

Real-Time Water Quality Report

Grieg NL Nurseries Ltd Monitoring Well

Annual Deployment:
January 23, 2024, to December 3, 2024



Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division

Prepared by:

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Grieg Monitoring Well

The Water Resources Management Division (WRMD) in partnership with Grieg NL Nurseries Ltd, maintain a real-time water quality groundwater monitoring station. The station is located near the Marystown YMCA and Track and Field Complex.

Grieg Seafood has two wells: a main production well that provides new water to the facility as needed; and a monitoring/backup well that houses the WRMD monitoring equipment. Both wells are functioning in good condition. In the event of a catastrophic failure of the main well, the monitoring well can serve as a backup.

To ensure the pump installed in the monitoring/backup well is functioning, the pump is operated periodically. Due to this groundwater well sharing its aquifer with the main pumping well, variations in the water parameters could be a result of pumping from either well. The water monitoring equipment, a YSI EXO1, is not removed during the pump test and as a result, there may be disruptions to the water quality data for a short period of time. Data can also be disrupted during routine calibration and maintenance of equipment by WRMD.



Figure 1: Location of Real-Time Groundwater Well



Figure 2: Hut Structure for groundwater well



Figure 3. View standing in front of well looking toward main road in Marystown, NL



Figure 4: Well Casing in the hut



Figure 5: View looking into well

Quality Assurance and Quality Control

WRMD staff (Environment & Climate Change (ECC)) are responsible for maintenance of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. Grab samples are collected at the beginning of each deployment period to compare against the initial in-situ logged data. The samples are collected from an internal tap located in the station hut. Grab samples complement the real-time data and provide an extra source of water quality data for comparisons when tracking changes over time at the station (Table 1). Combining both types of data can offer a more comprehensive understanding of the water quality.

Initial in-situ instrument measurements are recorded shortly after the freshly calibrated instrument is deployed. The limited time for the sonde to reach equilibrium with its surroundings can occasionally lead to variations in values between grab sample results and instrument measurements.

Table 1: Comparison of the In-Situ instrument vs. Grab Sample Results at deployment of new instrument

Date	Parameter	Grab Sample Result	In-Situ Instrument
January 23, 2024	pH (pH units)	8.02	7.85
	Specific Conductivity (µS/cm)	310	295.02
April 3, 2024	pH (pH units)	7.99	7.57
	Specific Conductivity (µS/cm)	430	358.25
July 4, 2024	pH (pH units)	7.99	7.42
	Specific Conductivity (µS/cm)	360	445.84
August 6, 2024	pH (pH units)	8.02	7.57
	Specific Conductivity (µS/cm)	300	298.06
December 3, 2024	pH (pH units)	7.99	7.42
	Specific Conductivity (µS/cm)	340	307.33

Grieg Monitoring Well Water Quality Parameters

Water Temperature

Between January 23, 2024, and December 3, 2024, the water temperature fluctuated within the range of 7.30°C to 7.84°C throughout the deployment period, as illustrated in Figure 6. The annual average water temperature was recorded at 7.44°C.

The water temperatures remain consistent throughout the year of data. Due to the depth of the instrument in the well, there is very little influence from air temperatures on the water, therefore there is minimal variance between the minimum and maximum values.

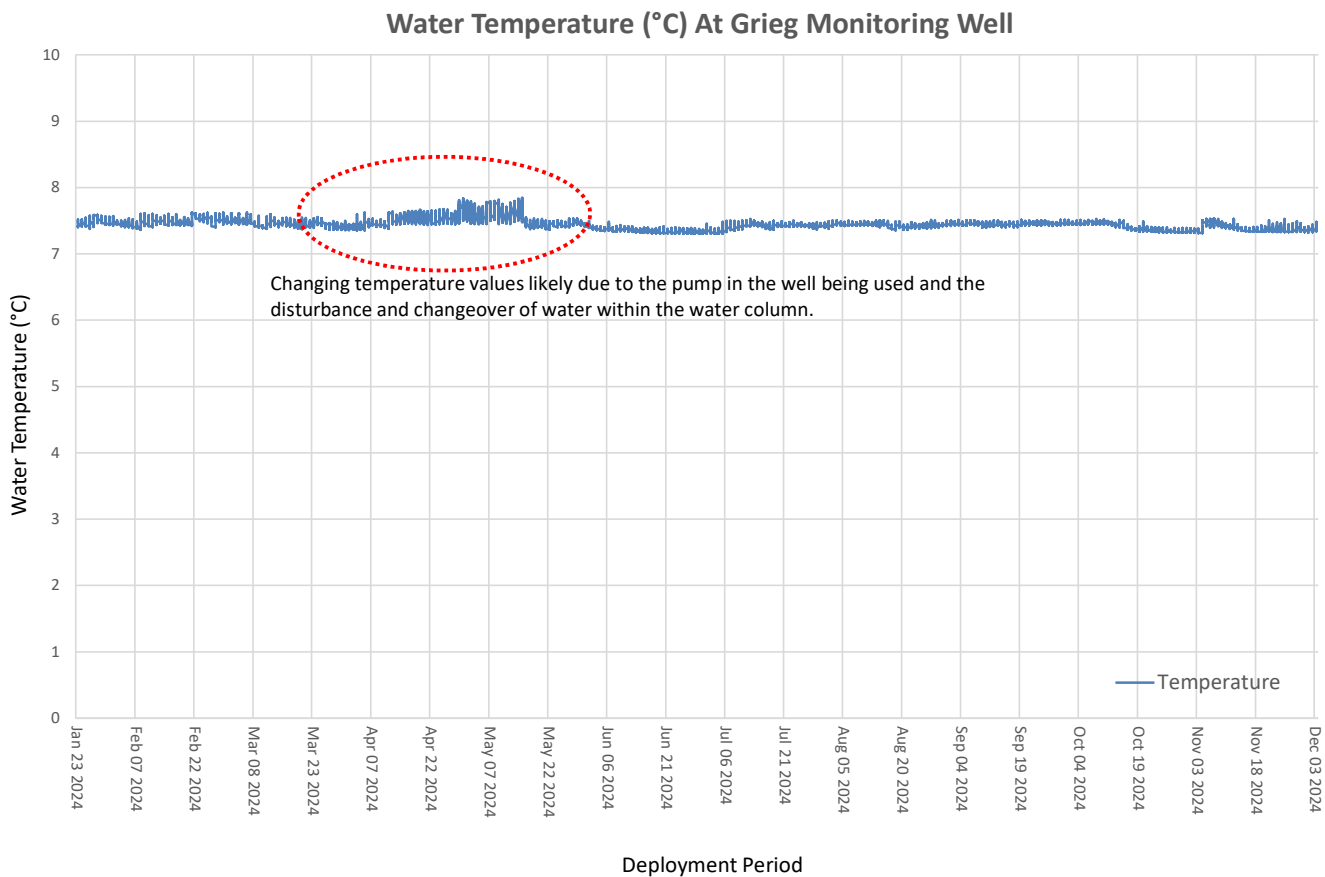


Figure 6: Water temperature (°C) values

pH

Between January 23, 2024, and December 3, 2024, pH values exhibited a range from 7.18 pH units to 8.01 pH units. Throughout the deployment year, pH remained reasonably consistent, with an average of 7.69 pH units.

A pH sensor measures the acidity or alkalinity of a water body and is a measure of the concentration of hydrogen ions (H^+) in a solution. Minor pH fluctuations were likely a consequence of aquifer pumping activities. The well's refilling process and subsequent level adjustments led to temporary variations in pH levels, as depicted in Figure 7.

The red points on the graph denote pH values derived from grab samples, offering complementary insights to the in-situ monitoring conducted by the water quality instrument (refer to Table 1). It is anticipated that there may be slight disparities between the pH values obtained from grab samples and the water quality instrument. Variations in the data could be attributed to factors such as delayed analysis of grab samples over several days and the pumping of the well before collecting grab samples, which may disturb the water column.

