VA24C2443-087	VA24C2443-088	VA24C2443-089	VA24C2443-090
ALS Sample ID	ISQG	PEL												
Physical Tests														
Moisture (%)					83	82	83	87	85	80	83	81	89	87
pH					6.0	5.5	5.3	6.3	6.2	6.0	5.5	5.3	6.2	5.5
Total Metals (mg/kg dw)														
Aluminum					19100	15600	14300	18300	17800	16400	17400	17100	18400	18100
Antimony					0.56	0.42	0.52	0.44	0.54	0.43	0.32	0.33	0.41	0.50
Arsenic*	5.9	17	5.9	83.1	38	442	455	17	25	155	234	236	14	26
Barium					124	117	116	125	130	114	108	132	122	114
Beryllium					1.5	1.2	1.2	1.3	1.2	1.4	1.5	1.4	1.4	1.3
Bismuth					0.59	0.51	0.48	0.49	0.48	0.54	0.59	0.57	0.52	0.55
Boron					9.4	8.1	6.8	9.4	9.1	5.9	6.8	7.4	11	9.4
Cadmium*	0.60	3.5	0.60	0.93	0.19	0.27	0.29	0.30	0.30	0.25	0.20	0.36	0.45	0.36
Calcium					3760	4170	3290	4180	4860	3280	2820	2930	4220	3910
Chromium*	37	90	37	80.6	100	74	80	97	110	83	79	81	85	99
Cobalt					12	15	18	9.6	12	18	15	17	9.7	11
Copper*	36	197	36	48.5	42	36	35	40	38	38	41	41	40	39
Iron					41600	168000	156000	24100	26600	91600	121000	108000	21900	30300
Lead	35	91	35	24.0	16	13	13	13	13	14	13	14	15	15
Lithium					19	14	14	21	20	15	15	16	20	17
Magnesium					8120	6460	6530	8260	8530	6880	6860	6870	7640	8120
Manganese					825	1870	2000	452	832	2360	1300	1980	288	397
Mercury	0.17	0.49	0.17	0.123	0.073	0.069	0.069	0.062	0.065	0.057	0.052	0.062	0.082	0.10
Molybdenum					4.7	6.8	6.3	2.3	3.0	5.5	7.0	5.8	2.3	3.6
Nickel					68	63	68	69	72	68	69	82	71	73
Phosphorus					875	3500	2990	660	692	977	1950	1950	644	771
Potassium					2540	2080	1880	2440	2360	2020	2250	2260	2550	2540
Selenium					0.58	0.72	0.65	0.48	0.42	0.57	0.77	0.77	0.56	0.56
Silver					0.30	0.25	0.22	0.32	0.31	0.20	0.24	0.26	0.35	0.34
Sodium					186	152	134	177	178	130	145	155	193	187
Strontium					39	42	39	37	40	36	31	34	40	39
Sulfur					1100	<i><1000</i>	1400	1700	1700	<i><1000</i>	<i><1000</i>	1200	2200	2600
Thallium					0.20	0.17	0.17	0.18	0.18	0.17	0.19	0.22	0.19	0.19
Tin					<i><2.0</i>	<i><2.0</i>	<i><2.0</i>	<i><2.0</i>	<i><2.0</i>	<i><2.0</i>	<i><2.0</i>	<i><2.0</i>	<i><2.0</i>	<i><2.0</i>
Titanium					424	358	333	406	362	315	375	368	403	426
Tungsten					<i><0.50</i>	<i><0.50</i>	<i><0.50</i>	<i><0.50</i>	<i><0.50</i>	<i><0.50</i>	<i><0.50</i>	<i><0.50</i>	<i><0.50</i>	<i><0.50</i>
Uranium					12	9.9	9.1	11	10	11	12	12	12	11
Vanadium					30	23	23	26	27	25	27	26	26	28
Zinc*	123	315	123	196	94	80	81	81	77	84	94	97	91	96
Zirconium					1.6	2.1	1.7	2.6	2.7	1.8	1.8	2.2	3	2.6

Notes:

- CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.
ISQG = interim sediment quality guideline; PEL = probable effect level
- Trigger and threshold values for Whale Tail lakes were developed for the 2019 CREMP, using baseline data collected in 2017 (Azimuth, 2020).
- Thresholds are set equal to CCME ISQG guidelines, where available.

* CCME guideline not used as threshold value because threshold value would be lower than trigger value.

123 Bolded concentrations exceed the lake specific trigger.

123 Bolded and shaded concentrations also exceed the threshold if threshold is greater than lake specific trigger.

Italicized numbers are below detection limits.



Table D2-1. Sediment core chemistry results, Whale Tail Lake - South Basin, 2024.

Lake & Basin	Screening Criteria			Whale Tail Lake - South Basin (WTS)														
Area-Replicate ID	CCME ¹		Thresholds ³ (All Lakes)	WTS-SC-11	WTS-SC-12	WTS-SC-13	WTS-SC-14	WTS-SC-15	WTS-SC-16	WTS-SC-17	WTS-SC-18	WTS-SC-19	WTS-SC-20	WTS-SC-21	WTS-SC-22	WTS-SC-23	WTS-SC-24	WTS-SC-25
Date				17-Aug-2024	17-Aug-2024	17-Aug-2024	17-Aug-2024	17-Aug-2024	17-Aug-2024	17-Aug-2024	17-Aug-2024	17-Aug-2024	17-Aug-2024	18-Aug-2024	18-Aug-2024	18-Aug-2024	18-Aug-2024	18-Aug-2024
Time				00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	ISQG	PEL		VA24C2443-091	VA24C2443-092	VA24C2443-093	VA24C2443-094	VA24C2443-095	VA24C2443-096	VA24C2443-097	VA24C2443-098	VA24C2443-099	VA24C2443-100	VA24C2443-101	VA24C2443-102	VA24C2443-103	VA24C2443-104	VA24C2443-105
Physical Tests																		
Moisture (%)				87	78	78	83	81	83	76	83	81	87	78	50	47	79	83
pH				4.9	5.4	5.9	5.5	5.9	5.7	5.9	5.5	5.3	5.7	6.4	6.1	6.3	5.5	5.6
Total Metals (mg/kg dw)																		
Aluminum				18400	17300	15500	18300	18800	18200	21700	15600	19500	14100	16200	7640	8800	18900	17000
Antimony				0.66	0.44	0.39	0.30	0.42	0.39	0.26	0.46	0.24	0.51	0.53	0.19	0.18	0.38	0.41
Arsenic*	5.9	17	5.9	44	236	55	60	84	81	107	208	58	474	26	15	37	113	156
Barium				93	121	84	164	117	102	113	154	91	192	103	36	42	102	110
Beryllium				1.5	1.5	1.2	1.3	1.6	1.6	1.7	1.3	1.8	1.2	1.1	0.51	0.74	1.6	1.5
Bismuth				0.57	0.58	0.49	0.62	0.58	0.60	0.73	0.49	0.62	0.47	0.44	<0.20	0.23	0.63	0.59
Boron				9.1	6.4	5.7	6.6	6.3	7.1	6.7	6.4	6.6	5.6	7.2	<5.0	<5.0	6.4	5.5
Cadmium*	0.60	3.5	0.60	0.30	0.27	0.14	0.25	0.20	0.15	0.070	0.29	0.18	0.34	0.15	0.086	0.21	0.19	0.19
Calcium				3300	3160	3540	2820	3970	3160	2600	3110	2560	3210	4380	1600	1450	3480	3230
Chromium*	37	90	37	113	82	74	80	102	88	83	81	78	81	100	45	41	89	87
Cobalt				14	21	13	35	16	17	11	24	18	19	11	9.3	13	15	16
Copper*	36	197	36	40	40	34	41	41	41	49	36	45	36	30	12	17	42	39
Iron				44600	127000	48400	69700	65300	71300	64400	123000	51200	172000	28900	18000	31000	74800	90000
Lead	35	91	35	15	14	12	14	14	14	16	12	14	12	13	6.4	7.8	15	14
Lithium				17	16	15	17	18	17	21	14	18	12	17	9.2	8.9	18	16
Magnesium				8260	7080	6700	7220	8080	7440	8460	6660	7070	6180	7620	3940	3750	7330	6950
Manganese				430	1940	953	4760	2090	1690	625	3240	443	5140	619	880	1760	1090	1400
Mercury	0.17	0.49	0.17	0.066	0.055	0.040	0.061	0.052	0.049	0.033	0.054	0.032	0.069	0.049	0.015	0.016	0.048	0.051
Molybdenum				4.9	5.9	3.6	3.8	5.2	4.9	6.2	4.8	5.4	7.2	2.9	1.3	2.2	5.2	5.2
Nickel				85	80	53	88	70	60	63	93	65	90	66	29	45	61	61
Phosphorus				814	1370	652	854	1340	957	1080	1540	1030	2380	647	228	374	1430	1570
Potassium				2420	2140	1920	2380	2380	2410	3100	2100	2480	1790	2210	920	970	2410	2170
Selenium				0.55	0.66	0.40	0.61	0.59	0.60	0.38	0.60	0.48	0.75	0.37	<0.20	0.26	0.68	0.89
Silver				0.29	0.21	0.19	0.27	0.19	0.17	0.15	0.19	0.14	0.22	0.19	<0.10	<0.10	0.20	0.24
Sodium				177	143	124	156	150	148	155	137	144	130	149	53	<50	200	154
Strontium				34	36	33	32	35	33	32	34	31	38	38	20	18	35	34
Sulfur				3000	1200	<1000	<1000	<1000	1000	<1000	<1000	<1000	1100	<1000	<1000	<1000	1300	1200
Thallium				0.21	0.18	0.15	0.25	0.20	0.18	0.19	0.22	0.21	0.20	0.17	0.098	0.11	0.21	0.18
Tin				<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium				452	361	396	384	384	425	593	404	505	283	455	463	368	420	346
Tungsten				<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium				13	12	9.8	12	12	12	20	9.8	14	9.4	8.6	3.9	6.5	13	12
Vanadium				29	27	25	27	29	28	34	25	29	22	26	13	14	28	26
Zinc*	123	315	123	105	100	78	89	91	88	94	92	96	89	78	35	45	95	91
Zirconium				3.4	2	1.4	1.4	2	1.4	4.1	1.4	2	2.3	2.2	1.2	1.1	1.9	3.3

Notes:

- CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.
ISQG = interim sediment quality guideline; PEL = probable effect level
- Trigger and threshold values for Whale Tail lakes were developed for the 2019 CREMP, using baseline data collected in 2017 (Azimuth, 2020).
- Thresholds are set equal to CCME ISQG guidelines, where available.

* CCME guideline not used as threshold value because threshold value would be lower than trigger value.

123 Bolded concentrations exceed the lake specific trigger.
123 Bolded and shaded concentrations also exceed the threshold if threshold is greater than lake specific trigger.

Italicized numbers are below detection limits.



Table D2-2. Sediment grab results, Whale Tail study lakes, 2024.

Lake & Basin	Lake A20 (Impoundment)					Whale Tail Lake - South Basin (WTS)				
Area-Replicate ID	A20-1	A20-2	A20-3	A20-4	A20-5	WTS-1	WTS-2	WTS-3	WTS-4	WTS-5
Date	18-Aug-2024	18-Aug-2024	18-Aug-2024	18-Aug-2024	18-Aug-2024	15-Aug-2024	15-Aug-2024	15-Aug-2024	15-Aug-2024	15-Aug-2024
ALS Sample ID	VA24C2443-055	VA24C2443-056	VA24C2443-057	VA24C2443-058	VA24C2443-059	VA24C2443-043	VA24C2443-044	VA24C2443-045	VA24C2443-046	VA24C2443-047
Physical Tests										
Moisture (%)	85	85	89	83	86	83	72	84	83	79
pH	5.3	5.4	5.8	5.9	5.1	5.8	5.7	5.5	5.5	5.5
Particle Size (%)										
clay (<0.004mm)	30	24	26	29	30	17	14	16	16	18
silt (0.063mm - 0.004mm)	69	76	74	71	70	81	79	83	83	81
sand (2.0mm - 0.063mm)	<1.0	<1.0	<1.0	<1.0	<1.0	2.3	6.9	1.4	1.1	1.9
gravel (>2mm)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Organic Carbon										
TOC (% dw)	4.0	4.3	6.6	4.5	4.2	4.1	3.7	4.4	5.0	4.1
Total Metals (mg/kg dw)										
Mercury	0.038	0.040	0.048	0.036	0.041	0.041	0.039	0.053	0.060	0.046

Notes:

1. CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.

* Previously referred to as Mammoth Lake (MAM).



Table D2-2. Sediment grab results, Whale Tail study lakes, 2024.

Lake & Basin	Kangisluik Lake (KAN)*					Lake A76				
Area-Replicate ID	MAM-1	MAM-2	MAM-3	MAM-4	MAM-5	A76-1	A76-2	A76-3	A76-4	A76-5
Date	18-Aug-2024	18-Aug-2024	18-Aug-2024	18-Aug-2024	18-Aug-2024	13-Aug-2024	13-Aug-2024	13-Aug-2024	13-Aug-2024	13-Aug-2024
ALS Sample ID	VA24C2443-049	VA24C2443-050	VA24C2443-051	VA24C2443-052	VA24C2443-053	VA24C2443-061	VA24C2443-062	VA24C2443-063	VA24C2443-064	VA24C2443-065
Physical Tests										
Moisture (%)	90	91	89	82	88	91	87	83	92	88
pH	5.9	5.8	6.0	6.1	6.0	5.8	5.2	5.2	5.7	5.7
Particle Size (%)										
clay (<0.004mm)	18	15	15	10	17	22	23	20	21	18
silt (0.063mm - 0.004mm)	82	85	84	53	80	78	77	80	79	82
sand (2.0mm - 0.063mm)	<1.0	<1.0	<1.0	37	3.6	<1.0	<1.0	<1.0	<1.0	<1.0
gravel (>2mm)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Organic Carbon										
TOC (% dw)	11	9.1	9.2	5.7	9.1	9.7	5.2	5.4	11	6.6
Total Metals (mg/kg dw)										
Mercury	0.083	0.070	0.069	0.051	0.088	-	-	-	-	-

Notes:

1. CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.

* Previously referred to as Mammoth Lake (MAM).



Table D2-2. Sediment grab results, Whale Tail study lakes, 2024.

Lake & Basin	Lake D51					Nemo Lake (NEM)				
Area-Replicate ID	D51-1	D51-2	D51-3	D51-4	D51-5	NEM-1	NEM-2	NEM-3	NEM-4	NEM-5
Date	16-Aug-2024	16-Aug-2024	16-Aug-2024	16-Aug-2024	16-Aug-2024	16-Aug-2024	16-Aug-2024	16-Aug-2024	16-Aug-2024	16-Aug-2024
ALS Sample ID	VA24C2443-067	VA24C2443-068	VA24C2443-069	VA24C2443-070	VA24C2443-071	VA24C2443-037	VA24C2443-038	VA24C2443-039	VA24C2443-040	VA24C2443-041
Physical Tests										
Moisture (%)	71	66	74	74	63	89	78	85	77	88
pH	6.4	6.5	6.5	6.3	6.1	6.2	6.1	6.1	6.3	6.2
Particle Size (%)										
clay (<0.004mm)	16	15	14	16	18	8.9	4.7	9.6	8.0	8.5
silt (0.063mm - 0.004mm)	84	85	85	84	80	79	53	79	70	71
sand (2.0mm - 0.063mm)	<1.0	<1.0	<1.0	<1.0	1.4	13	42	12	22	21
gravel (>2mm)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Organic Carbon										
TOC (% dw)	2.5	1.7	2.3	2.6	1.5	8.4	5.0	8.4	7.3	7.2
Total Metals (mg/kg dw)										
Mercury	-	-	-	-	-	-	-	-	-	-

Notes:

1. CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.

* Previously referred to as Mammoth Lake (MAM).



Table D2-3. Hydrocarbon and PAH results for composite sediment grabs at Whale Tail study area lakes, 2024.

Area-Replicate ID	CCME Sediment Quality Guidelines ¹		Lowest Detection Limit	A20-COMP	WTS-COMP	MAM-COMP	A76-COMP	DS1-COMP	NEM-COMP
Date				18-Aug-2024	15-Aug-2024	18-Aug-2024	13-Aug-2024	16-Aug-2024	16-Aug-2024
Time				00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	ISQG	PEL		VA24C2443-060	VA24C2443-048	VA24C2443-054	VA24C2443-066	VA24C2443-072	VA24C2443-042
Physical Parameters									
Moisture (%)	-	-	0.25	88	83	90	89	72	90
Aggregate Organics (mg/kg)									
Mineral Oil and Grease	-	-	500	<500	<500	<500	<500	<500	<500
Hydrocarbons (mg/kg)									
EPH10-19	-	-	200	<530	<360	<600	<540	<210	<570
EPH19-32	-	-	200	<530	<360	<600	<540	<210	<570
LEPH	-	-	200	<530	<360	<600	<540	<210	<570
HEPH	-	-	200	<530	<360	<600	<540	<210	<570
Polycyclic Aromatic Hydrocarbons (mg/kg)									
Acenaphthene	0.0067	0.089	0.005	<0.0246	<0.0180	<0.0301	<0.0271	<0.0104	<0.0286
Acenaphthylene	0.0059	0.13	0.005	<0.0246	<0.0180	<0.0301	<0.0271	<0.0104	<0.0286
Acridine	-	-	0.010	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Anthracene	0.047	0.25	0.004	<0.0246	<0.0180	<0.0301	<0.0271	<0.0104	<0.0286
Benz[a]anthracene	0.032	0.39	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Benzo[a]pyrene	0.032	0.78	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Benzo[b+j]fluoranthene	-	-	0.010	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Benzo[b+j+k]fluoranthene	-	-	0.015	<0.035	<0.025	<0.042	<0.038	<0.015	<0.041
Benzo[g,h,i]perylene	-	-	0.010	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Benzo[k]fluoranthene	-	-	0.010	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Chrysene	0.057	0.86	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Dibenz[a,h]anthracene	0.0062	0.14	0.005	<0.0246	<0.0180	<0.0301	<0.0271	<0.0104	<0.0286
Fluoranthene	0.11	2.36	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Fluorene	0.021	0.144	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Indeno[1,2,3-c,d]pyrene	-	-	0.010	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Methylnaphthalene, 1-	-	-	0.010	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Methylnaphthalene, 2-	0.020	0.20	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Naphthalene	0.035	0.39	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Phenanthrene	0.042	0.52	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Pyrene	0.053	0.88	0.01	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
Quinoline	-	-	0.010	<0.025	<0.018	<0.030	<0.027	<0.010	<0.029
PAH Surrogates (%)									
Acridine-d9	-	-	0.010	90	92	119	90	96	93
Chrysene-d12	-	-	0.010	79	84	124	80	79	82
Naphthalene-d8	-	-	0.010	97	101	129	97	99	99
Phenanthrene-d10	-	-	0.010	96	110	129	107	108	108

Notes:

1. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.

ISQG = Interim freshwater Sediment Quality Guideline; PEL = probably effect level concentration

Bolded concentrations exceed the ISQG guideline.

Italicized numbers are below detection limits.



APPENDIX E

PHYTOPLANKTON TAXONOMY DATA AND SUPPLEMENTAL PLOTS

Appendix E1

Phyto Data – Meadowbank Study Area Lakes

LIST OF TABLES – APPENDIX E1

Table E1-1. Phytoplankton density (cells/L), biomass (mg/m ³), and diversity by major taxa group, Meadowbank study lakes, 2024.	1
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LIST OF FIGURES – APPENDIX E1

Figure E1-1. Cyanophyte biomass (mg/m ³) from Meadowbank study area lakes since 2006.....	2
Figure E1-2. Chlorophyte biomass (mg/m ³) from Meadowbank study area lakes since 2006.....	3
Figure E1-3. Chrysophyte biomass (mg/m ³) from Meadowbank study area lakes since 2006.	4
Figure E1-4. Diatom biomass (mg/m ³) from Meadowbank study area lakes since 2006.	5
Figure E1-5. Cryptophyte biomass (mg/m ³) from Meadowbank study area lakes since 2006.....	6
Figure E1-6. Dinoflagellate biomass (mg/m ³) from Meadowbank study area lakes since 2006.	7
Figure E1-7. Phytoplankton density (cells/L) by major taxa group from Meadowbank study area lakes since 2006.	8
Figure E1-8. Relative phytoplankton density by major taxa group from Meadowbank study area lakes since 2006.	9
Figure E1-9. Cyanophyte density (cells/L) from Meadowbank study area lakes since 2006.....	10
Figure E1-10. Chlorophyte density (cells/L) from Meadowbank study area lakes since 2006.	11
Figure E1-11. Chrysophyte density (cells/L) from Meadowbank study area lakes since 2006.....	12
Figure E1-12. Diatoms density (cells/L) from Meadowbank study area lakes since 2006.....	13
Figure E1-13. Cryptophytes density (cells/L) from Meadowbank study area lakes since 2006.	14
Figure E1-14. Dinoflagellates density (cells/L) from Meadowbank study area lakes since 2006.	15
Figure E1-15. Simpsons' Diversity for the phytoplankton community from Meadowbank study area lakes since 2006.	16

Table E1-1. Phytoplankton density (cells/L), biomass (mg/m3), and diversity by major taxa group, Meadowbank study lakes, 2024.

Area-Replicate	Date	Phytoplankton Biomass (mg/m ³)							TOTAL	Taxa Richness	Simpson's Diversity	Phytoplankton Density (cells/L)						
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate				Cyanophyte	Chlorophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	TOTAL
Inuggugayualik Lake																		
INUG - 160	12-Jul-24	0.71	2.2	0	164	11	16	18	212	33	0.81	3,200	21,752	1,965,280	117,360	9,000	2,600	
INUG - 161	12-Jul-24	2.7	2.2	0	190	10	15	16	235	35	0.87	25,752	15,168	1,599,896	155,680	8,200	2,200	
INUG - 162	10-Aug-24	8.4	17	0	136	24	0.87	1.1	187	33	0.87	63,920	711,216	1,985,584	221,320	21,552	200	
INUG - 163	10-Aug-24	10	15	0	138	18	0.71	4.5	187	32	0.88	51,736	532,816	1,957,648	246,256	400	800	
INUG - 164	17-Sep-24	14	22	0	127	21	4.7	1.8	190	36	0.92	77,504	619,024	1,330,640	261,640	29,336	400	
INUG - 165	17-Sep-24	9.2	18	0	150	25	2.0	5.2	210	41	0.93	51,952	483,328	1,403,080	222,320	7,784	1,000	
Percent Biomass or Density		3.7	6.3	<0.1	74	9.0	3.2	3.8				1.9	17	72	8.6	0.54	<0.1	
Pipedream Lake																		
PDL - 125	12-Jul-24	0.32	0.58	0	100	19	16	19	155	25	0.82	1,800	115,144	1,501,672	218,552	88,608	2,800	
PDL - 126	12-Jul-24	0.51	0.51	0	141	19	17	37	215	25	0.84	3,000	79,424	1,377,560	181,464	56,288	6,400	
PDL - 127	11-Aug-24	0.58	16	0	88	3.6	0	5.9	114	27	0.79	3,400	316,296	1,122,304	75,240	0	1,000	
PDL - 128	11-Aug-24	0.51	9.3	0	87	17	1.4	4.8	120	31	0.89	3,000	318,296	827,360	269,008	800	800	
PDL - 129	6-Sep-24	1.4	4.2	0	40	6.8	6.2	2.9	62	28	0.87	7,400	223,304	489,312	210,936	30,936	600	
PDL - 130	6-Sep-24	2.8	11	0	56	13	4.6	2.9	90	28	0.89	14,800	740,352	546,384	182,800	23,152	600	
Percent Biomass or Density		0.80	5.4	<0.1	68	10	6.0	9.6				0.37	20	65	13	2.2	0.13	
Third Portage Lake - East Basin																		
TPE - 172	2-Jul-24	0	0.45	0	90	14	2.7	89	196	24	0.63	0	14,968	1,099,168	143,696	8,184	12,784	
TPE - 173	2-Jul-24	0	0.96	0	77	9.8	4.5	24	116	26	0.76	0	144,280	1,126,104	88,824	29,136	10,584	
TPE - 174	12-Aug-24	0.17	5.1	0	51	3.1	2.2	2.9	65	21	0.63	1,000	991,592	440,040	95,992	1,200	400	
TPE - 175	12-Aug-24	1.3	7.1	0	55	5.0	1.2	11	81	22	0.63	115,744	991,592	264,040	109,360	600	1,800	
TPE - 176	5-Sep-24	0.27	5.1	0	219	2.4	2.8	5.9	235	25	0.87	1,200	316,696	1,284,184	102,376	1,600	600	
TPE - 177	5-Sep-24	0.29	5.3	0	137	6.8	8.7	5.2	163	24	0.87	1,200	424,456	785,688	403,504	32,336	400	
Percent Biomass or Density		0.23	2.9	<0.1	73	4.9	2.6	16				1.3	32	55	10	0.81	0.29	
Third Portage Lake - North Basin																		
TPN - 172	9-Jul-24	0	0.44	0	57	53	5.2	33	149	23	0.83	0	29,536	764,104	380,768	2,800	4,400	
TPN - 173	9-Jul-24	0	0.55	0	78	22	6.0	27	133	24	0.79	0	22,752	1,354,392	202,368	9,984	11,184	
TPN - 174	9-Aug-24	0.031	2.2	0	71	14	1.1	4.4	92	28	0.90	200	136,696	489,712	183,200	600	800	
TPN - 175	9-Aug-24	0.28	0.76	0	66	16	2.0	3.3	88	21	0.87	1,400	179,600	577,120	209,736	7,784	600	
TPN - 176	5-Sep-24	0.048	8.7	0	48	3.8	4.5	33	99	24	0.89	200	575,920	361,800	109,360	23,152	400	
TPN - 177	5-Sep-24	0	7.7	0	62	4.4	9.0	33	116	26	0.88	0	446,008	464,976	46,104	59,872	400	
Percent Biomass or Density		<0.1	3.0	<0.1	56	17	4.1	20				<0.1	21	60	17	1.6	0.27	
Second Portage Lake																		
SP - 172	3-Jul-24	0	0.076	0	138	5.7	25	11	180	27	0.79	0	200	1,751,712	70,472	134,312	2,000	
SP - 173	3-Jul-24	0	0.38	0	136	11	20	97	264	28	0.77	0	14,368	1,721,576	95,008	91,208	3,200	
SP - 174	14-Aug-24	0.24	9.3	0	64	16	4.5	1.8	96	26	0.60	600	1,652,720	697,248	141,096	22,552	200	
SP - 175	14-Aug-24	0	7.8	0	38	11	1.6	0	59	19	0.75	0	855,096	438,624	184,200	7,584	0	
SP - 176	8-Sep-24	0	4.8	0	57	18	7.5	2.2	89	27	0.89	0	359,400	956,072	340,648	24,752	600	
SP - 177	8-Sep-24	0	2.0	0	37	27	17	5.6	89	24	0.82	0	280,576	604,056	343,048	50,704	800	
Percent Biomass or Density		<0.1	3.1	<0.1	60	12	9.8	15				<0.1	29	57	11	3.1	<0.1	
Wally Lake																		
WAL - 141	3-Jul-24	0	2.0	0	133	8.9	21	16	181	28	0.83	0	79,024	1,539,208	87,440	92,008	2,600	
WAL - 142	3-Jul-24	0	1.1	0	194	8.9	22	12	238	31	0.75	0	29,136	2,264,592	55,904	138,896	2,400	
WAL - 143	9-Aug-24	0	13	0	28	21	4.5	2.2	69	23	0.86	0	784,056	581,904	158,064	22,552	400	
WAL - 144	9-Aug-24	0	9.2	0	23	13	1.6	1.1	48	17	0.87	0	625,008	517,248	126,528	7,584	200	
WAL - 145	5-Sep-24	0.40	5.9	0	38	15	6.6	13	79	22	0.89	7,184	302,328	337,648	176,816	24,352	1,400	
WAL - 146	5-Sep-24	0	6.6	0	57	10	9.3	4.5	87	23	0.85	0	266,408	625,008	17,568	32,736	200	
Percent Biomass or Density		<0.1	5.4	<0.1	67	11	9.3	6.9				<0.1	23	66	7.0	3.6	<0.1	
All locations																		
		1.1	4.5	<0.1	68	10	5.5	11				0.74	23	63	11	1.9	0.13	

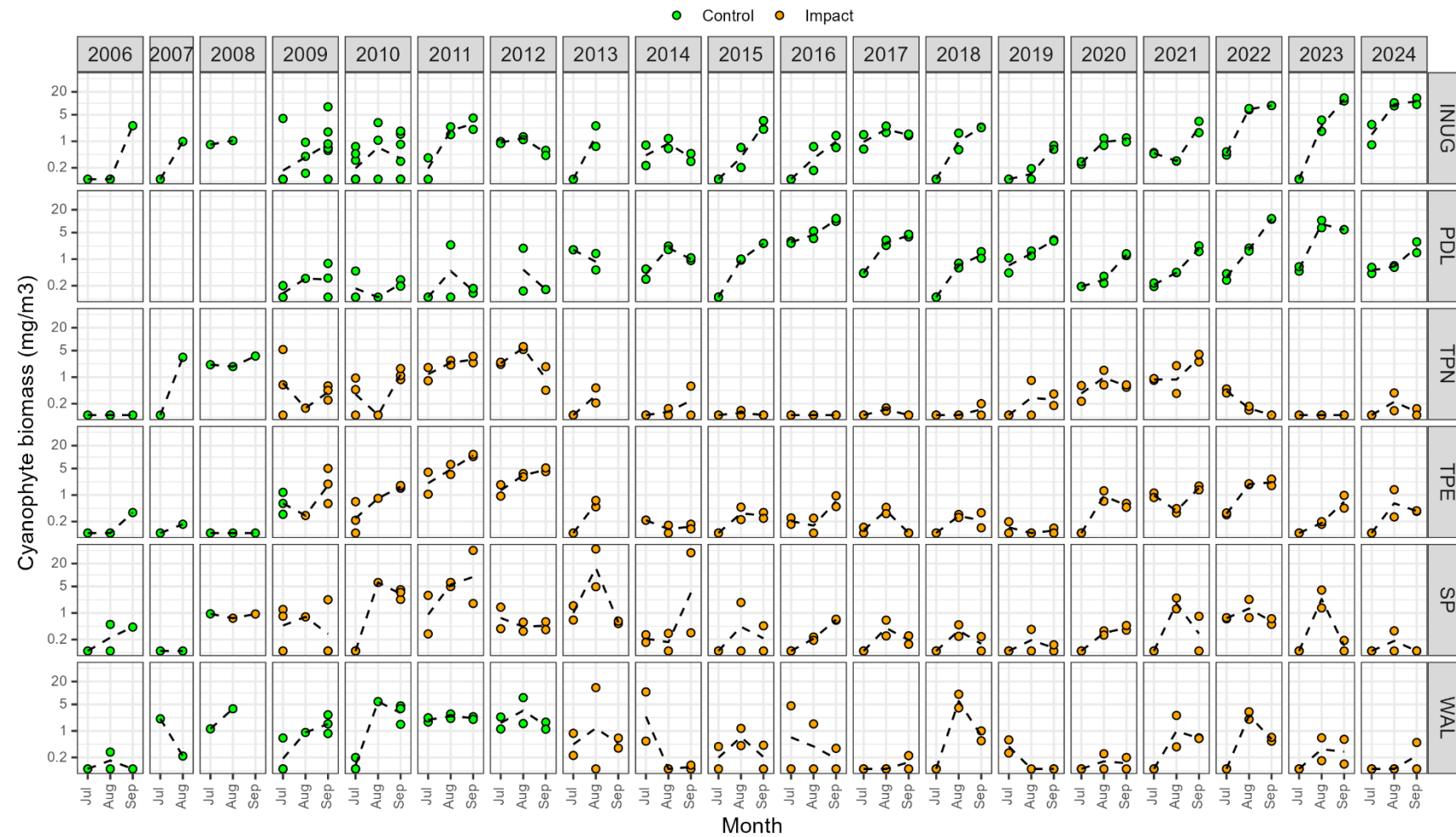
Figure E1-1. Cyanophyte biomass (mg/m³) from Meadowbank study area lakes since 2006.

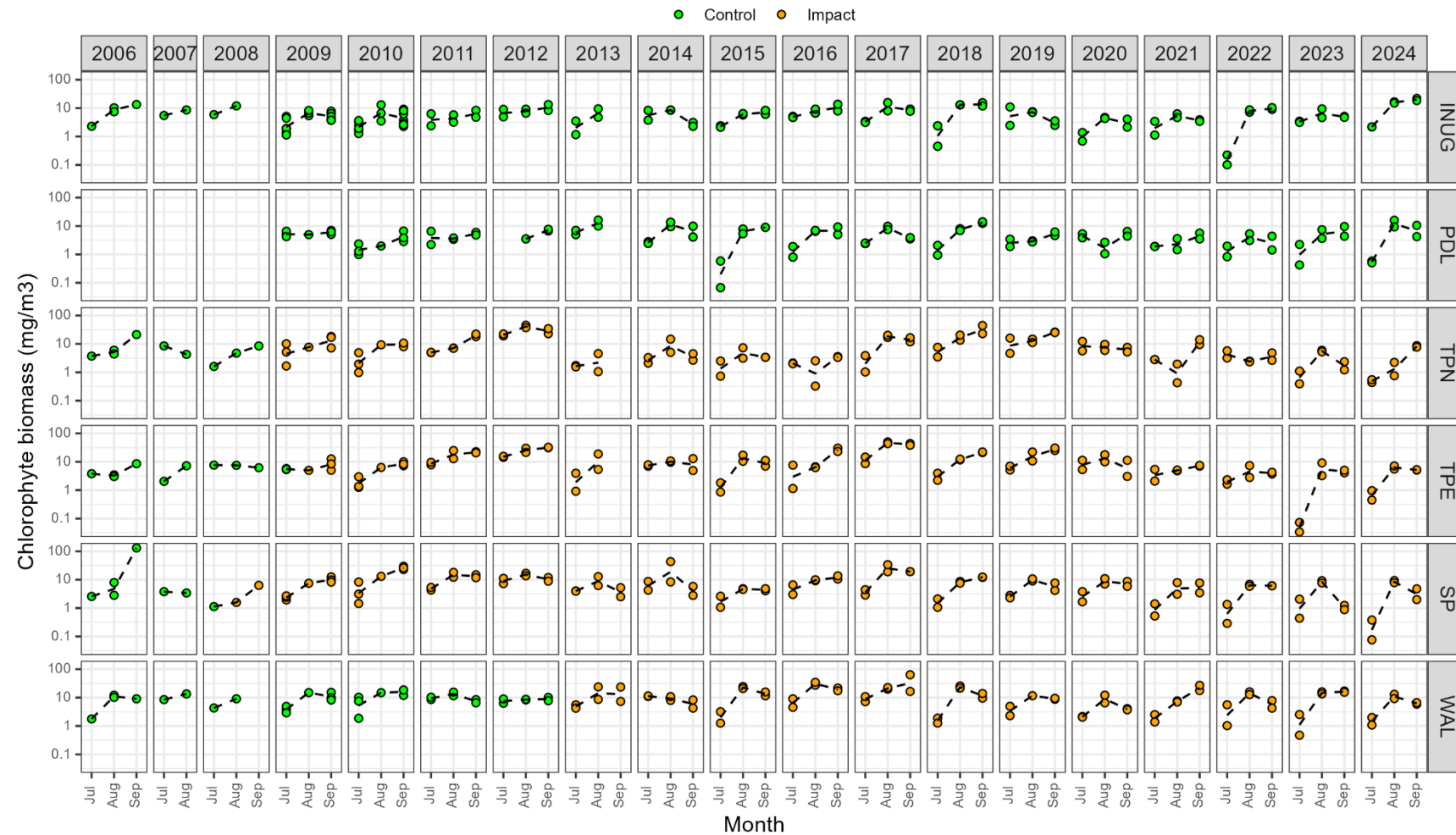
Figure E1-2. Chlorophyte biomass (mg/m³) from Meadowbank study area lakes since 2006.