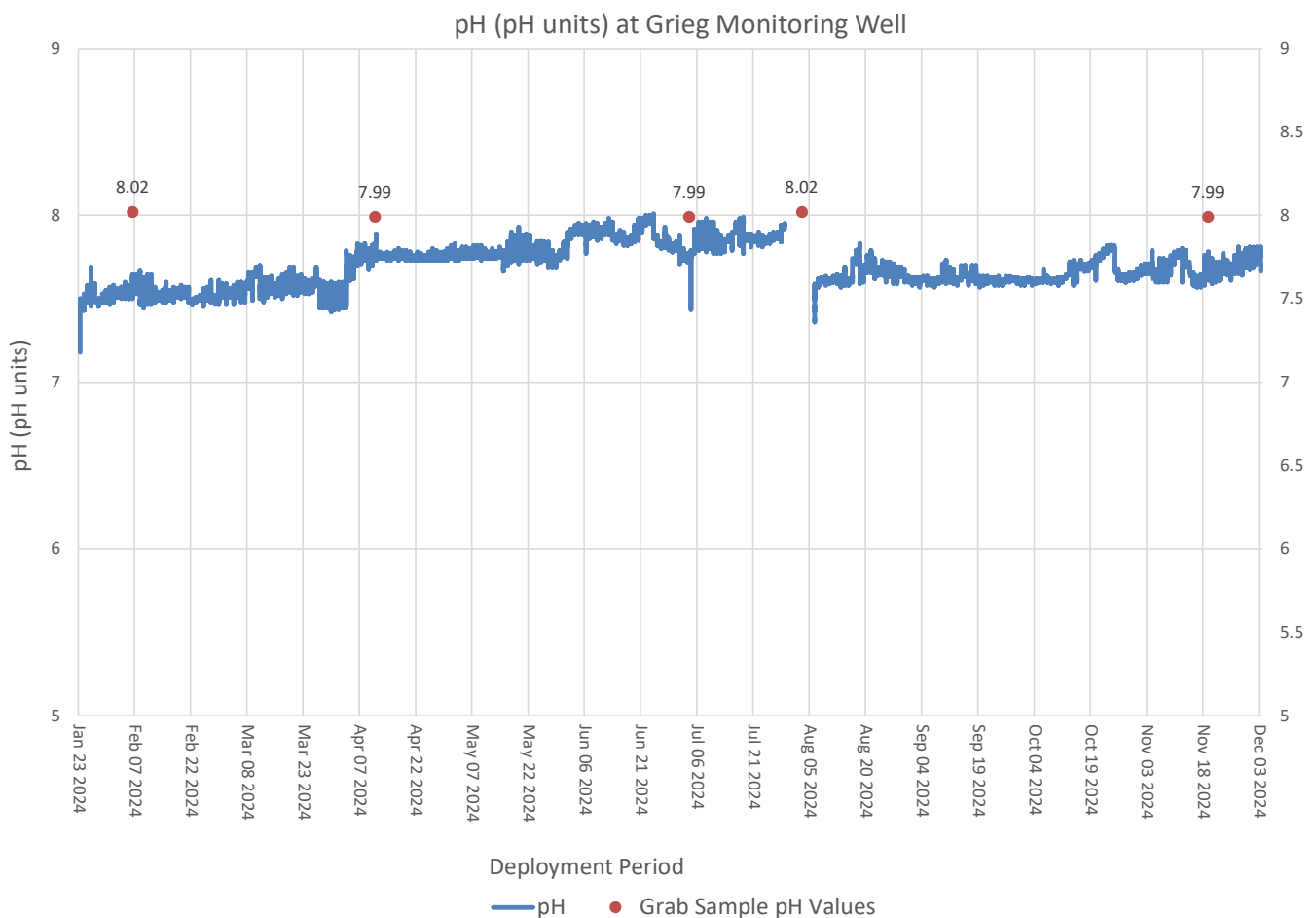


Figure 7: pH (pH units) values

Specific Conductivity & Total Dissolved Solids (TDS)

Throughout the annual deployment season, conductivity levels were within 252.68 $\mu\text{S}/\text{cm}$ and 574.20 $\mu\text{S}/\text{cm}$ (Figure 8), with an average of 319.42 $\mu\text{S}/\text{cm}$. The specific conductivity probe measures the presence of diluted salts and inorganic materials in a water source. In instances where there is minimal or no external influence, the conductivity in the groundwater well remains relatively stable, experiencing minimal fluctuations (Figure 8). Elevated spikes in conductivity are likely attributed to pumping activities and disturbances within the aquifer which can disturb the water column (Figure 9).

The red points on the graph represent the specific conductivity results from the grab samples collected at the beginning of a deployment (Table 1). It is expected that there would be some differences between the in-situ data and the grab sample data. Variations in the data can arise due to factors such as delayed analysis of grab samples spanning several days, as well as the pumping of the well prior to collecting grab samples.

Total Dissolved Solids data is derived from the specific conductivity data. The water quality instrument is programmed to calculate an estimated TDS value from a conductivity value. TDS data will mirror the movement of the specific conductivity data, however the TDS is calculated in g/L (Figure 10). For the deployment year, TDS ranged within 0.16 g/L to 0.57 g/L.

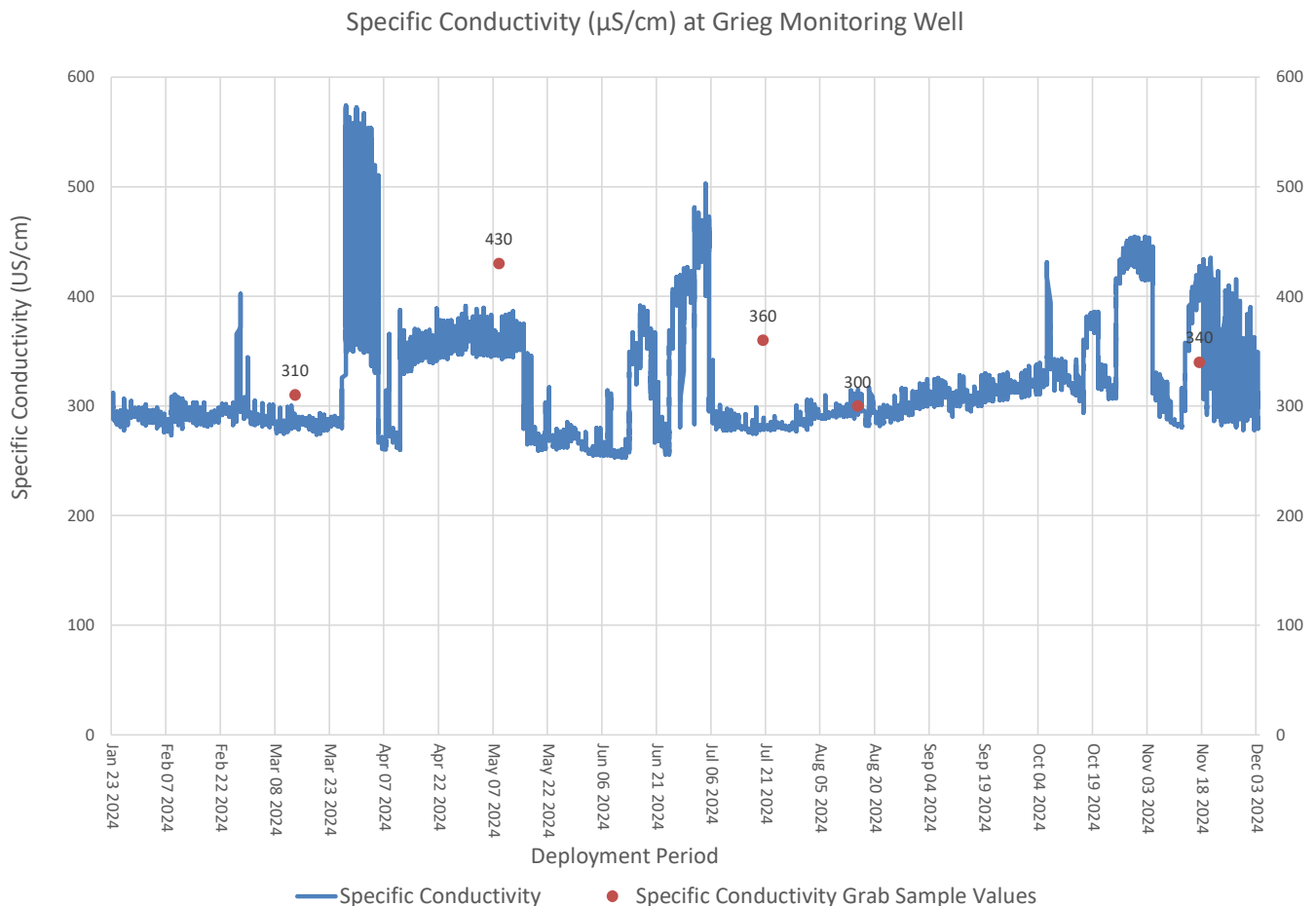


Figure 8: Specific conductivity ($\mu\text{S}/\text{cm}$) values

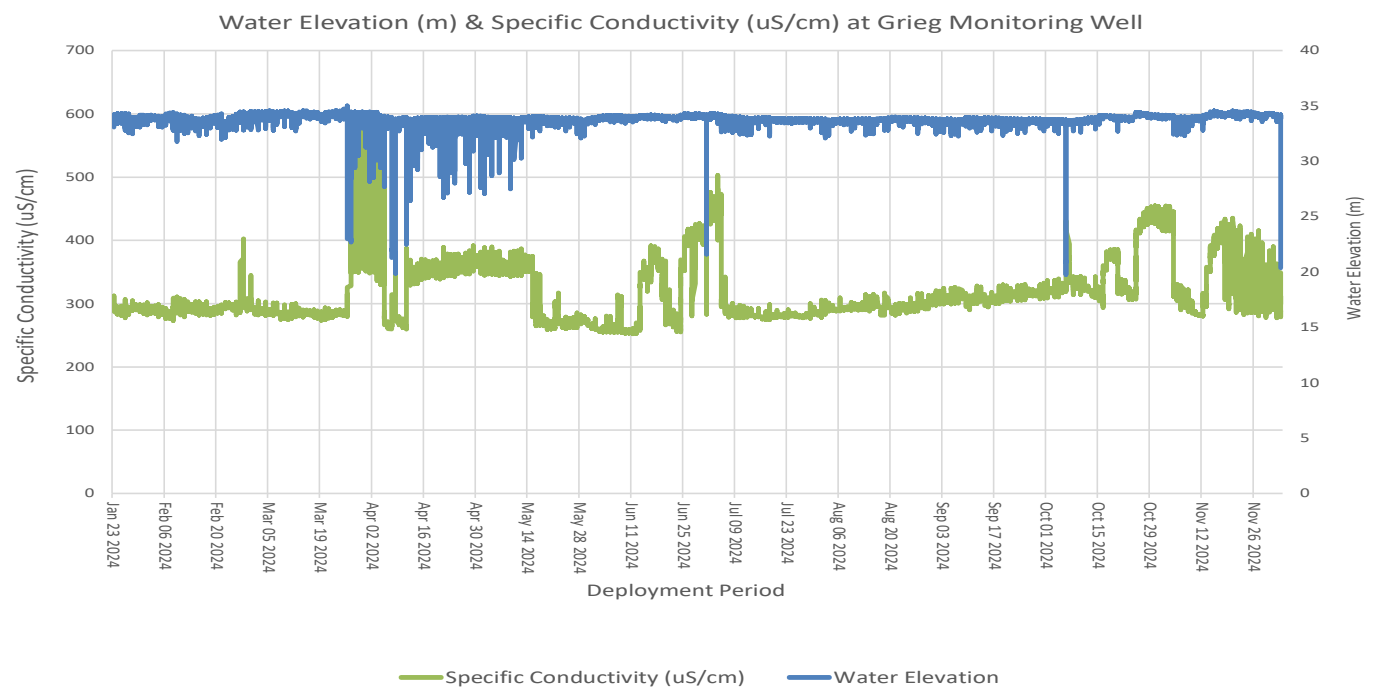


Figure 9: Annual Specific Conductivity & Water Elevation

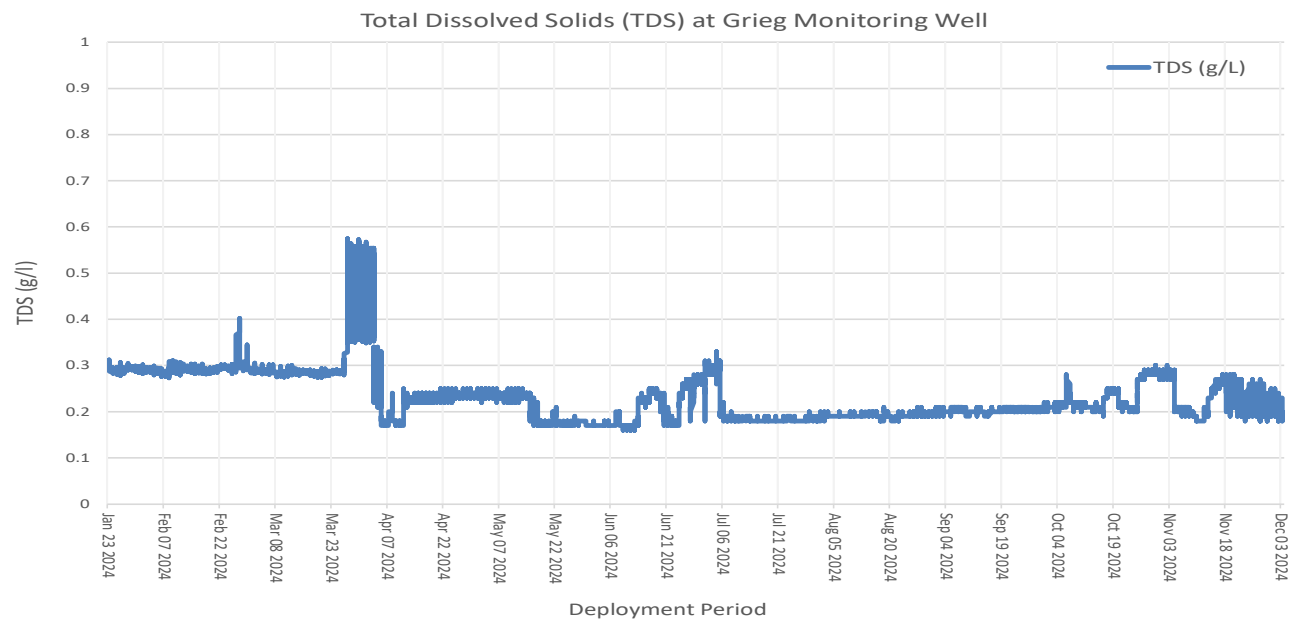


Figure 10: Total Dissolved Solids (TDS)

Oxidation-Reduction Potential (ORP)

ORP levels during the year of deployment ranged within 31.90 mV to 480.10 mV, with an average of 314.23 mV, a decrease from the 2023 average of 322.66 mV (Table 2, Appendix I). As expected, due to periodic pumping of the well, fluctuations in ORP levels were observed, but values generally remained within typical ranges over the course of the year. The variations in ORP values throughout the deployment are visually evident in Figure 11, showcasing dips and increases. It's worth noting that ORP can take days to weeks to equilibrate in groundwater, which may explain the lower values observed at the beginning of each deployment period.