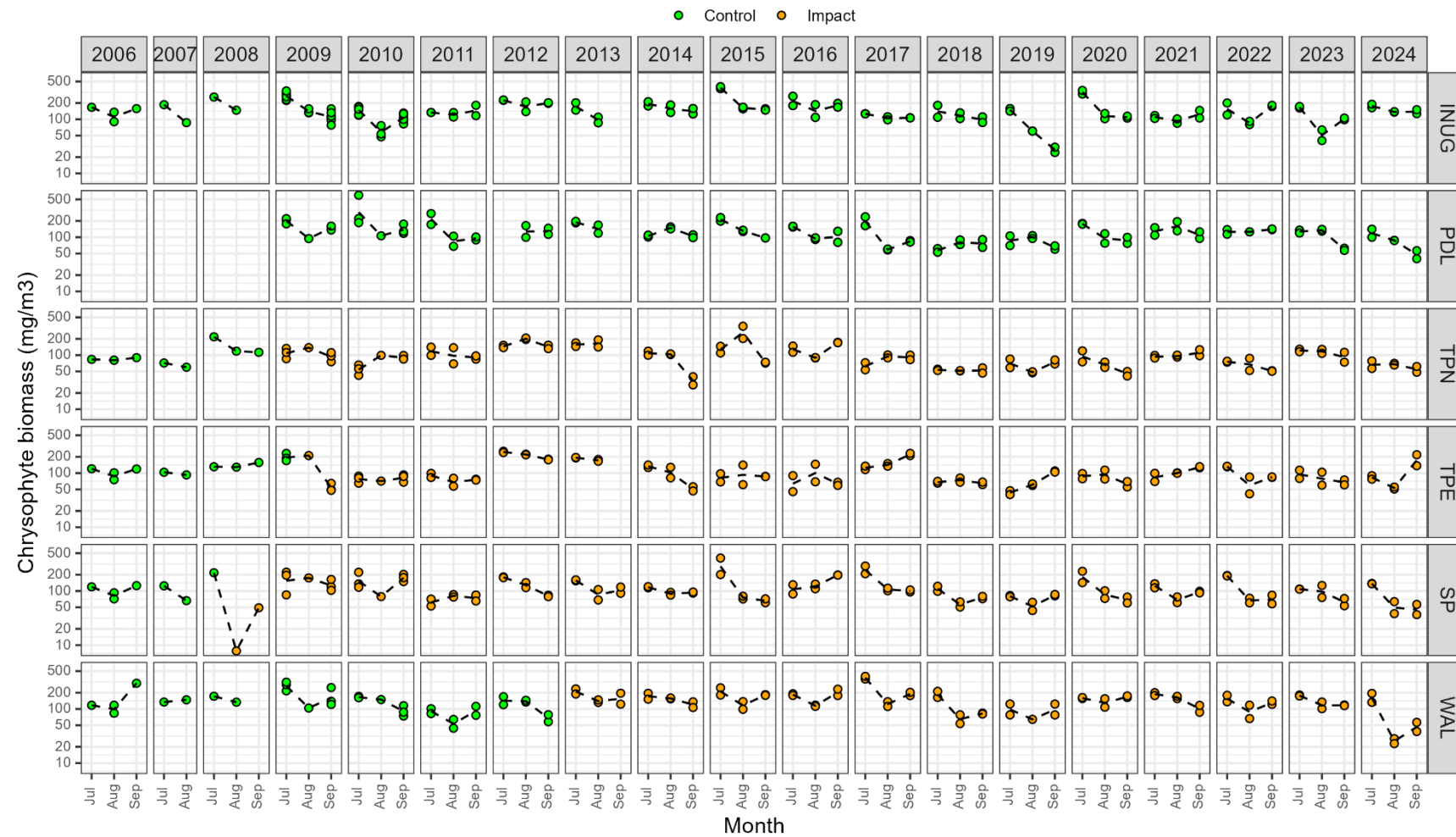
Figure E1-3. Chrysophyte biomass (mg/m³) from Meadowbank study area lakes since 2006.

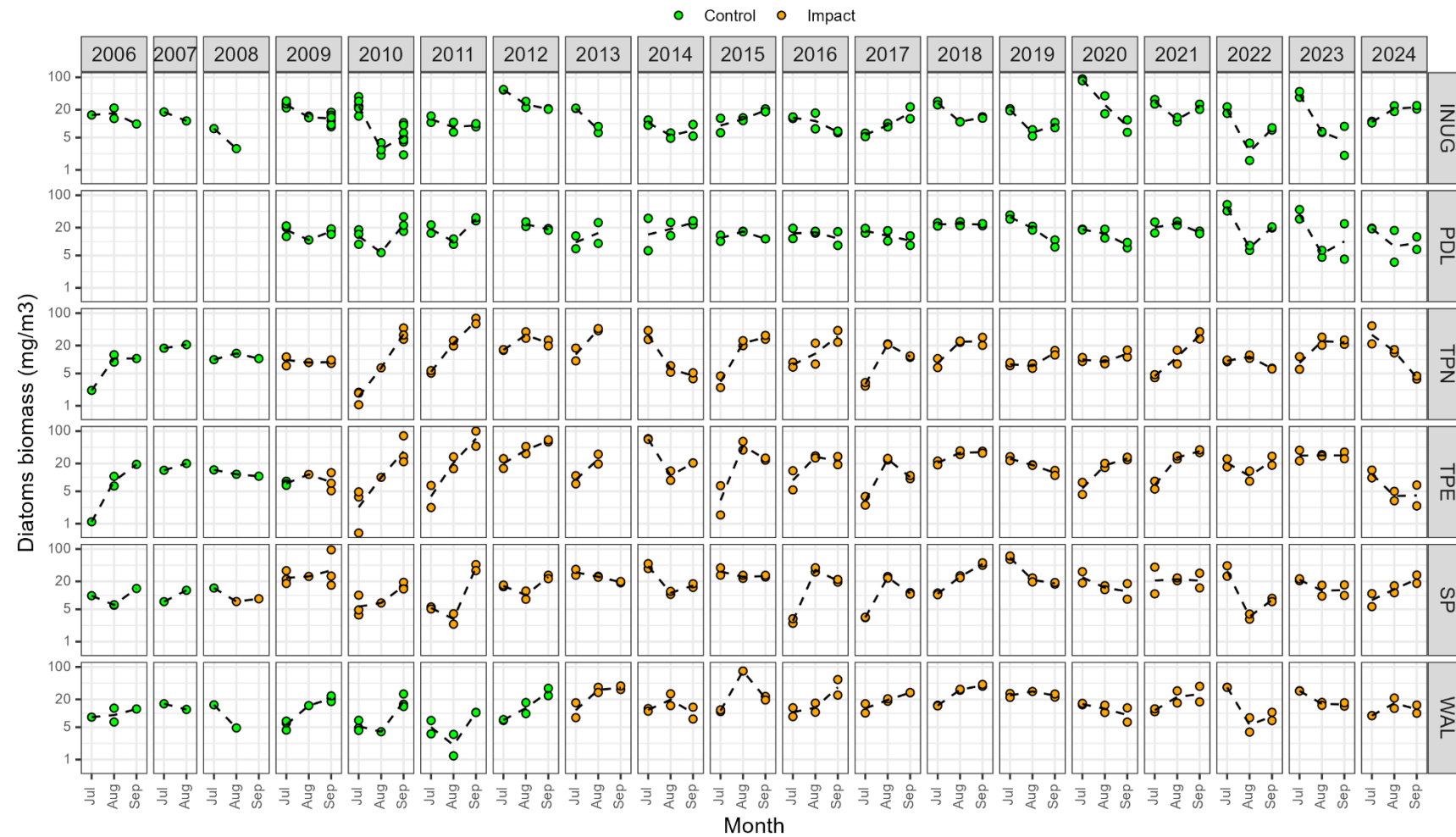
Figure E1-4. Diatom biomass (mg/m³) from Meadowbank study area lakes since 2006.

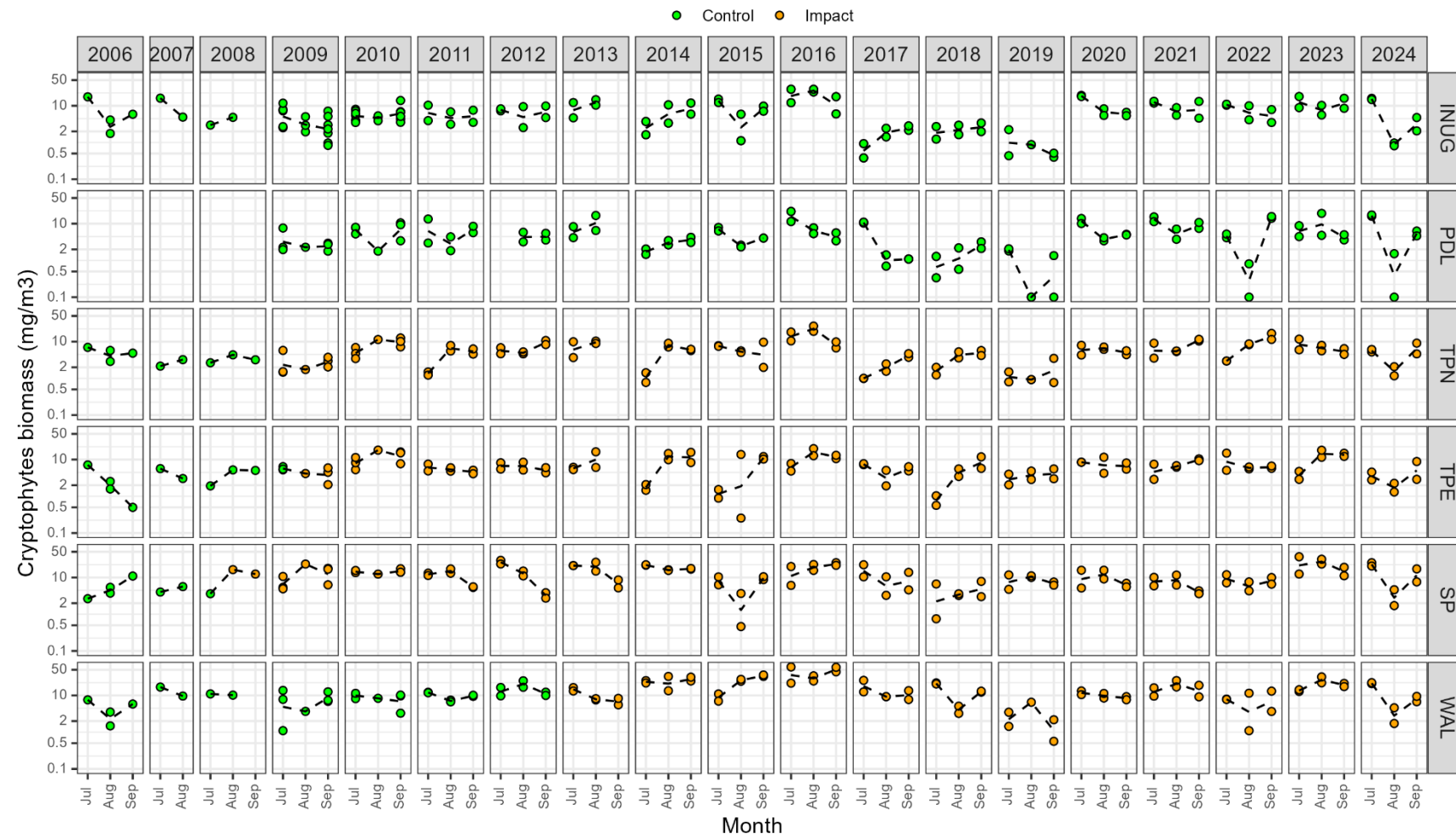
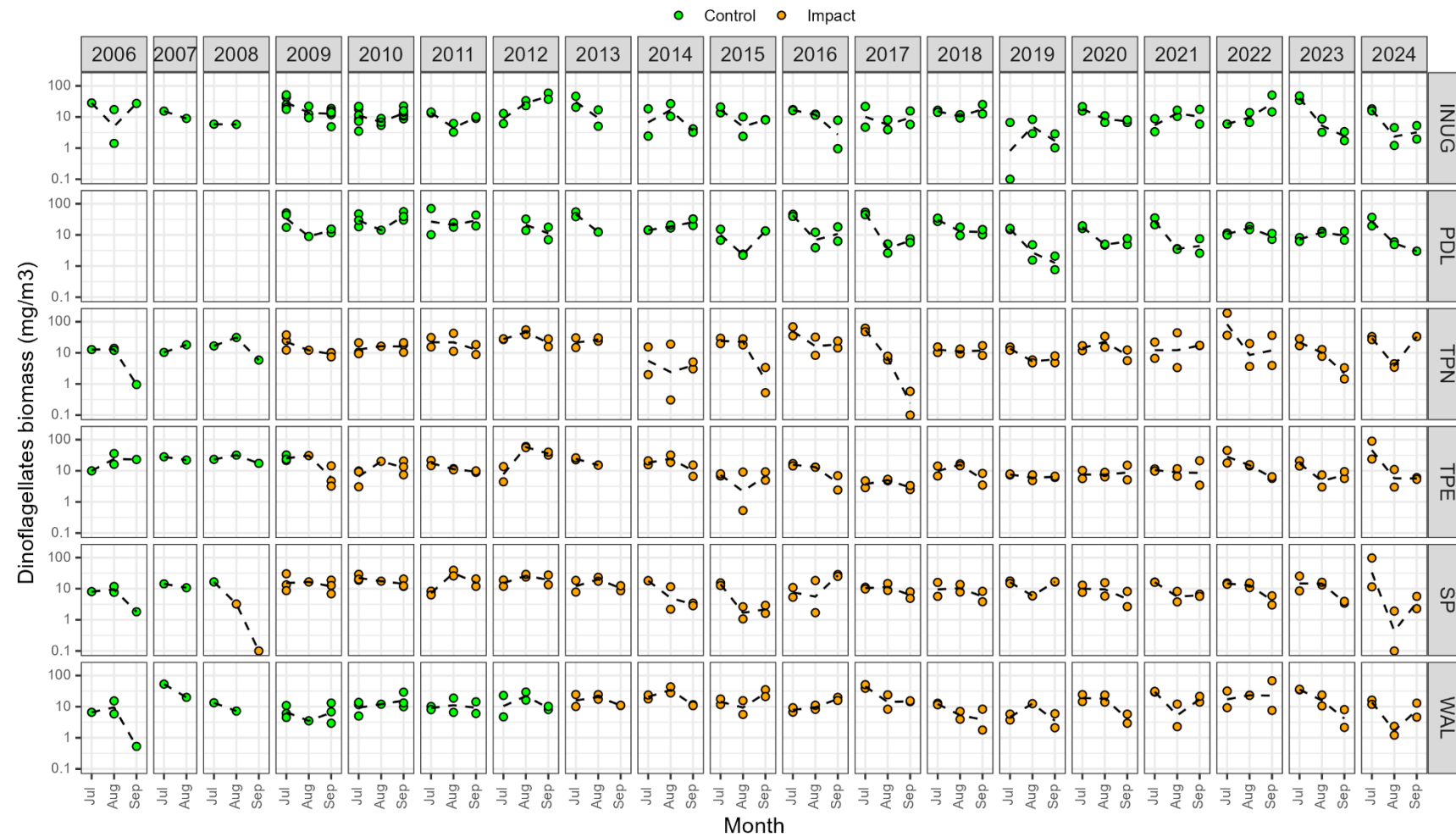
Figure E1-5. Cryptophyte biomass (mg/m³) from Meadowbank study area lakes since 2006.

Figure E1-6. Dinoflagellate biomass (mg/m³) from Meadowbank study area lakes since 2006.

Phytoplankton Taxonomy – Meadowbank Study Area Lakes

Figure E1-7. Phytoplankton density (cells/L) by major taxa group from Meadowbank study area lakes since 2006.

Note: High chlorophyll value in December 2011 at TPE omitted.