ORP, measuring the oxidizing-reduction potential of groundwater, plays a crucial role in identifying the mobility and persistence of contaminants that could impact water quality. The values can be influenced by local conditions, the presence of specific contaminants, and the geochemical characteristics of the aquifer. Natural aquifer materials may release specific chemicals, leading to concentration changes over time. pH and ORP are inversely related, therefore pH can also play a role in influencing ORP (Figure 12). ORP values are unique to each water body and collecting background data is essential for understanding the significance of changes in the data and their potential implications.

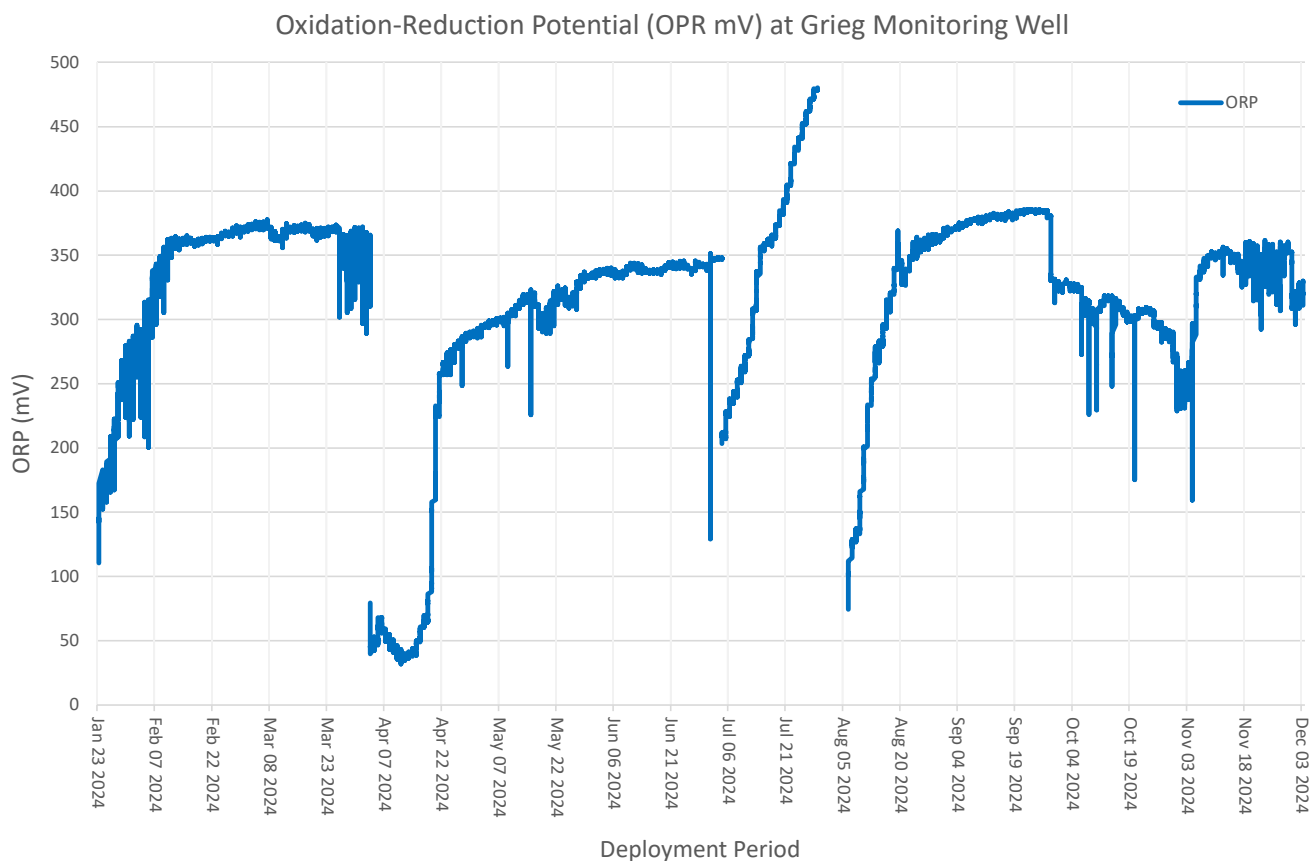


Figure 11: ORP values (mV)

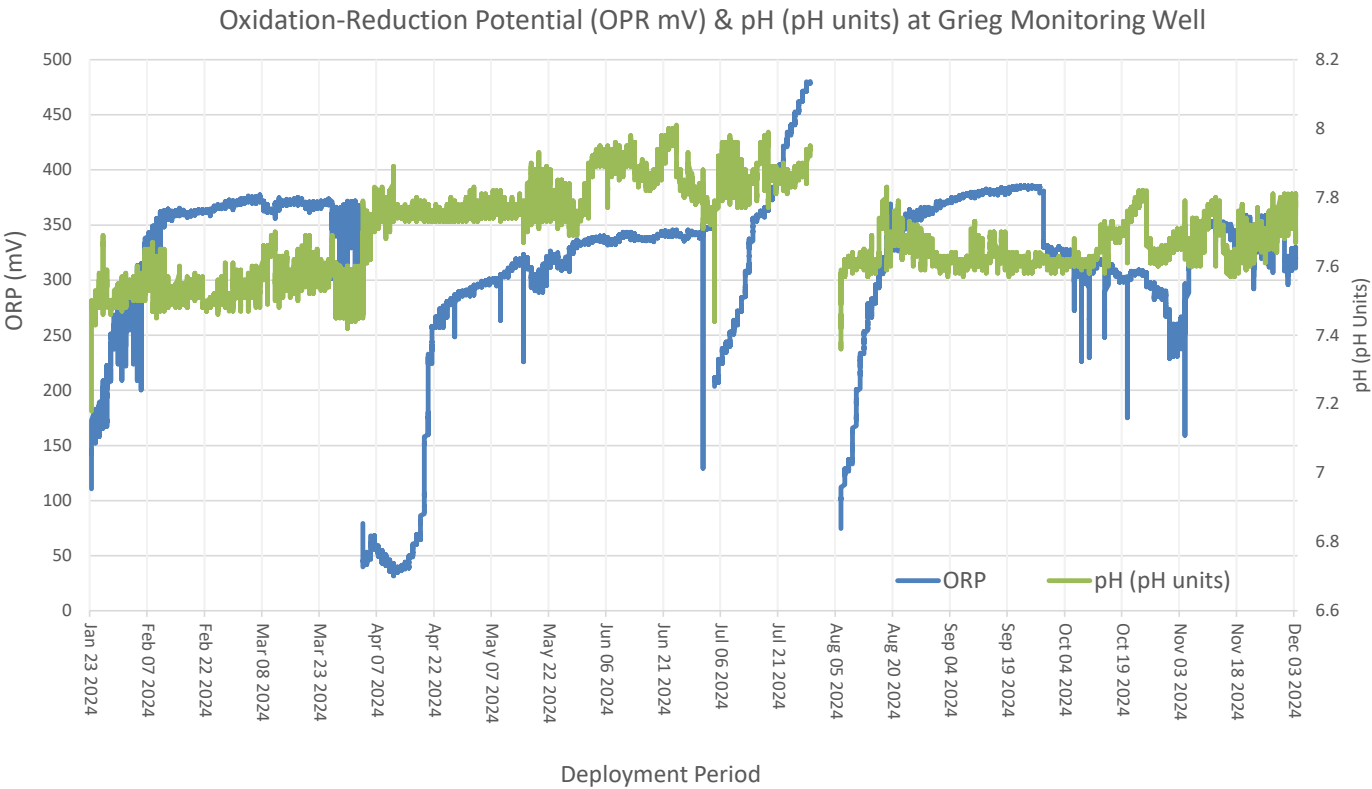


Figure 12: ORP (mV) graphed with pH (pH units) at Grieg Monitoring Well

Water Elevation

Water Elevation monitors the height of the water surface in the well measured to an assumed datum. Water Elevation at the monitoring well, ranged within 19.77 m to 35.02 m throughout the year of deployment, with an annual average of 33.73 m. Generally, the water elevation within this groundwater well remains constant. This well and its aquifer are intermittently accessed through pumping. There will be fluctuations in water elevation during deployment (Figure 13). Despite the larger dips in water elevation, the range of the elevation was reasonably consistent across deployment.

Fluctuations in the water elevation do influence the other water parameters covered in this report (Figure 14). Figure 14 displays this relationship.

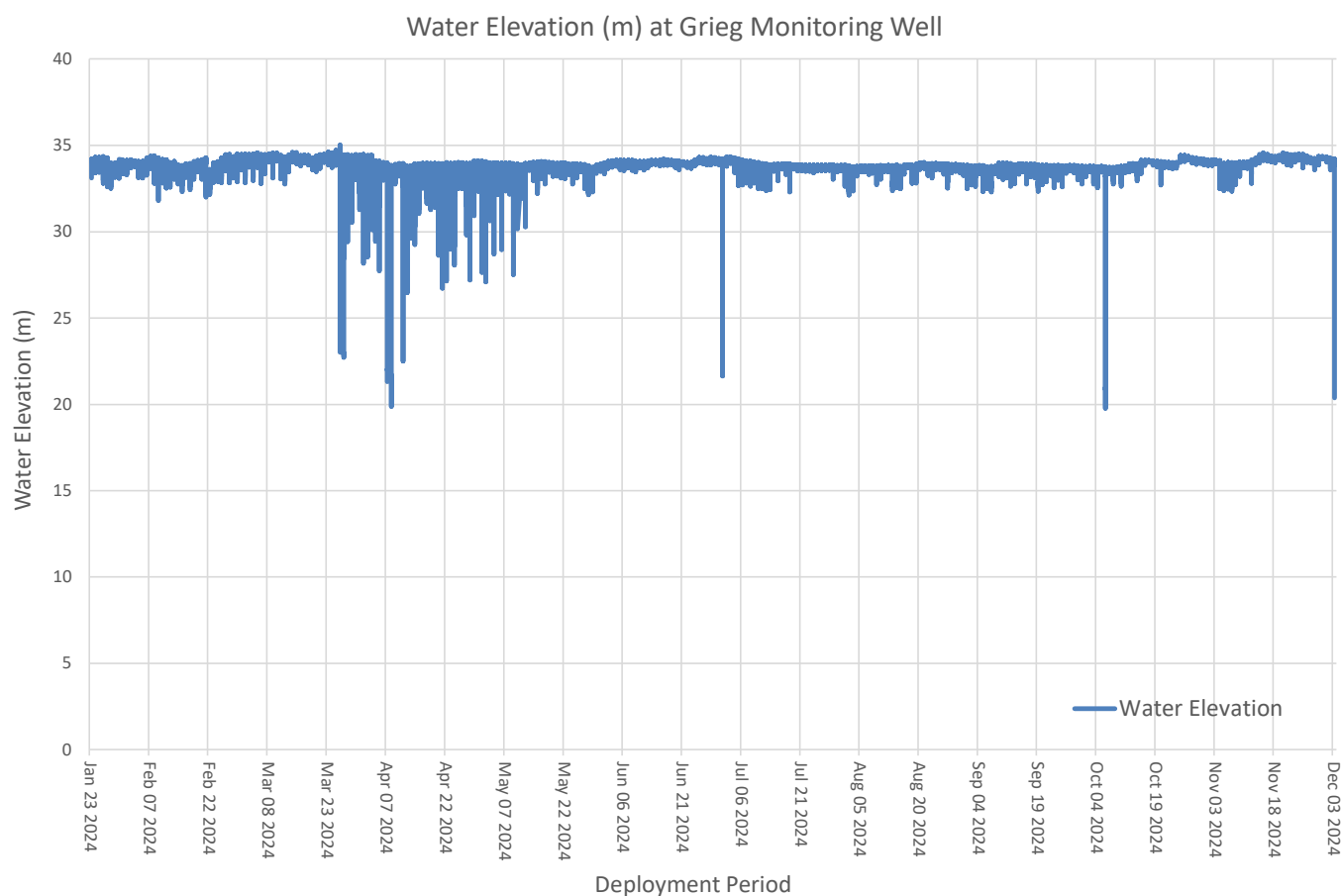


Figure 13: Water Elevation (m)

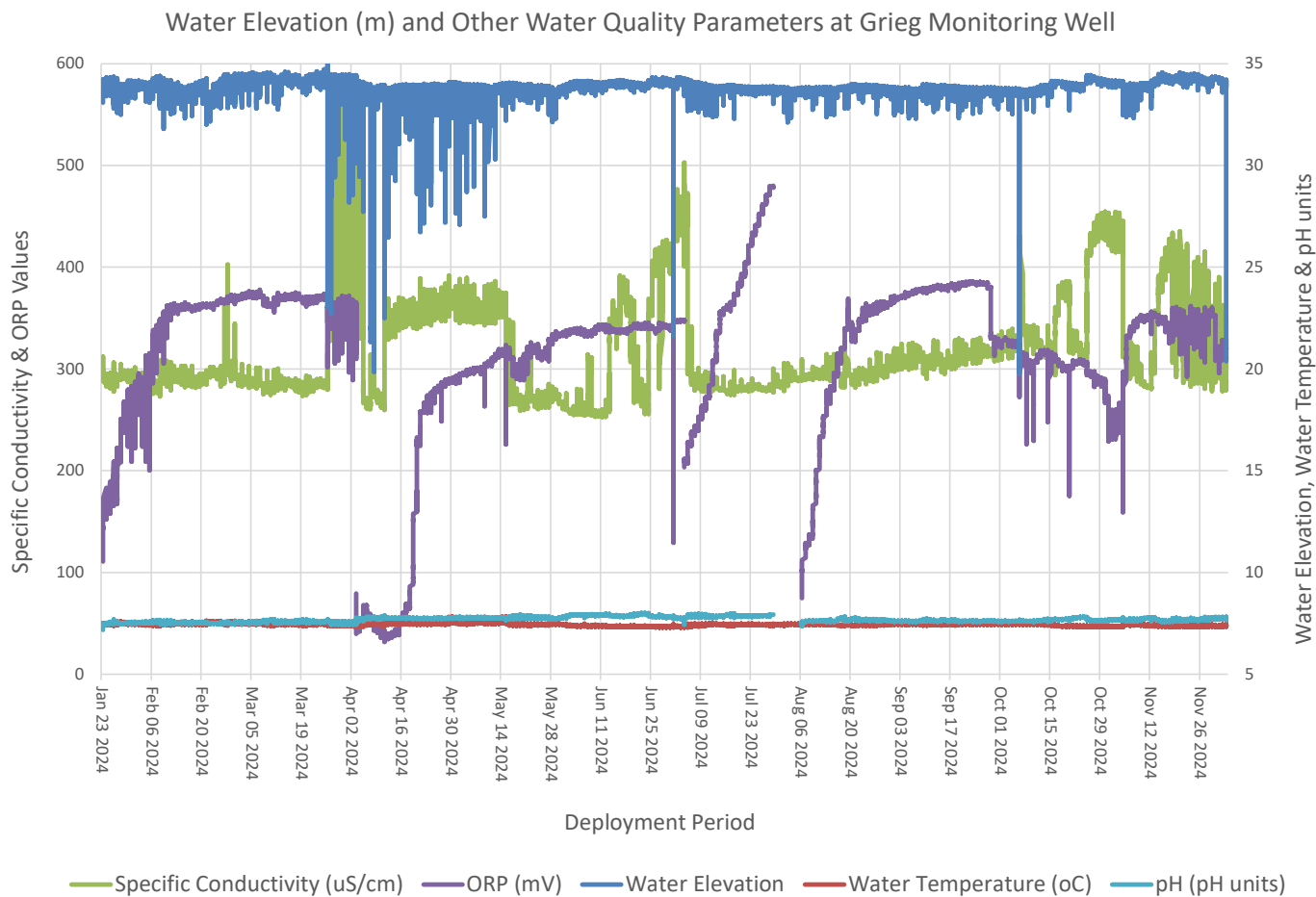


Figure 14: Water Elevation (m) and other water quality parameters.