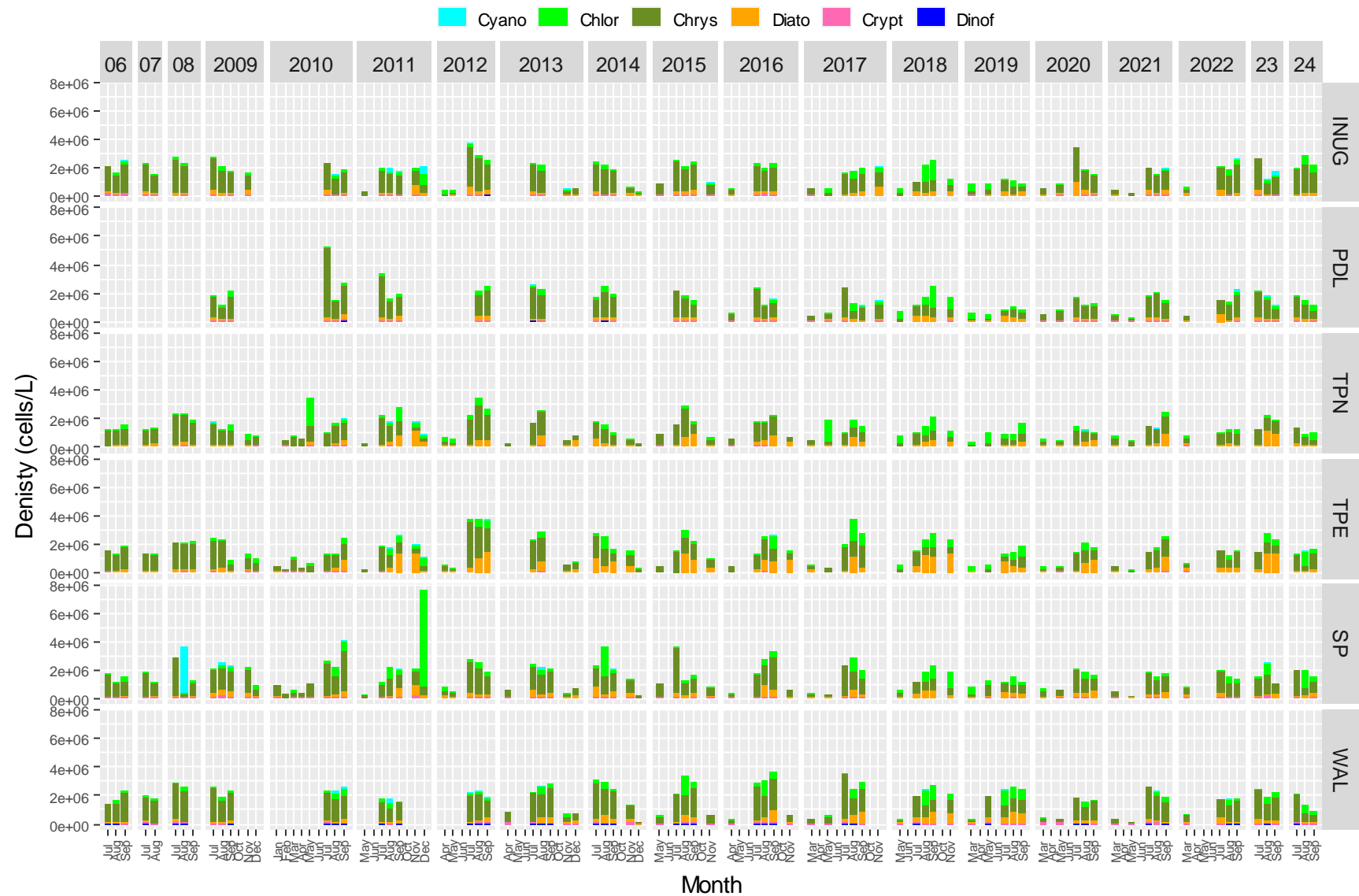


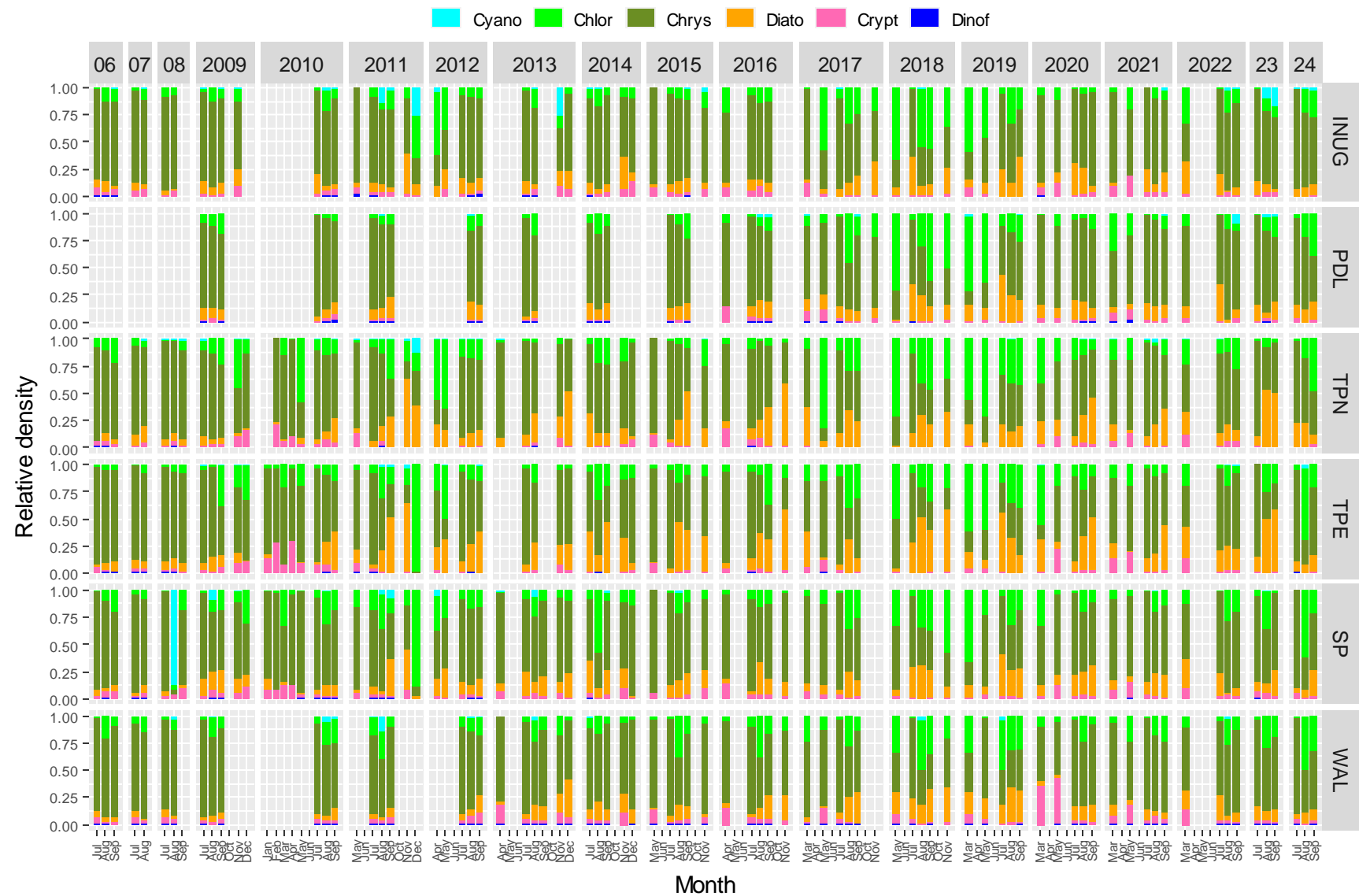
Figure E1-8. Relative phytoplankton density by major taxa group from Meadowbank study area lakes since 2006.

Figure E1-9. Cyanophyte density (cells/L) from Meadowbank study area lakes since 2006.

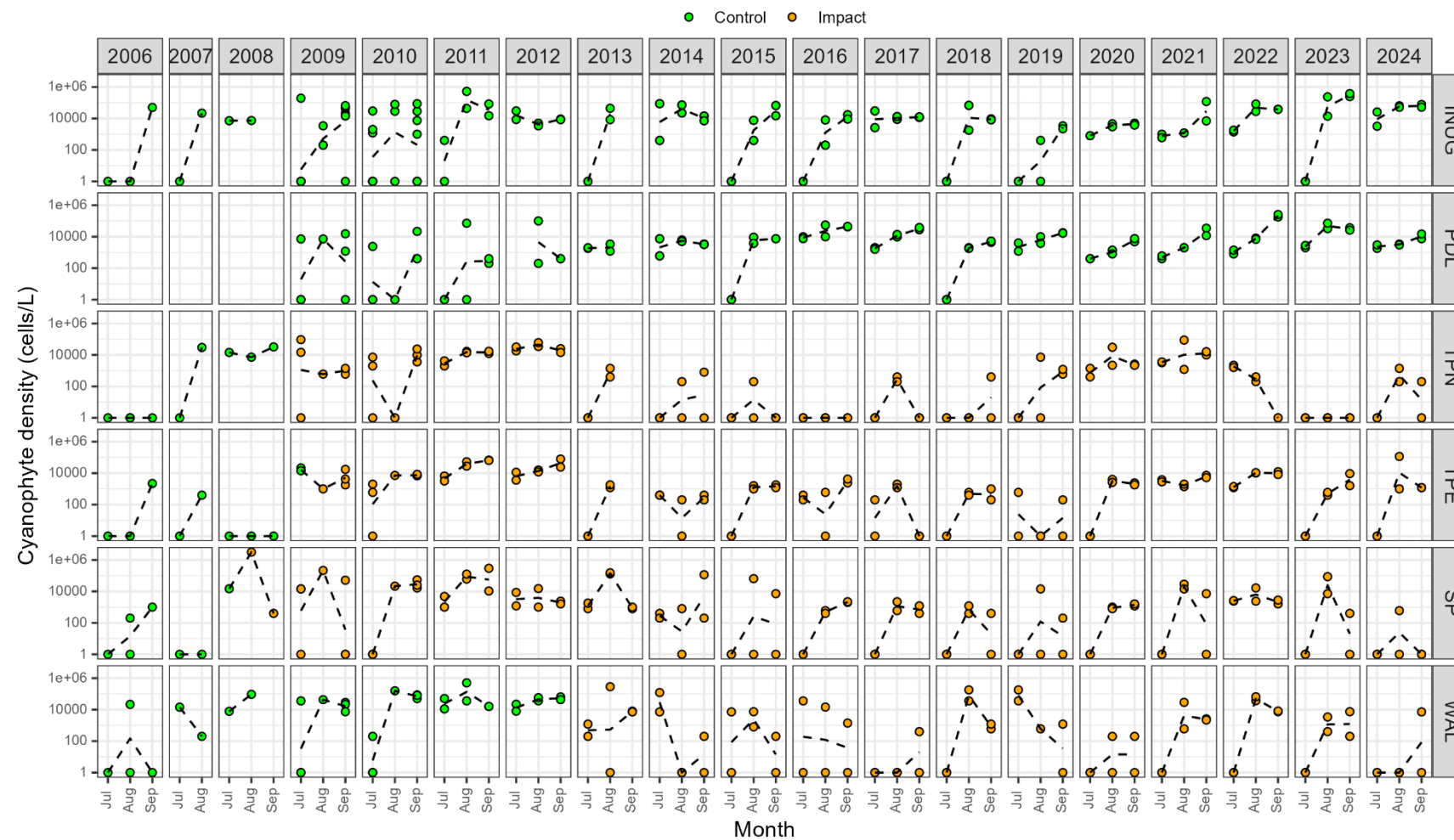




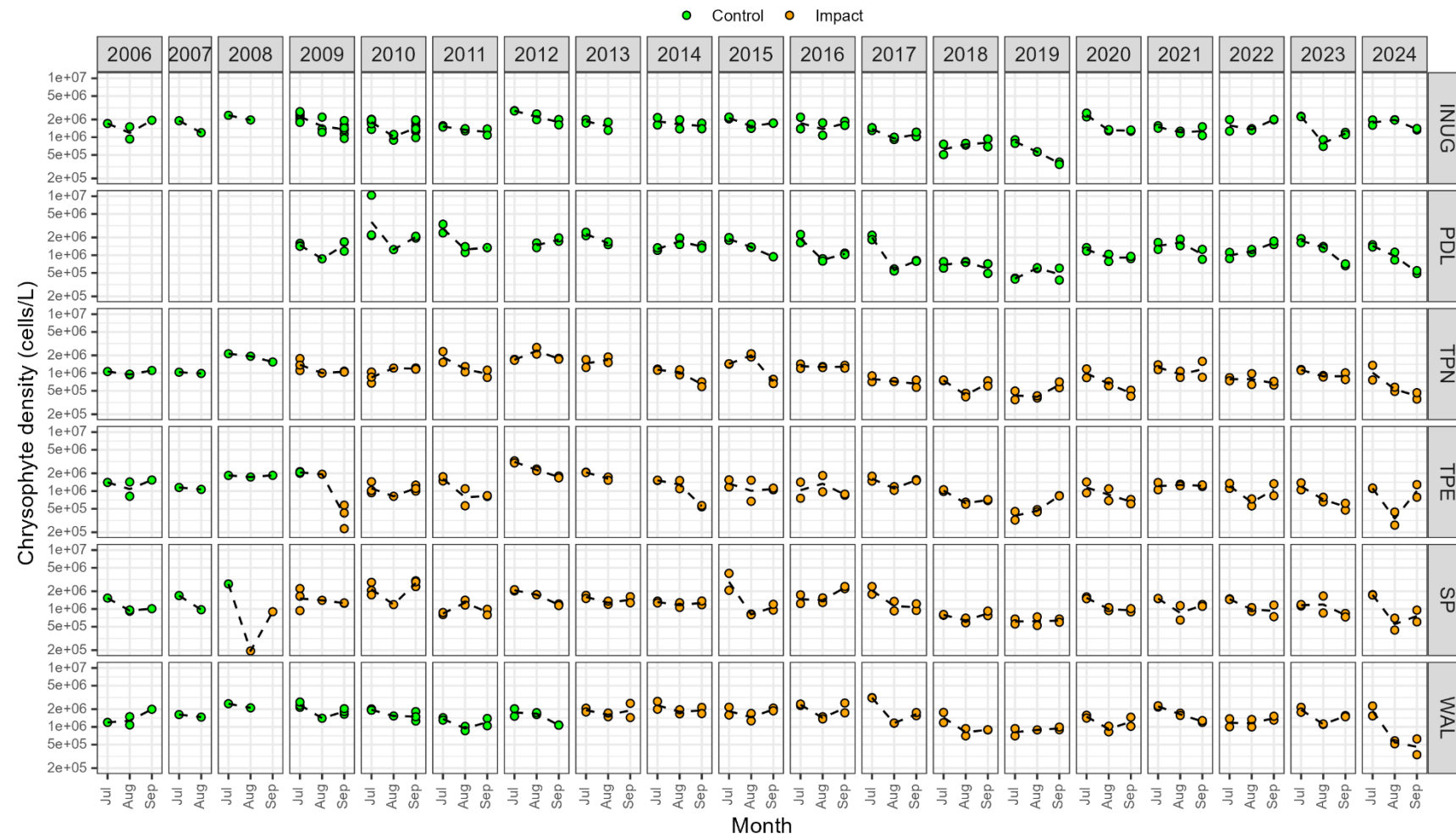
Figure E1-11. Chrysophyte density (cells/L) from Meadowbank study area lakes since 2006.

Figure E1-12. Diatoms density (cells/L) from Meadowbank study area lakes since 2006.

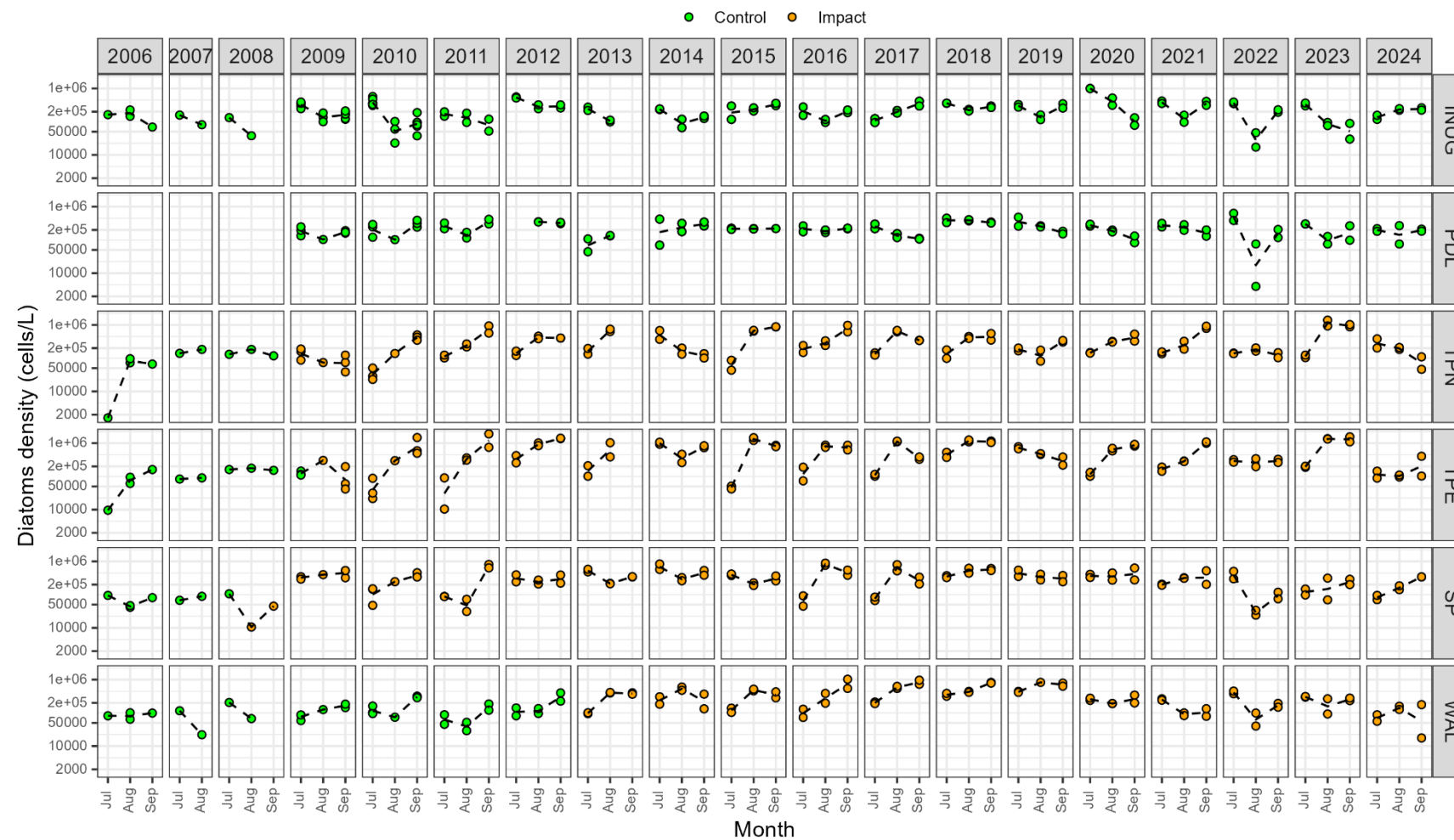


Figure E1-13. Cryptophytes density (cells/L) from Meadowbank study area lakes since 2006.