Conclusion

The comprehensive monitoring of various parameters, including pH, conductivity, Total Dissolved Solids (TDS), and Oxidation-Reduction Potential (ORP) throughout 2024 has provided valuable insights into the dynamic nature of the groundwater well and its aquifer. Collecting background data is crucial for recognizing potential concerns in a water body. Different areas may have specific parameters that are inherent to their natural conditions but might appear abnormal elsewhere. It is essential to monitor and document background data of water bodies that are influenced by anthropogenic activity.

The water elevation measurements consistently demonstrated stability within an expected range, even amidst sporadic pumping activities. The pH levels exhibited relative consistency with minor fluctuations, and the specific conductivity and TDS data remained consistent other than periodic elevated spikes which corresponded with pumping events. The ORP levels showcased expected variations, underscoring the importance of continued monitoring to understand contaminant mobility and persistence. The integration of grab sample data, represented by red points on the graphs, complemented the in-situ monitoring, albeit acknowledging slight differences due to factors like delayed analysis and well pumping disturbances.

Other than the pumping of the aquifer and the management of the instrumentation in the well, there was no indication of any other external factors influencing the water quality parameters of this station. Given that this station is four years old, a better baseline dataset for water quality parameters will be established as the monitoring of this site continues.

Moving forward into the 2025 season, WRMD will maintain its schedule of maintenance and calibration activities approximately every 10-12 weeks, along with site visits in between when necessary to address any issues that arise.

Appendix I

Table 1.

2024 Water Quality Statistics for Grieg Groundwater Well

January 23, 2024, to December 3, 2024

Water Quality Parameters	Minimum	Maximum	Median	Mean
Water Temperature (°C)	7.3	7.84	7.44	7.44
pH (pH units)	7.18	8.01	7.68	7.69
Specific Conductivity (µS/cm)	252.68	574.2	300.15	319.42
Total Dissolved Solids (g/L)	0.16	0.57	0.21	0.23
ORP (mV)	31.9	480.1	337.3	314.23
Water Elevation (m)	19.77	35.02	33.89	33.73

Table 2.

Data Comparison: Average Annual Water Quality Parameters Across Previous Deployment Years

Parameter	2021	2022	2023	2024
Water Temperature (°C)	7.254	7.325	7.4	7.44
pH (pH units)	7.63	7.55	7.56	7.69
Specific Conductivity (µS/cm)	288.8	284.95	287.6	319.42
Total Dissolved Solids (g/L)	0.18	0.19	0.19	0.23
ORP (mV)	265.9	288.7	322.66	314.23
Water Elevation (m)	32.16	33.59	33.19	33.73