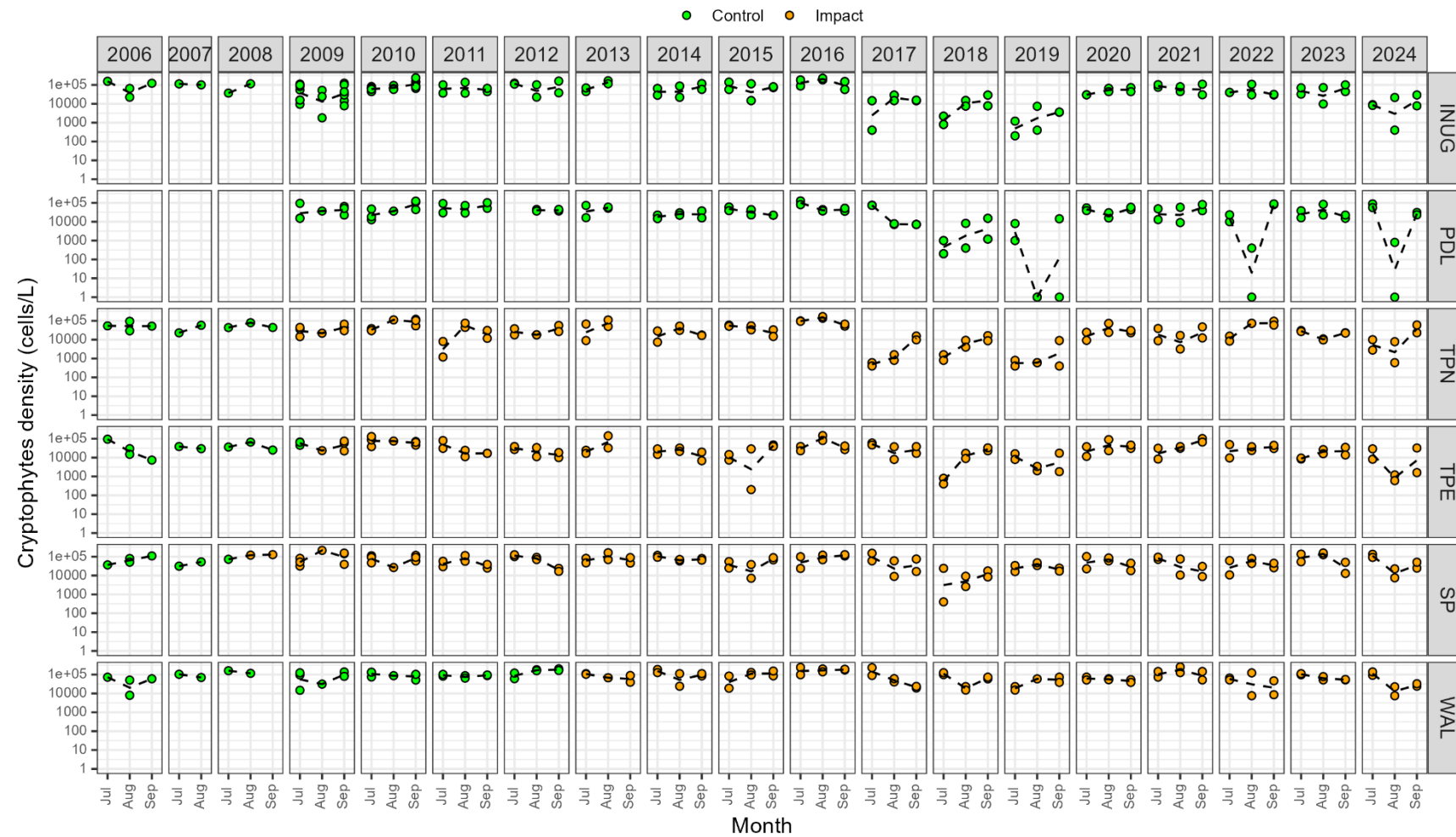


Figure E1-14. Dinoflagellates density (cells/L) from Meadowbank study area lakes since 2006.

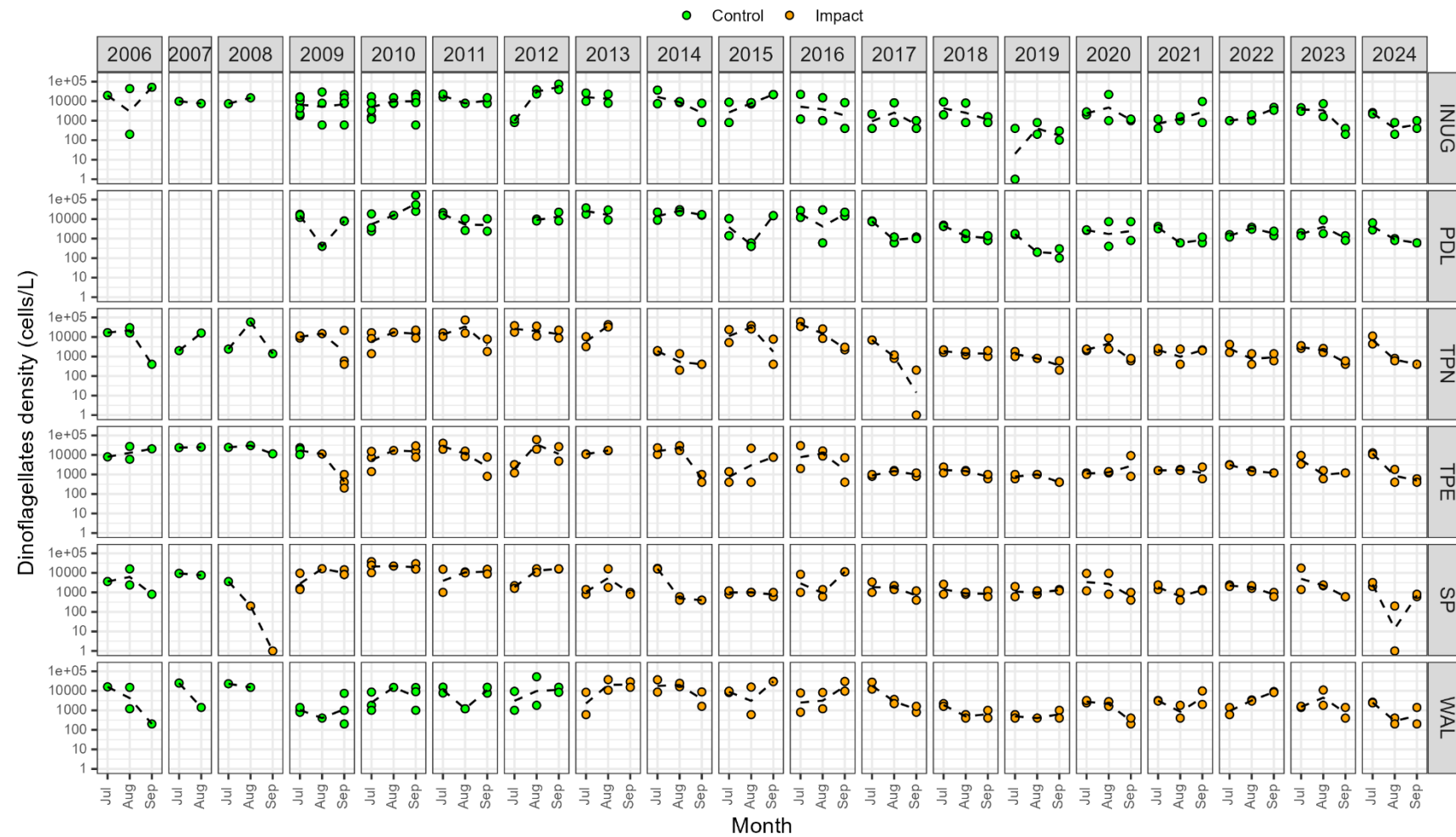
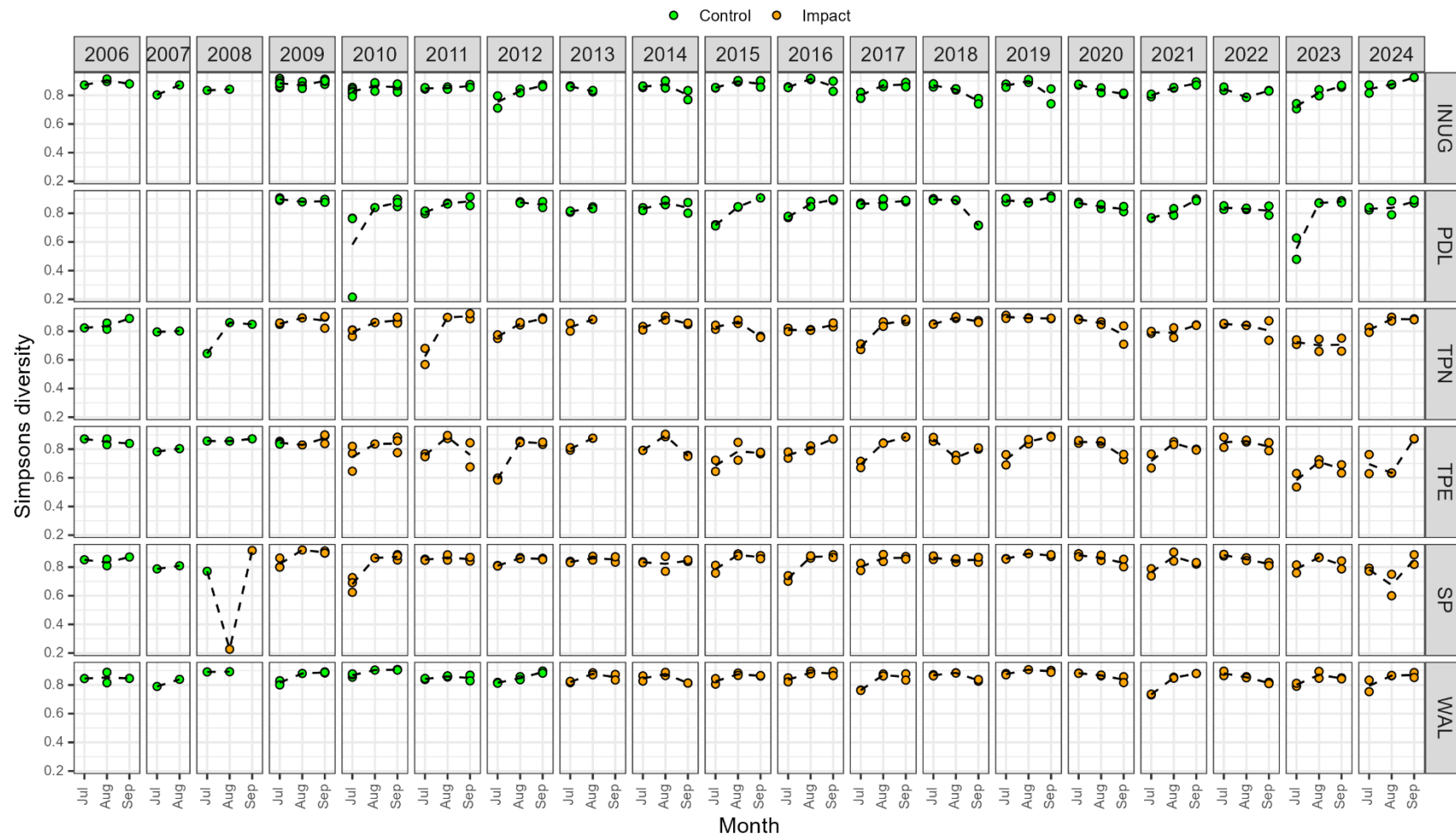


Figure E1-15. Simpsons' Diversity for the phytoplankton community from Meadowbank study area lakes since 2006.

Appendix E2

Phyto Data – Whale Tail Study Area Lakes

LIST OF TABLES – APPENDIX E2

Table E2-1. Phytoplankton density (cells/L), biomass (mg/m ³), and diversity by major taxa group, Whale Tail study area lakes, 2024.	1
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LIST OF FIGURES – APPENDIX E2

Figure E2-1. Cyanophyte biomass (mg/m ³) from Whale Tail study area lakes since 2014.	2
Figure E2-2. Chlorophyte biomass (mg/m ³) from Whale Tail study area lakes since 2014.	3
Figure E2-3. Chrysophyte biomass (mg/m ³) from Whale Tail study area lakes since 2014.	4
Figure E2-4. Diatoms biomass (mg/m ³) from Whale Tail study area lakes since 2014.	5
Figure E2-5. Cryptophytes biomass (mg/m ³) from Whale Tail study area lakes since 2014.	6
Figure E2-6. Dinoflagellates biomass (mg/m ³) from Whale Tail study area lakes since 2014.	7
Figure E2-7. Phytoplankton density (cells/L) by major taxa group from Whale Tail study area lakes since 2014.	8
Figure E2-8. Relative phytoplankton density by major taxa group from Whale Tail study area lakes since 2014.	9
Figure E2-9. Cyanophyte density (cells/L) from Whale Tail study area lakes since 2014.	10
Figure E2-10. Chlorophyte density (cells/L) from Whale Tail study area lakes since 2014.	11
Figure E2-11. Chrysophyte density (cells/L) from Whale Tail study area lakes since 2014.	12
Figure E2-12. Diatoms density (cells/L) from Whale Tail study area lakes since 2015.	13
Figure E2-13. Cryptophytes density (cells/L) from Whale Tail study area lakes since 2015.	14
Figure E2-14. Dinoflagellates density (cells/L) from Whale Tail study area lakes since 2014.	15
Figure E2-15. Simpsons' Diversity for the phytoplankton community from Whale Tail study area lakes since 2014.	16

Table E2-1. Phytoplankton density (cells/L), biomass (mg/m3), and diversity by major taxa group, Whale Tail study lakes, 2024.

Area-Replicate	Date	Phytoplankton Biomass (mg/m ³)						Taxa Richness	Simpson's Diversity	Phytoplankton Density (cells/L)						TOTAL	
		Cyanophyte	Chlorophyte	Chrysohyte	Diatom	Cryptophyte	Dinoflagellate			Cyanophyte	Chlorophyte	Chrysohyte	Diatom	Cryptophyte	Dinoflagellate		
Kangisluik Lake (KAN) *																	
MAM - 91	30-Jun-24	0	2.3	603	109	33	14	761	25	0.37	0	86,208	9,219,304	712,680	171,432	2,600	10,192,224
MAM - 92	30-Jun-24	0	1.9	126	105	31	26	290	24	0.82	0	57,472	2,061,640	666,376	123,944	17,968	2,927,400
MAM - 93	15-Aug-24	0	4.8	59	337	20	13	433	19	0.23	0	114,944	323,880	9,925,104	45,120	1,800	10,410,848
MAM - 94	15-Aug-24	0.057	10	48	307	12	9.1	387	22	0.25	400	287,960	280,176	9,160,216	33,936	2,200	9,764,888
MAM - 95	3-Sep-24	0	23	52	260	15	1.8	352	23	0.41	0	611,040	380,952	7,716,632	8,800	400	8,717,824
MAM - 96	3-Sep-24	0	27	51	246	13	7.0	344	25	0.48	0	1,049,064	474,744	7,337,864	7,200	1,800	8,870,672
Percent Density or Biomass		<0.1	2.7	37	53	4.8	2.8				<0.1	4.3	25	70	0.77	<0.1	
Nemo Lake																	
NEM - 89	4-Jul-24	0	0.92	104	67	4.8	10	187	24	0.86	0	36,120	1,207,544	376,264	9,384	1,200	1,630,512
NEM - 90	4-Jul-24	0	1.6	84	97	9.5	16	208	23	0.85	0	7,384	1,192,376	503,992	25,352	1,600	1,730,704
NEM - 91	16-Aug-24	6.5	13	161	30	20	4.5	235	26	0.87	31,200	618,424	1,523,808	550,984	138,096	800	2,863,312
NEM - 92	16-Aug-24	6.6	12	130	32	1.6	10	193	29	0.87	36,784	489,712	1,431,216	487,928	7,584	2,000	2,455,224
NEM - 93	2-Sep-24	19	29	73	23	2.7	9.2	155	28	0.89	146,040	625,408	705,232	511,464	8,384	400	1,996,928
NEM - 94	2-Sep-24	20	34	71	24	7.7	17	172	29	0.90	220,064	754,320	848,112	453,992	59,072	1,000	2,336,560
Percent Density or Biomass		4.5	7.8	54	24	4.0	5.8				3.3	19	53	22	1.9	<0.1	
Whale Tail South																	
WTS - 91	1-Jul-24	0	1.3	316	9.7	60	11	398	28	0.58	0	57,472	3,458,520	96,888	137,760	2,400	3,753,040
WTS - 92	1-Jul-24	0	2.5	301	7.9	59	11	381	28	0.56	0	57,672	3,420,800	112,040	138,160	2,200	3,730,872
WTS - 93	14-Aug-24	0.92	24	138	21	16	3.3	204	29	0.87	6,000	689,864	1,682,856	617,904	82,624	600	3,079,848
WTS - 94	14-Aug-24	0.31	13	171	11	15	3.3	214	27	0.79	2,000	395,320	2,774,624	293,024	35,136	600	3,500,704
WTS - 95	2-Sep-24	2.8	33	60	60	16	0.67	172	32	0.79	12,400	1,192,744	1,115,520	1,872,104	55,488	200	4,248,456
WTS - 96	2-Sep-24	3.8	34	43	43	6.4	0	131	30	0.82	16,800	1,444,584	993,592	1,713,008	10,184	0	4,178,168
Percent Density or Biomass		0.52	7.2	69	10	12	1.9				0.17	17	60	21	2.0	<0.1	
Lake A20																	
A20 - 83	4-Jul-24	0	7.4	177	25	25	27	261	28	0.87	0	266,008	2,238,240	554,280	33,752	3,400	3,095,680
A20 - 84	4-Jul-24	0	5.3	186	24	31	19	266	27	0.85	0	150,864	2,277,960	448,704	50,320	3,200	2,931,048
A20 - 85	18-Aug-24	2.0	63	308	23	9.3	16	422	35	0.87	174,216	1,308,488	3,359,928	370,816	32,336	3,200	5,248,984
A20 - 86	18-Aug-24	2.6	51	330	12	18	10	424	32	0.87	245,056	1,157,024	3,991,120	235,304	77,440	2,000	5,707,944
A20 - 87	3-Sep-24	0.18	24	212	51	16	13	315	32	0.90	1,000	632,792	2,073,824	774,152	29,552	2,400	3,513,720
A20 - 88	3-Sep-24	0	33	187	127	14	3.5	364	30	0.88	0	797,624	1,919,944	1,833,648	21,768	700	4,573,684
Percent Density or Biomass		0.23	8.9	68	13	5.5	4.3				1.7	17	63	17	0.98	<0.1	
Lake A76																	
A76 - 81	9-Jul-24	0	3.2	94	15	6.4	9.2	128	28	0.83	0	222,704	1,704,608	134,544	16,768	1,800	2,080,424
A76 - 82	9-Jul-24	0	2.7	89	24	13	7.7	136	30	0.81	0	179,600	1,811,768	137,344	53,688	1,600	2,184,000
A76 - 83	13-Aug-24	0	3.1	40	105	20	13	182	17	0.25	0	107,760	373,568	3,724,528	77,840	2,000	4,285,696
A76 - 84	13-Aug-24	0.86	5.5	98	101	21	6.3	233	28	0.55	86,208	158,048	948,288	2,826,128	44,720	1,400	4,064,792
A76 - 85	19-Sep-24	0	11	7.7	153	7.7	6.5	185	19	0.23	0	229,888	172,416	4,090,912	4,400	1,000	4,498,616
A76 - 86	19-Sep-24	0	21	25	154	10.0	11	220	26	0.33	0	359,400	201,152	3,778,000	32,936	600	4,372,088
Percent Density or Biomass		<0.1	4.3	33	51	7.2	5.0				0.40	5.9	24	68	1.1	<0.1	
Lake DS1																	
DS1 - 79	9-Jul-24	2.2	1.6	128	8.8	16	12	169	33	0.82	215,520	22,352	2,007,936	24,568	56,488	1,600	2,328,464
DS1 - 80	9-Jul-24	0	3.8	166	12	9.9	22	214	32	0.84	0	65,056	2,160,200	106,392	65,856	10,784	2,408,288
DS1 - 81	17-Aug-24	0.034	8.1	362	10	22	30	432	32	0.75	200	280,376	3,083,736	75,056	26,368	6,400	3,472,136
DS1 - 82	17-Aug-24	1.3	5.5	414	1.1	28	14	464	31	0.52	7,184	202,352	3,944,816	11,984	129,928	3,000	4,299,264
DS1 - 83	19-Sep-24	0.10	5.0	198	22	16	21	262	31	0.82	200	94,192	2,171,168	229,968	56,888	2,800	2,555,216
DS1 - 84	19-Sep-24	0.96	7.4	238	26	26	21	320	36	0.86	28,736	187,584	2,248,408	356,464	35,152	3,200	2,859,544
Percent Density or Biomass		0.24	1.7	81	4.3	6.4	6.5				1.4	4.8	87	4.5	2.1	0.16	
All Locations																	
Relative Density or Biomass (%)		0.68	5.2	57	26	6.4	4.2				0.82	9.9	46	42	1.3	<0.1	

Note:

*Kangisluik Lake (KAN) was formerly Mammoth Lake (MAM).

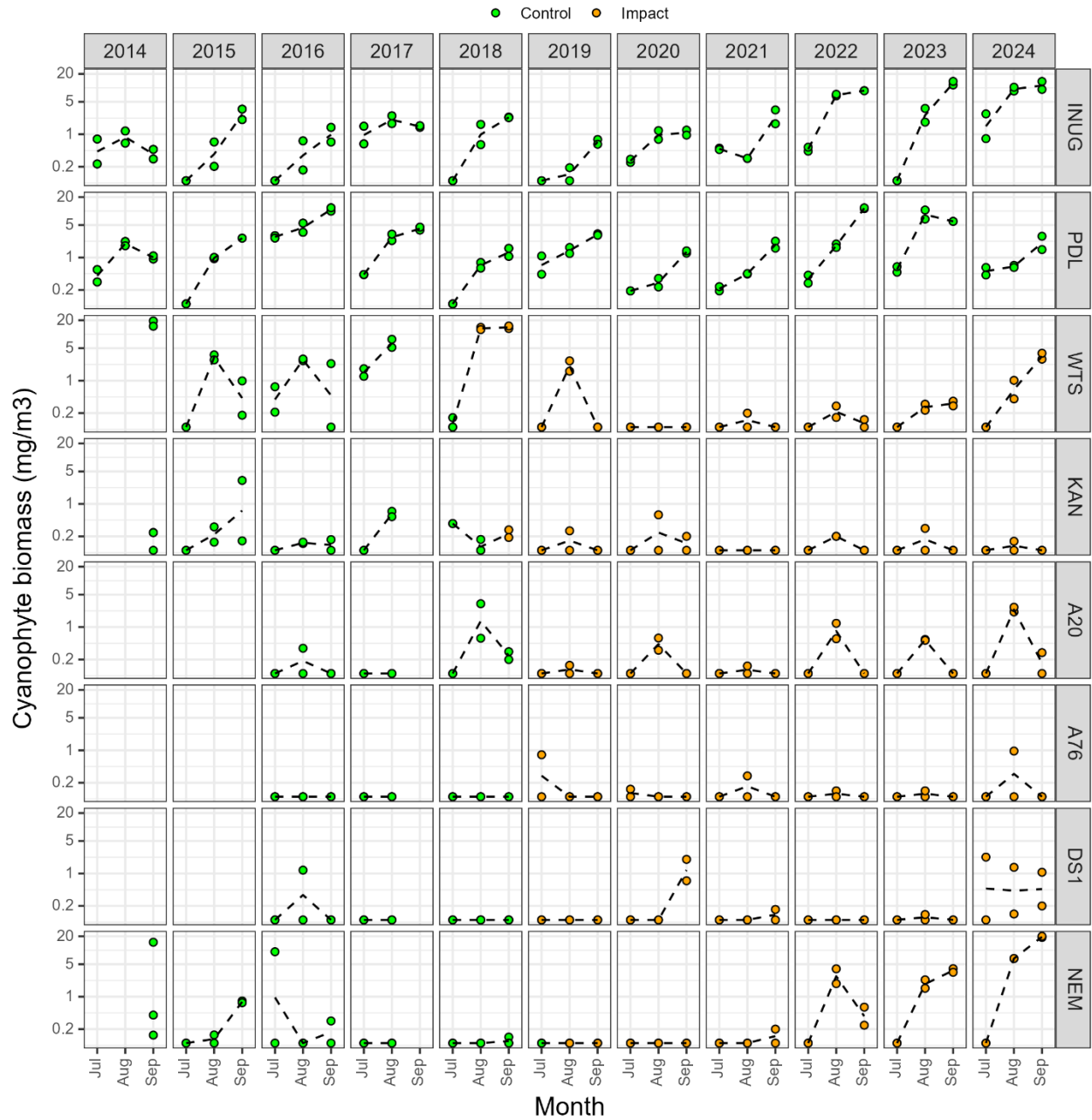
Figure E2-1. Cyanophyte biomass (mg/m³) from Whale Tail study area lakes since 2014.

Figure E2-2. Chlorophyte biomass (mg/m³) from Whale Tail study area lakes since 2014.

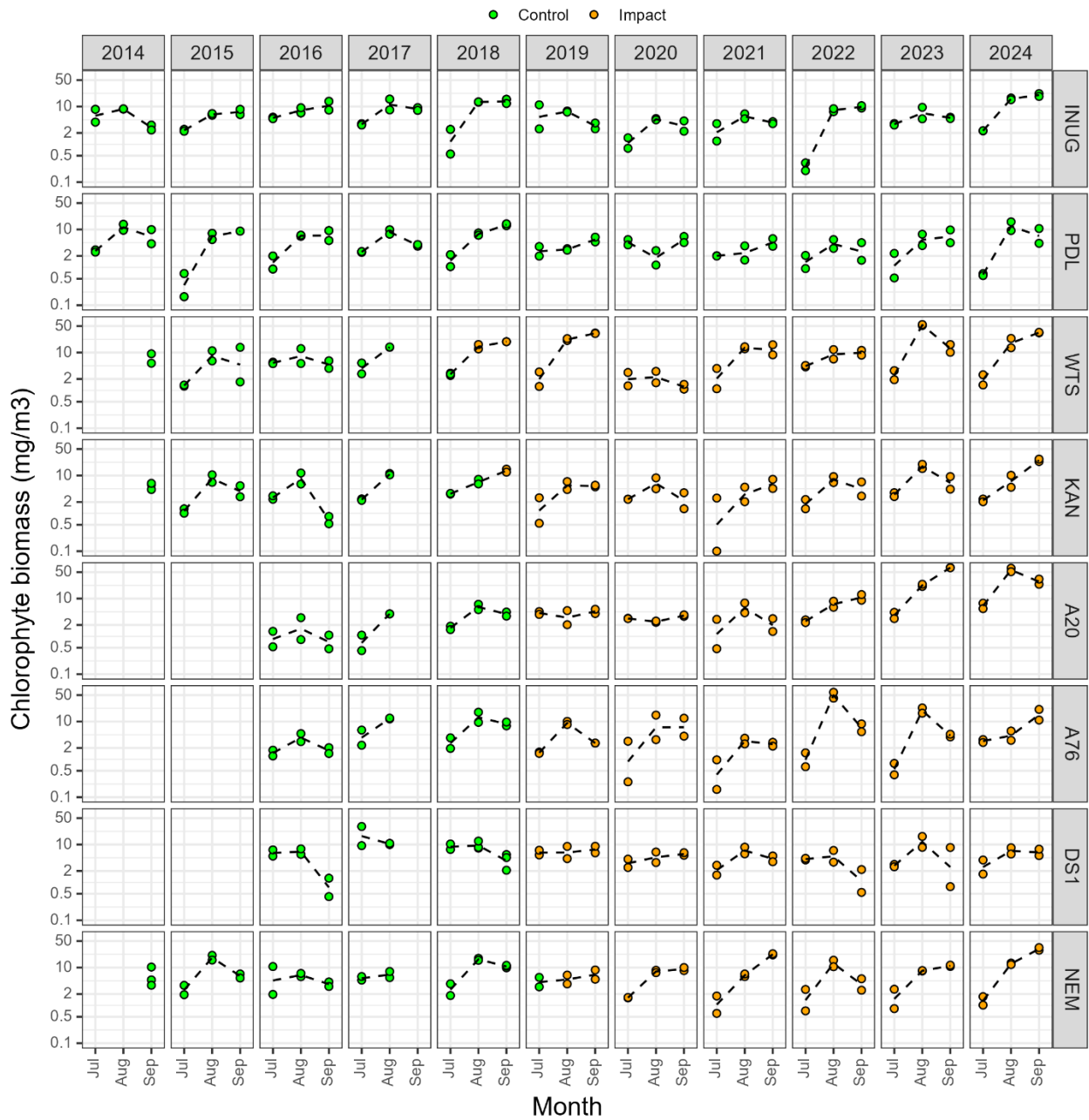


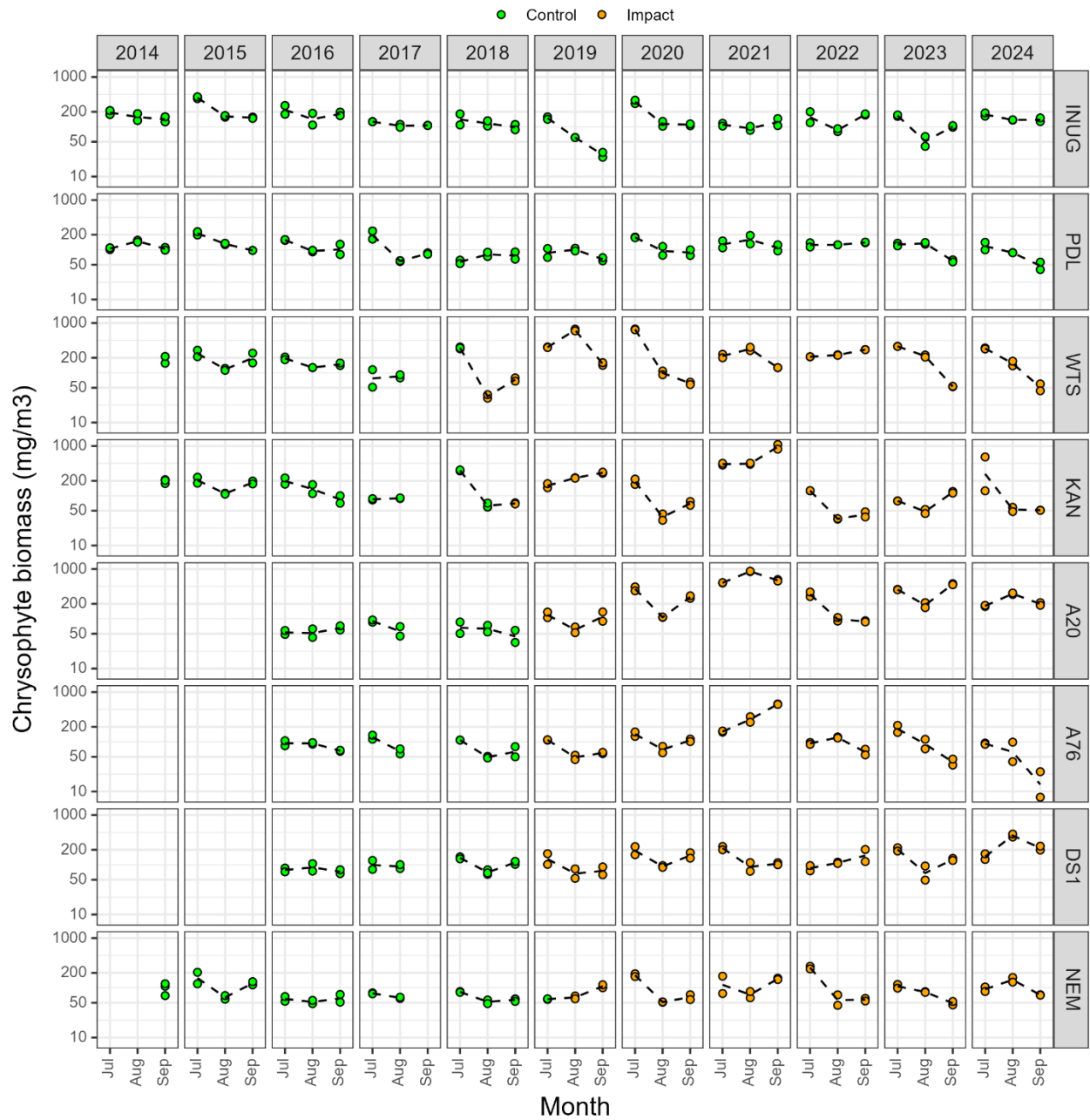
Figure E2-3. Chrysophyte biomass (mg/m³) from Whale Tail study area lakes since 2014.