Appendix II

Grab Sample Results 2024

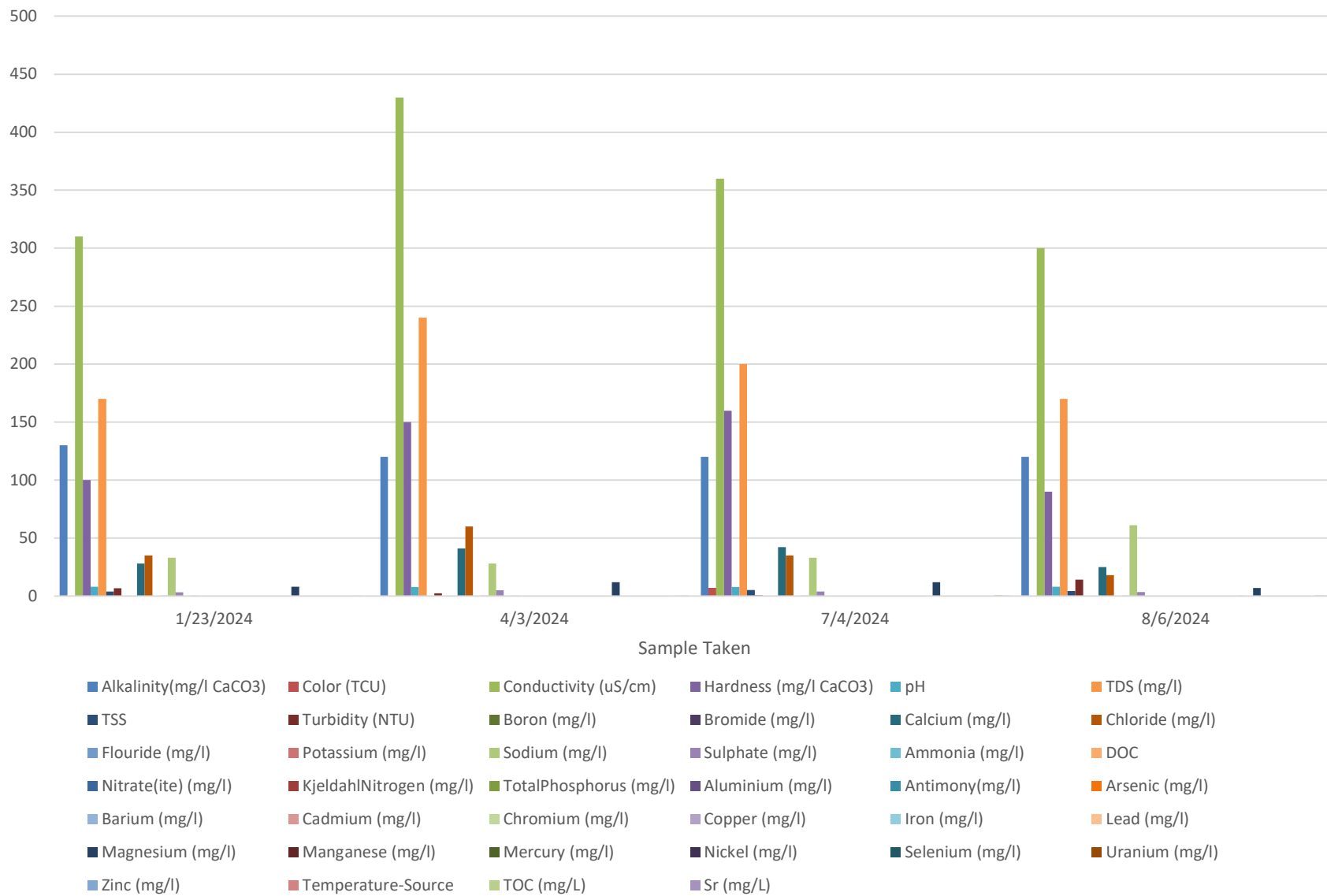


Figure 15. Graph of all parameters captured with the grab samples taken in 2024

GRAB SAMPLE RESULTS 2024

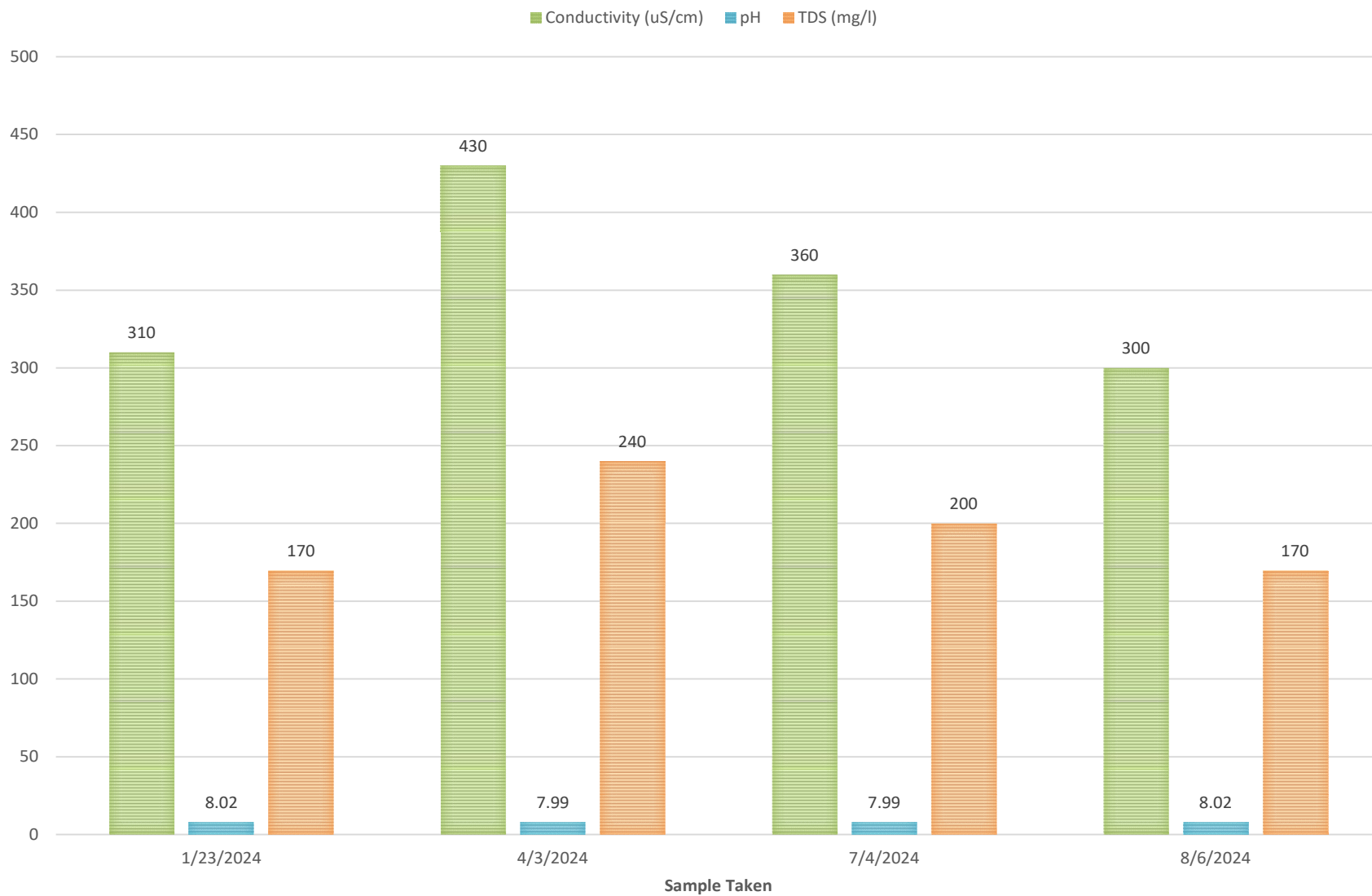


Figure 16. Graph of the parameters used for QAQC Comparison



Your P.O. #: 220028978-9
Your C.O.C. #: N/A, 2024-1900-00-SI-SP

Attention: Robert Richard Harvey

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
St. John's, NL
CANADA A1B 4J6

Report Date: 2024/02/05
Report #: R8016239
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C427216

Received: 2024/01/29, 09:41

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	1	N/A	2024/01/30	ATL SOP 00142	SM 24 2320 B
Anions (1)	1	N/A	2024/02/01	CAM SOP-00435	SM 23 4110 B m
Colour	1	N/A	2024/01/30	ATL SOP 00020	SM 24 2120C m
Organic carbon - Diss (DOC) (2)	1	N/A	2024/01/31	ATL SOP 00203	SM 24 5310B m
Conductance - water	1	N/A	2024/01/30	ATL SOP 00004	SM 24 2510B m
Fluoride	1	N/A	2024/01/30	ATL SOP 00043	SM 24 4500-F- C m
Hardness (calculated as CaCO3)	1	N/A	2024/02/01	ATL SOP 00048	Auto Calc
Mercury - Total (CVAA,LL)	1	2024/01/29	2024/01/30	ATL SOP 00026	EPA 245.1 R3 m
Metals Water Total MS	1	2024/01/30	2024/01/31	ATL SOP 00058	EPA 6020B R2 m
Nitrogen Ammonia - water	1	N/A	2024/01/30	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2024/01/31	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2024/01/31	ATL SOP 00017	SM 24 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2024/01/31	ATL SOP 00018	ASTM D3867-16
pH (3)	1	N/A	2024/01/30	ATL SOP 00003	SM 24 4500-H+ B m
Calculated TDS (DW Pkg)	1	N/A	2024/01/31	N/A	Auto Calc
Total Kjeldahl Nitrogen in Water (1)	1	2024/01/31	2024/02/02	CAM SOP-00938	OMOE E3516 m
Organic carbon - Total (TOC) (2)	1	N/A	2024/01/31	ATL SOP 00203	SM 24 5310B m
Total Phosphorus (Colourimetric) (1)	1	2024/01/31	2024/02/02	CAM SOP-00407	SM 24 4500-P I
Total Suspended Solids	1	2024/01/30	2024/01/31	ATL SOP 00007	SM 24 2540D m
Turbidity	1	N/A	2024/01/31	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8

(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

(3) The APHA Standard Method requires pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.



BUREAU
VERITAS

Bureau Veritas Job #: C427216

Report Date: 2024/02/05

NL Department of Environment, Climate Change and

Municipalities

Your P.O. #: 220028978-9

Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
YFR518 GRIEG MONITORING WELL								
Sampling Date 2024/01/23 14:15								
Matrix W								
Sample # 2024-1900-00-SI-SP								
Registration # SA-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO ₃)	-	100	1.0	mg/L	N/A	2024/02/01		9187658
Nitrate (N)	-	0.14	0.050	mg/L	N/A	2024/01/31		9187661
Total dissolved solids (calc., EC)	-	170	1.0	mg/L	N/A	2024/01/31		9187779
Inorganics								
Conductivity	-	310	1.0	uS/cm	N/A	2024/01/30	LJV	9189754
Chloride (Cl ⁻)	-	35	1.0	mg/L	N/A	2024/02/01	LKH	9193756
Bromide (Br ⁻)	-	ND	1.0	mg/L	N/A	2024/02/01	LKH	9193756
Sulphate (SO ₄)	-	3.4	1.0	mg/L	N/A	2024/02/01	LKH	9193756
Total Alkalinity (Total as CaCO ₃)	-	130	2.0	mg/L	N/A	2024/01/30	LJV	9189756
Colour	-	ND	5.0	TCU	N/A	2024/01/30	M2C	9190241
Dissolved Fluoride (F ⁻)	-	0.10	0.10	mg/L	N/A	2024/01/30	LJV	9189753
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2024/01/31	2024/02/02	KJP	9194628
Dup.Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2024/01/31	2024/02/02	KJP	9194628
Nitrate + Nitrite (N)	-	0.15	0.050	mg/L	N/A	2024/01/31	MCN	9190243
Nitrite (N)	-	0.018	0.010	mg/L	N/A	2024/01/31	MCN	9190247
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/01/30	HGV	9189789
Dissolved Organic Carbon (C)	-	0.51	0.50	mg/L	N/A	2024/01/31	CPP	9190844
Total Organic Carbon (C)	-	0.55	0.50	mg/L	N/A	2024/01/31	CPP	9190829
pH	-	8.02		pH	N/A	2024/01/30	LJV	9189752
Total Phosphorus	-	ND	0.004	mg/L	2024/01/31	2024/02/02	SPC	9194658
Total Suspended Solids	-	4.0	1.0	mg/L	2024/01/30	2024/01/31	ADD	9189807
Turbidity	-	6.6	0.10	NTU	N/A	2024/01/31	LJV	9192429
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	0.000015	0.000013	mg/L	2024/01/29	2024/01/30	SGK	9188238
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.012	0.0050	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Arsenic (As)	-	0.0011	0.0010	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Barium (Ba)	-	0.077	0.0010	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Boron (B)	-	ND	0.050	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Calcium (Ca)	-	28	0.10	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Copper (Cu)	-	0.00091	0.00050	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Iron (Fe)	-	0.38	0.050	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Magnesium (Mg)	-	8.1	0.10	mg/L	2024/01/30	2024/01/31	MOA	9190111