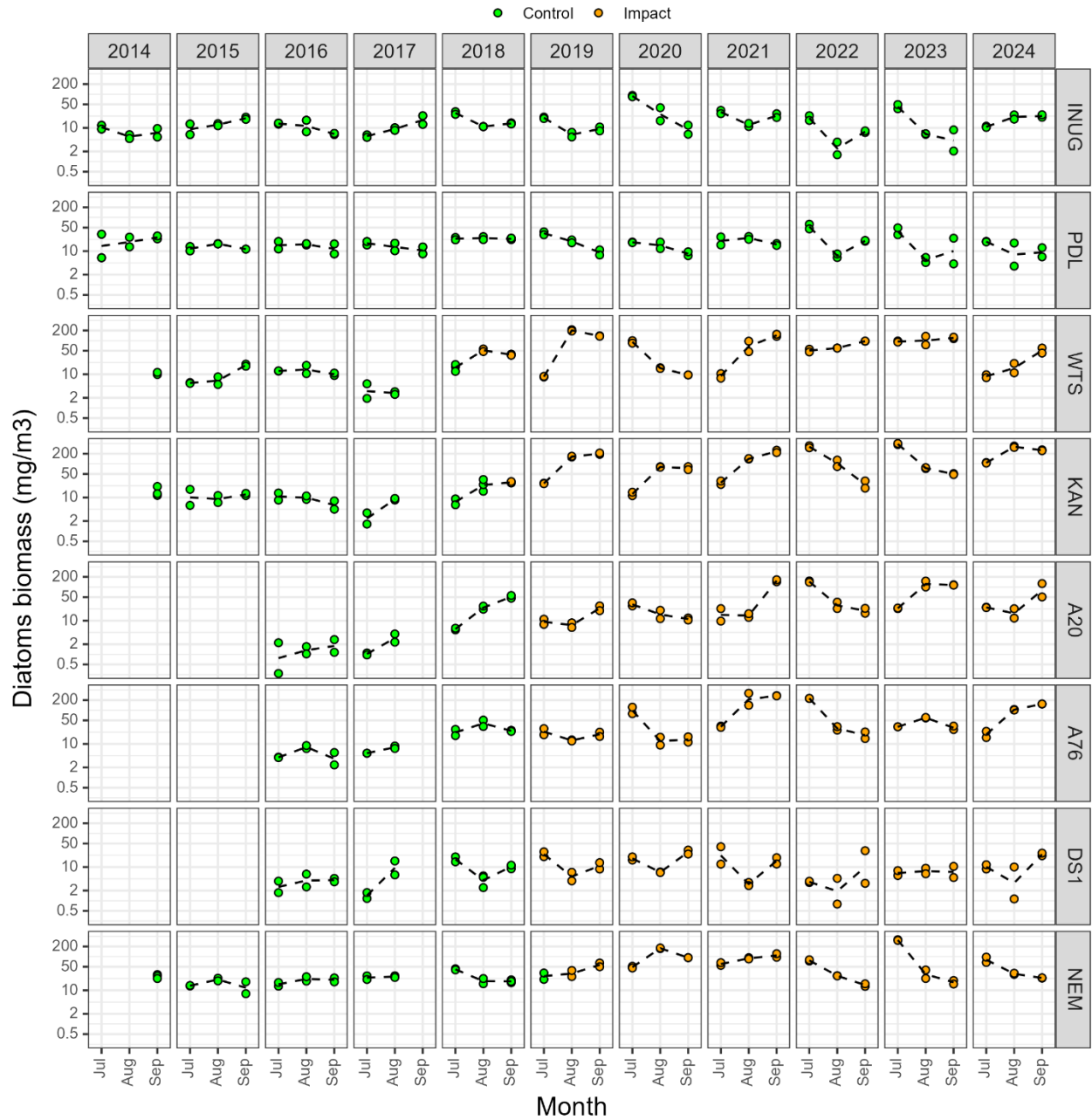
Figure E2-4. Diatoms biomass (mg/m³) from Whale Tail study area lakes since 2014.

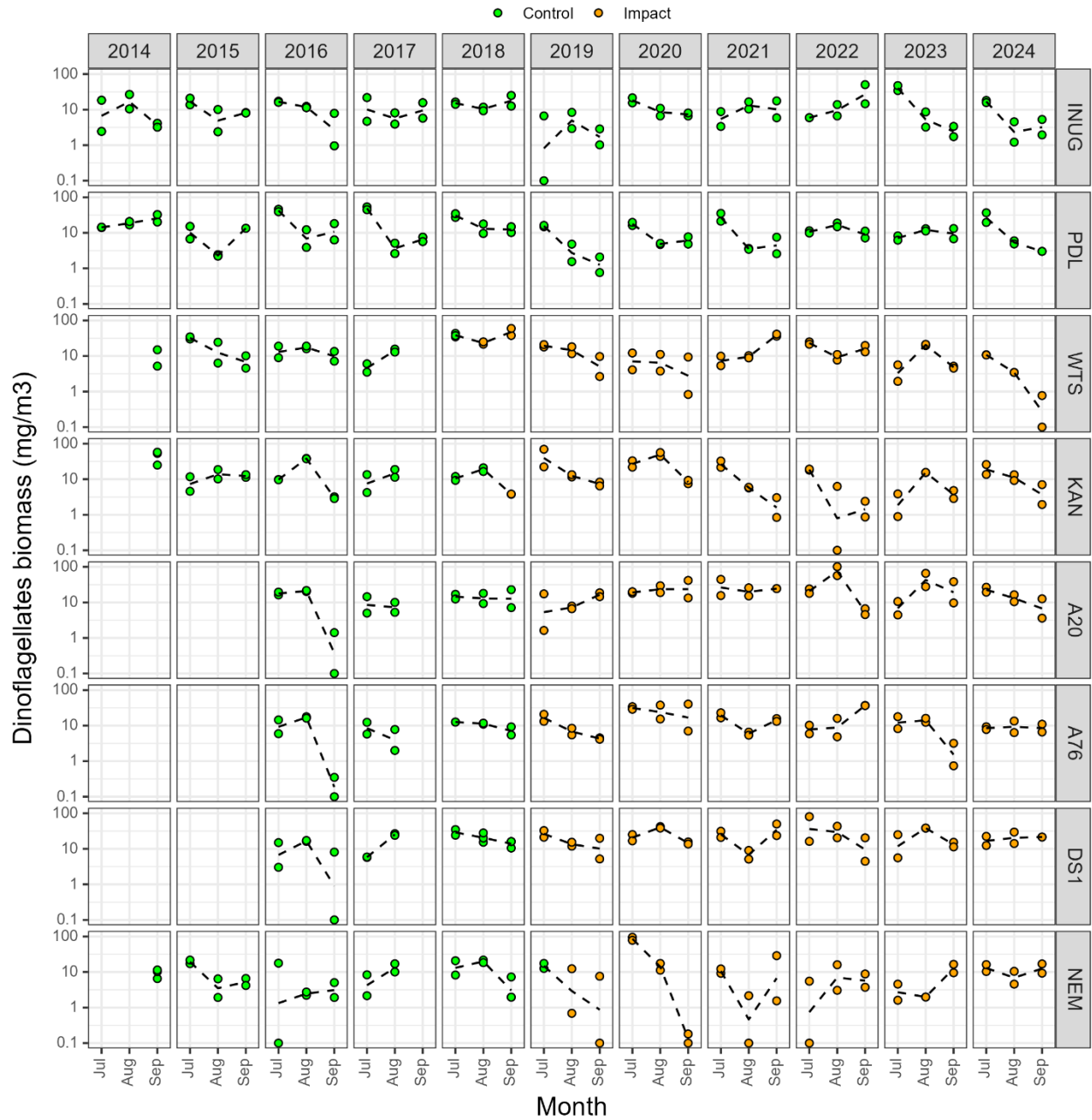
Figure E2-6. Dinoflagellates biomass (mg/m³) from Whale Tail study area lakes since 2014.

Figure E2-7. Phytoplankton density (cells/L) by major taxa group from Whale Tail study area lakes since 2014.

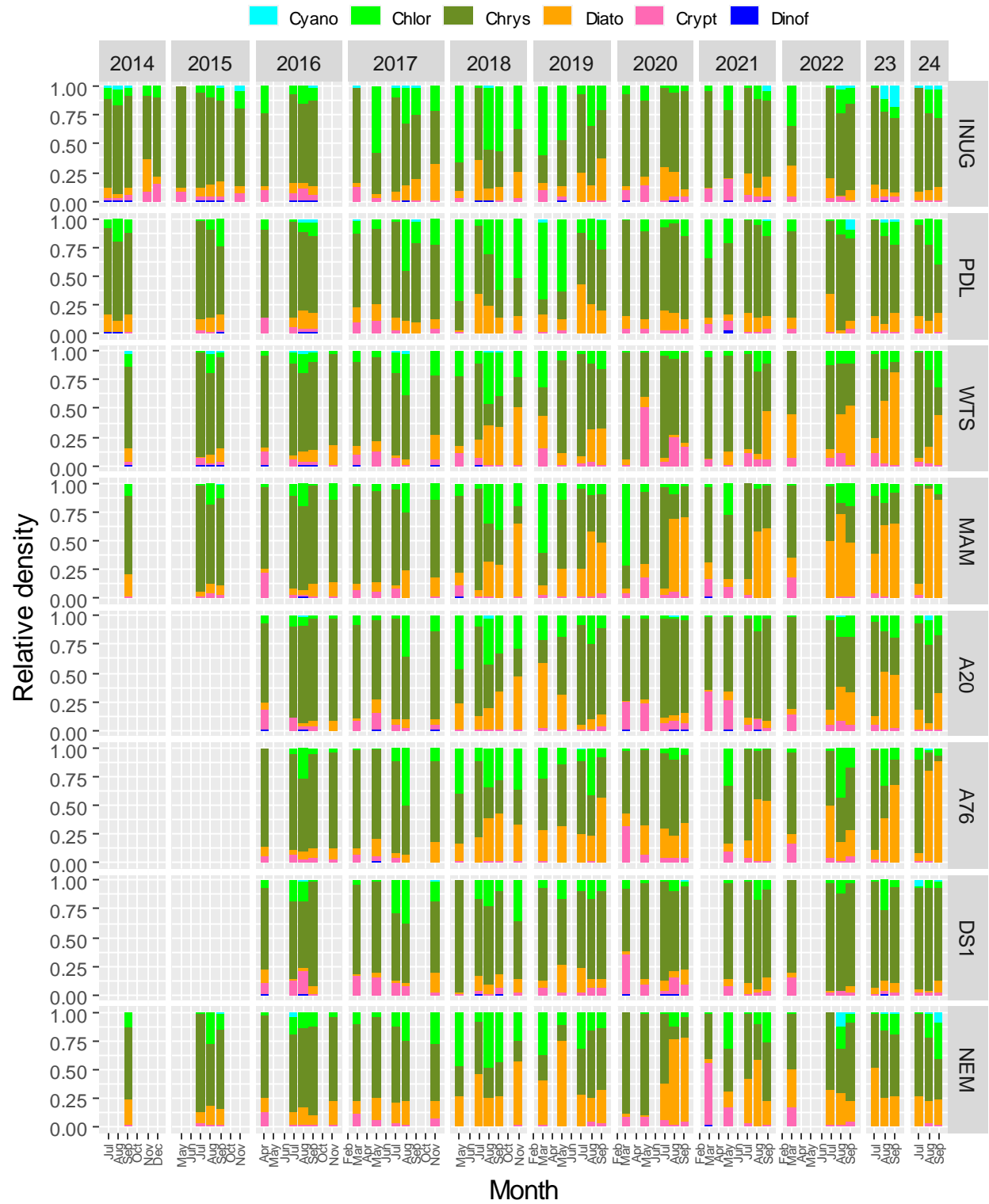
Figure E2-8. Relative phytoplankton density by major taxa group from Whale Tail study area lakes since 2014.

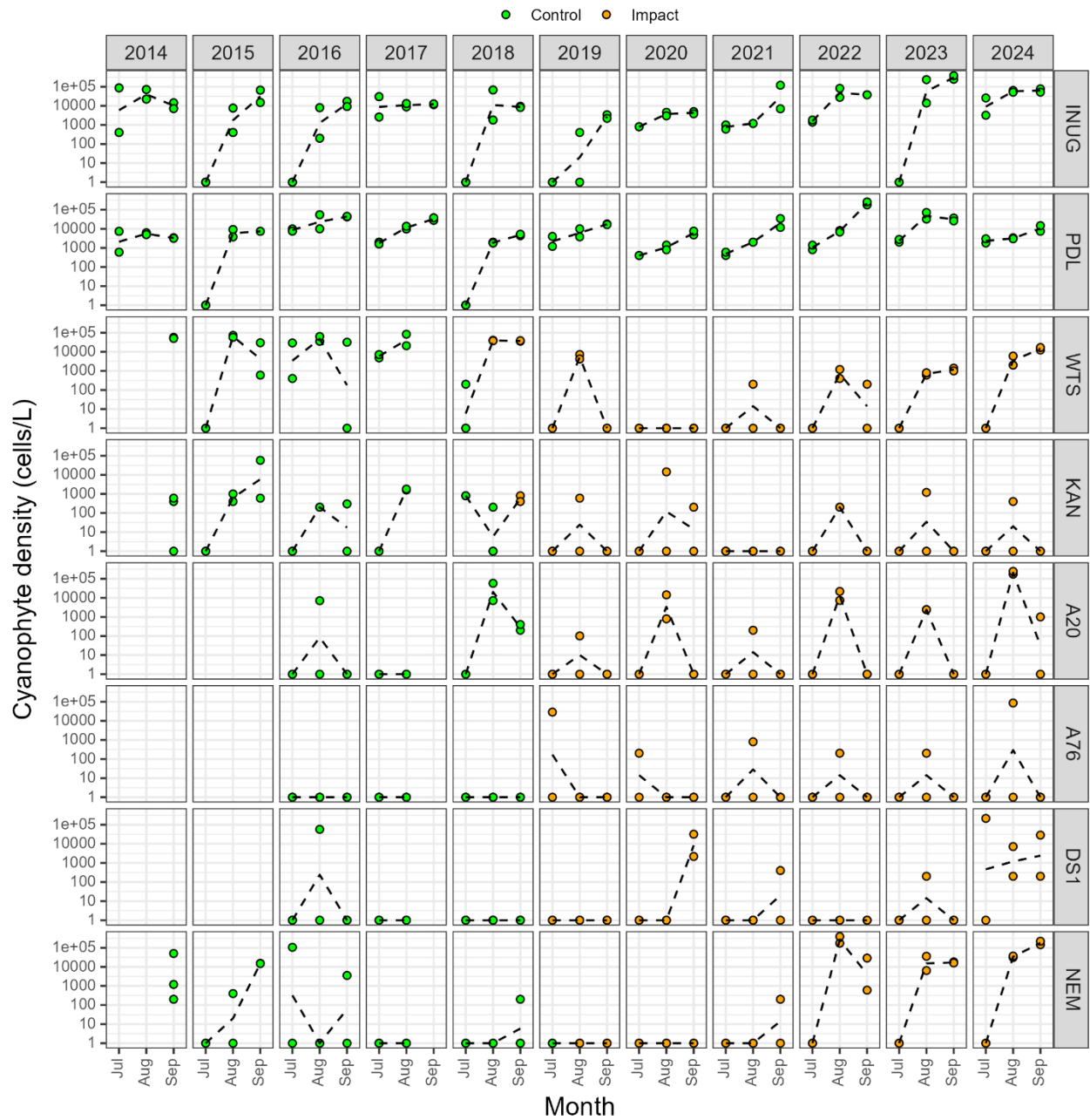
Figure E2-9. Cyanophyte density (cells/L) from Whale Tail study area lakes since 2014.

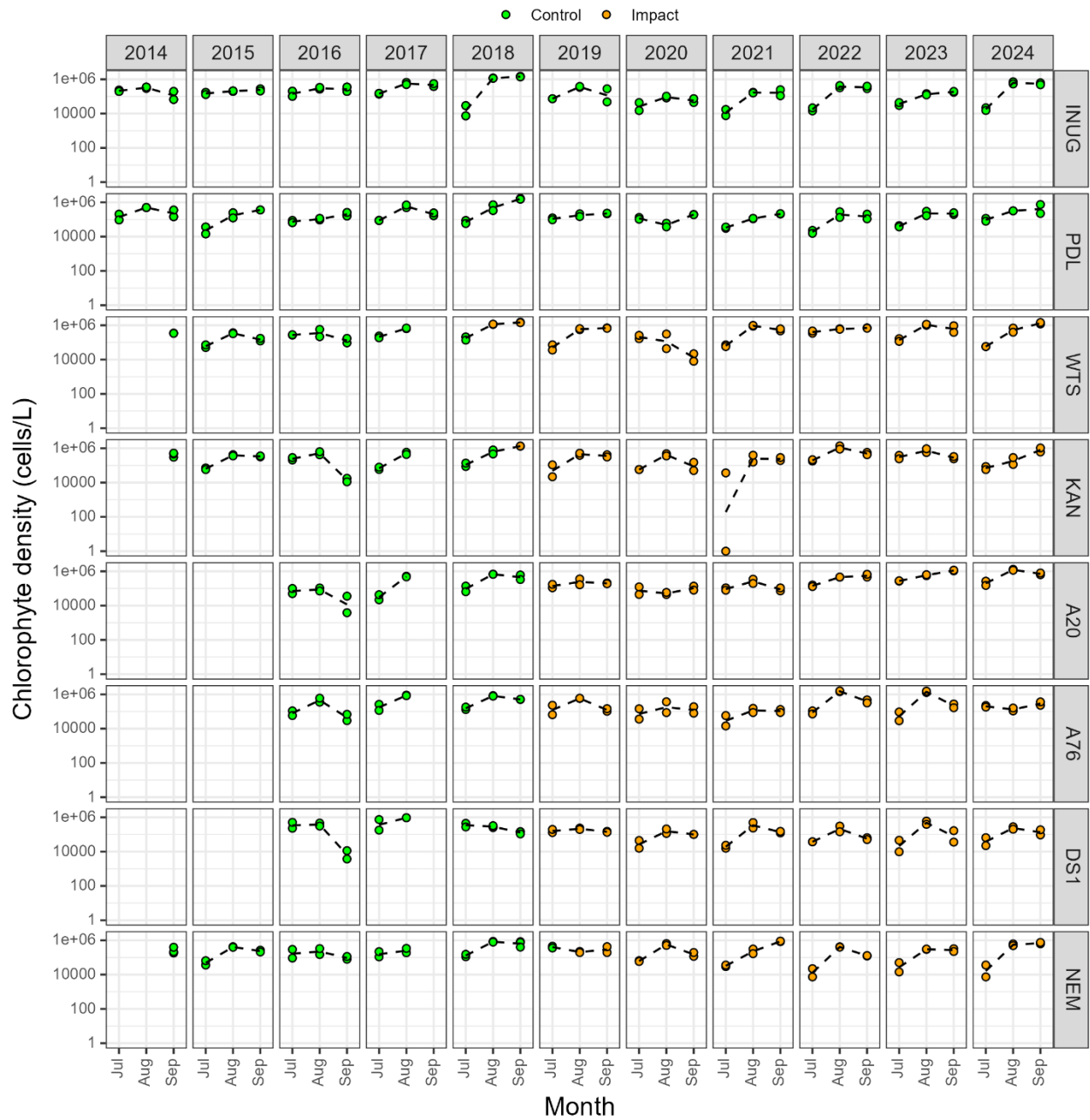
Figure E2-10. Chlorophyte density (cells/L) from Whale Tail study area lakes since 2014.

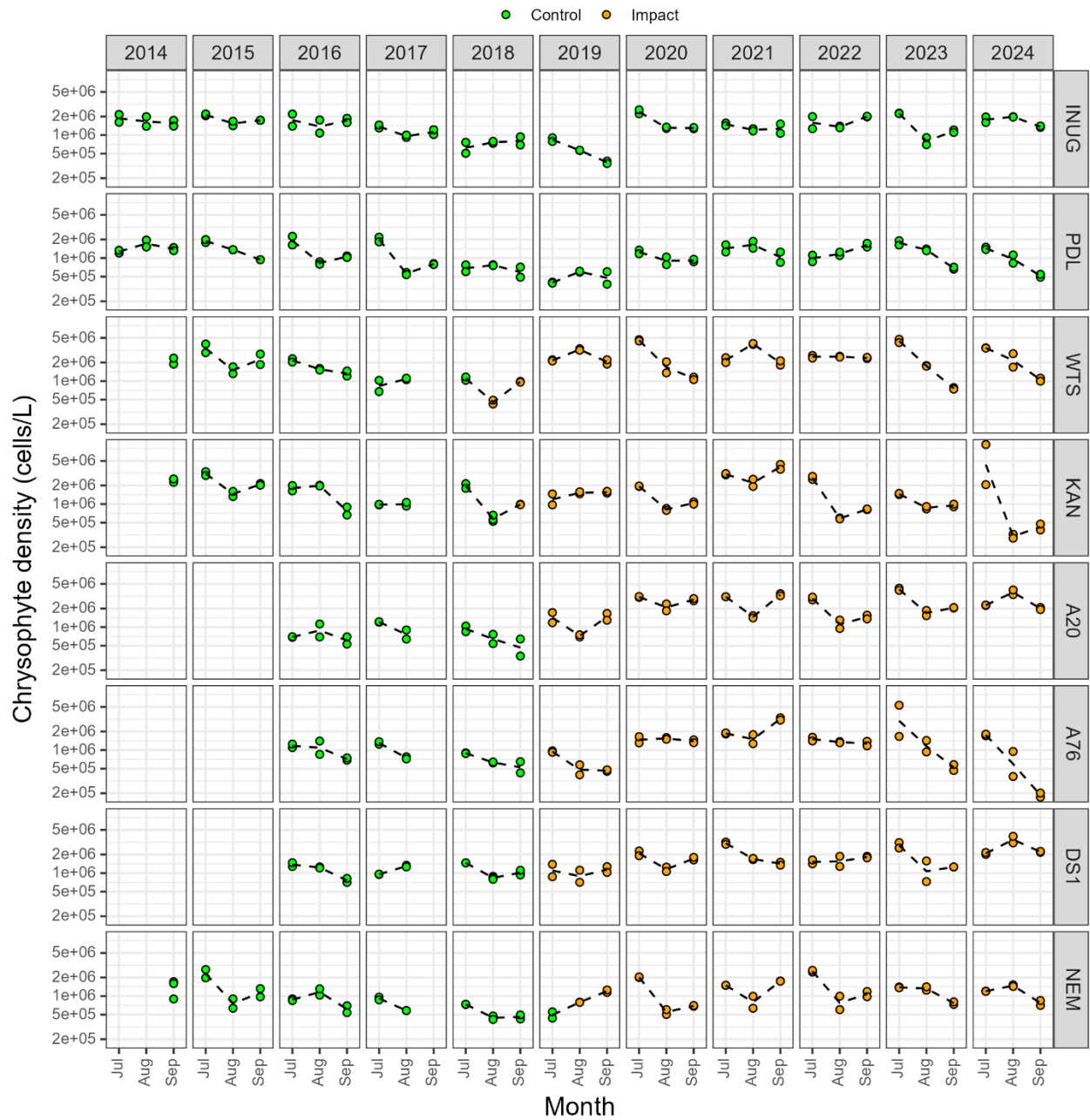
Figure E2-11. Chrysophyte density (cells/L) from Whale Tail study area lakes since 2014.

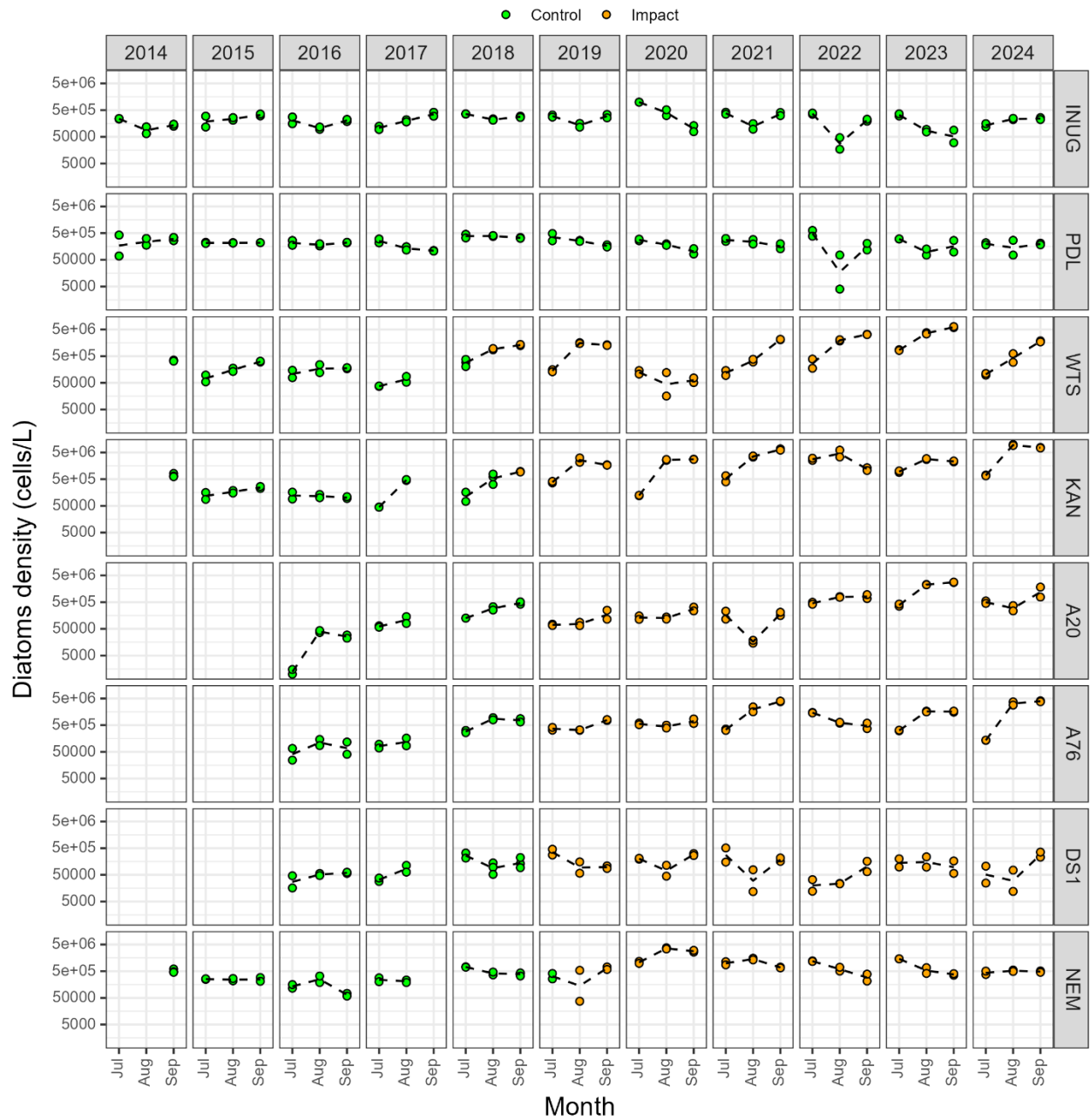
Figure E2-12. Diatoms density (cells/L) from Whale Tail study area lakes since 2015.

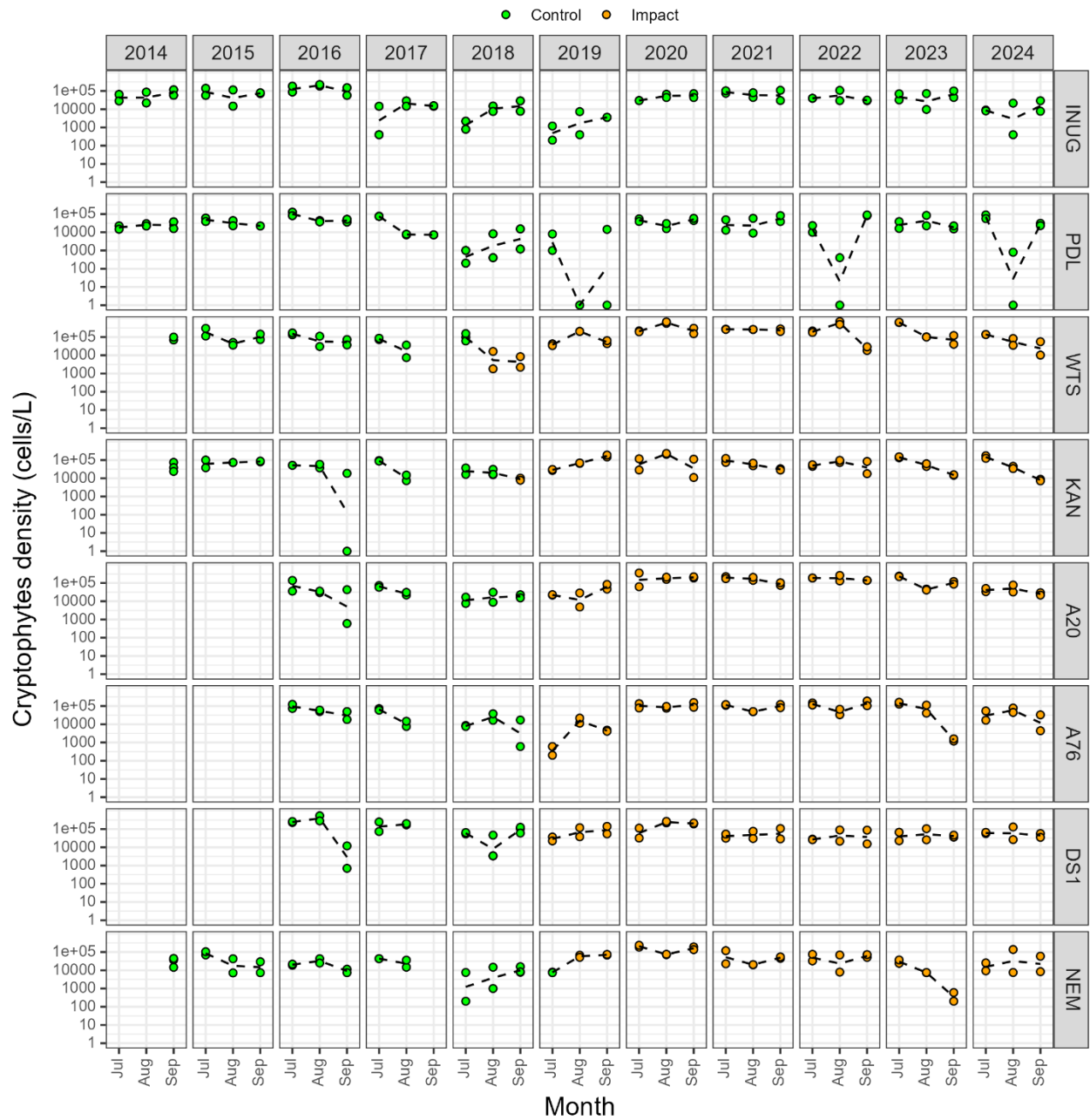
Figure E2-13. Cryptophytes density (cells/L) from Whale Tail study area lakes since 2015.

Figure E2-14. Dinoflagellates density (cells/L) from Whale Tail study area lakes since 2014.

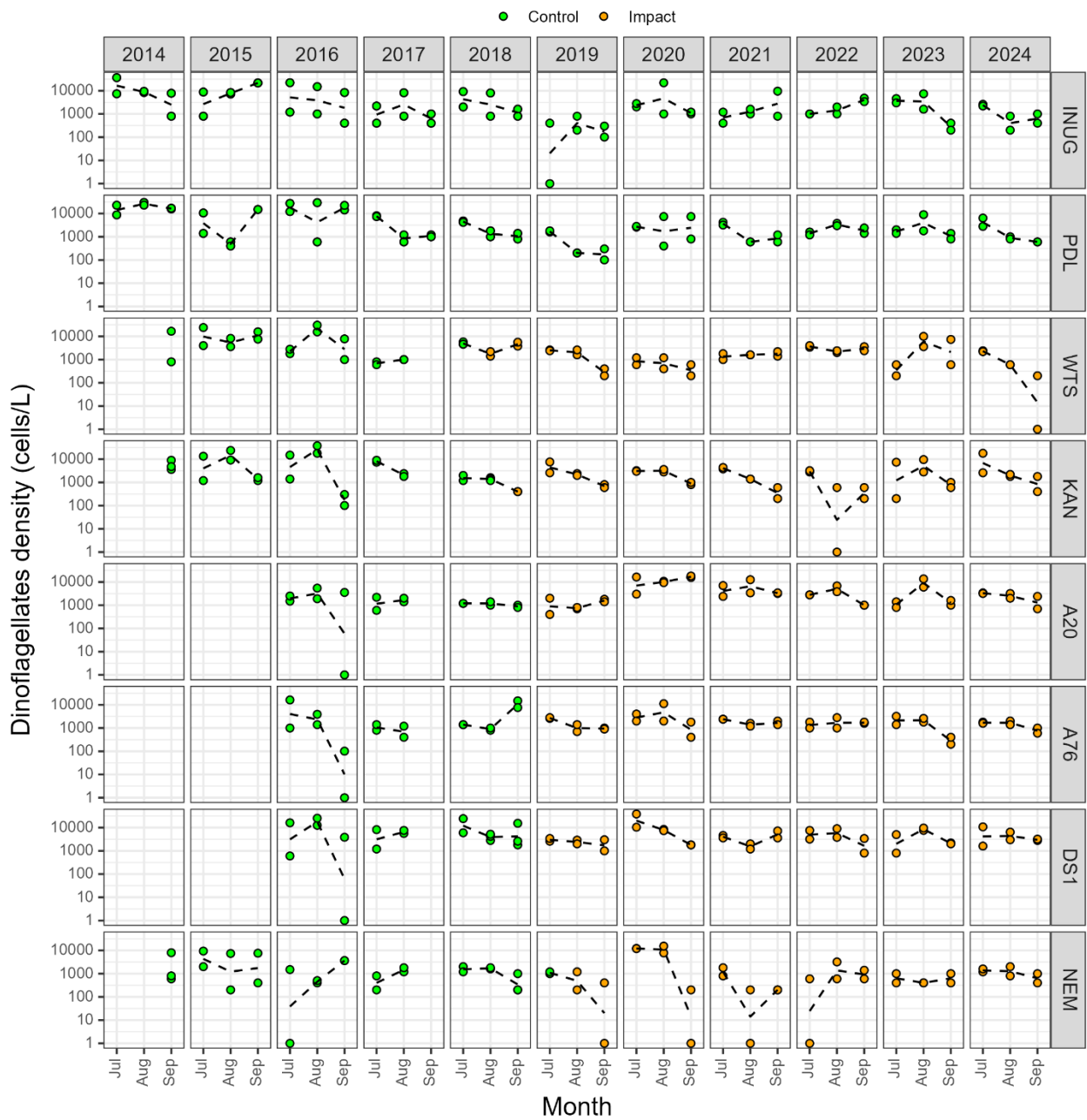


Figure E2-15. Simpsons' Diversity for the phytoplankton community from Whale Tail study area lakes since 2014.