BUREAU
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Bureau Veritas Job #: C427216
Report Date: 2024/02/05

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 220028978-9
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
YFR518 GRIEG MONITORING WELL								
Sampling Date 2024/01/23 14:15								
Matrix W								
Sample # 2024-1900-00-SI-SP								
Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Manganese (Mn)	-	0.0065	0.0020	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Potassium (K)	-	0.45	0.10	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Sodium (Na)	-	33	0.10	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Strontium (Sr)	-	0.34	0.0020	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Uranium (U)	-	0.00016	0.00010	mg/L	2024/01/30	2024/01/31	MOA	9190111
Total Zinc (Zn)	-	0.0091	0.0050	mg/L	2024/01/30	2024/01/31	MOA	9190111



Your P.O. #: 220028978-9
Your C.O.C. #: N/A, 2024-1901-00-SI-SP

Attention: Robert Richard Harvey

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
St. John's, NL
CANADA A1B 4J6

Report Date: 2024/04/15
Report #: R8107884
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4A2114

Received: 2024/04/08, 08:25

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	1	N/A	2024/04/10	ATL SOP 00142	SM 24 2320 B
Anions (1)	1	N/A	2024/04/09	CAM SOP-00435	SM 23 4110 B m
Colour	1	N/A	2024/04/10	ATL SOP 00020	SM 24 2120C m
Organic carbon - Diss (DOC) (2)	1	N/A	2024/04/09	ATL SOP 00203	SM 24 5310B m
Conductance - water	1	N/A	2024/04/10	ATL SOP 00004	SM 24 2510B m
Fluoride	1	N/A	2024/04/10	ATL SOP 00043	SM 24 4500-F- C m
Hardness (calculated as CaCO3)	1	N/A	2024/04/10	ATL SOP 00048	Auto Calc
Mercury - Total (CVAA,LL)	1	2024/04/11	2024/04/12	ATL SOP 00026	EPA 245.1 R3 m
Metals Water Total MS	1	2024/04/08	2024/04/09	ATL SOP 00058	EPA 6020B R2 m
Nitrogen Ammonia - water	1	N/A	2024/04/09	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2024/04/10	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2024/04/09	ATL SOP 00017	SM 24 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2024/04/10	ATL SOP 00018	ASTM D3867-16
pH (3)	1	N/A	2024/04/10	ATL SOP 00003	SM 24 4500-H+ B m
Calculated TDS (DW Pkg)	1	N/A	2024/04/11	N/A	Auto Calc
Total Kjeldahl Nitrogen in Water (1)	1	2024/04/09	2024/04/10	CAM SOP-00938	OMOE E3516 m
Organic carbon - Total (TOC) (2)	1	N/A	2024/04/08	ATL SOP 00203	SM 24 5310B m
Total Phosphorus (Colourimetric) (1)	1	2024/04/09	2024/04/10	CAM SOP-00407	SM 24 4500-P I
Total Suspended Solids	1	2024/04/09	2024/04/10	ATL SOP 00007	SM 24 2540D m
Turbidity	1	N/A	2024/04/11	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8

(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

(3) The APHA Standard Method requires pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.



**BUREAU
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Bureau Veritas Job #: C4A2114
Report Date: 2024/04/15

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 220028978-9

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
YVF522 GRIEG MONITERING WELL								
Sampling Date 2024/04/03 15:35								
Matrix W								
Sample # 2024-1901-00-SI-SP								
Registration # sa-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	150	1.0	mg/L	N/A	2024/04/10		9319800
Nitrate (N)	-	0.26	0.050	mg/L	N/A	2024/04/10		9319803
Total dissolved solids (calc., EC)	-	240	1.0	mg/L	N/A	2024/04/11		9319894
Inorganics								
Conductivity	-	430	1.0	uS/cm	N/A	2024/04/10	LJV	9324339
Chloride (Cl-)	-	60	1.0	mg/L	N/A	2024/04/09	LKH	9322881
Dup.Chloride (Cl-)	-	57	1.0	mg/L	N/A	2024/04/09	LKH	9322881
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/04/09	LKH	9322881
Dup.Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/04/09	LKH	9322881
Sulphate (SO4)	-	5.1	1.0	mg/L	N/A	2024/04/09	LKH	9322881
Dup.Sulphate (SO4)	-	5.1	1.0	mg/L	N/A	2024/04/09	LKH	9322881
Total Alkalinity (Total as CaCO3)	-	120	2.0	mg/L	N/A	2024/04/10	LJV	9324334
Colour	-	ND	5.0	TCU	N/A	2024/04/10	EMT	9321908
Dissolved Fluoride (F-)	-	0.12	0.10	mg/L	N/A	2024/04/10	LJV	9324340
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2024/04/09	2024/04/10	RTY	9322290
Nitrate + Nitrite (N)	-	0.26	0.050	mg/L	N/A	2024/04/10	EMT	9321915
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/04/09	MCN	9321921
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/04/09	MCN	9321913
Dissolved Organic Carbon (C)	-	0.52	0.50	mg/L	N/A	2024/04/09	CPP	9320509
Total Organic Carbon (C)	-	0.58	0.50	mg/L	N/A	2024/04/08	CPP	9320497
pH	-	7.99		pH	N/A	2024/04/10	LJV	9324338
Total Phosphorus	-	ND	0.004	mg/L	2024/04/09	2024/04/10	SPC	9322151
Total Suspended Solids	-	ND	2.0	mg/L	2024/04/09	2024/04/10	ACK	9322212
Turbidity	-	2.3	0.10	NTU	N/A	2024/04/11	LJV	9327023
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/04/11	2024/04/12	SGK	9327307
Dup.Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/04/11	2024/04/12	SGK	9327307
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.0080	0.0050	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Barium (Ba)	-	0.11	0.0010	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Boron (B)	-	ND	0.050	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Calcium (Ca)	-	41	0.10	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Copper (Cu)	-	0.0017	0.00050	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Iron (Fe)	-	0.11	0.050	mg/L	2024/04/08	2024/04/09	MTZ	9319982



BUREAU
VERITAS

Bureau Veritas Job #: C4A2114
Report Date: 2024/04/15

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 220028978-9

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
YVF522 GRIEG MONITERING WELL								
Sampling Date 2024/04/03 15:35								
Matrix W								
Sample # 2024-1901-00-SI-SP								
Registration # sa-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Magnesium (Mg)	-	12	0.10	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Manganese (Mn)	-	0.0024	0.0020	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Potassium (K)	-	0.44	0.10	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Sodium (Na)	-	28	0.10	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Strontium (Sr)	-	0.47	0.0020	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Uranium (U)	-	0.00022	0.00010	mg/L	2024/04/08	2024/04/09	MTZ	9319982
Total Zinc (Zn)	-	0.012	0.0050	mg/L	2024/04/08	2024/04/09	MTZ	9319982



Your P.O. #: 220028978-13

Attention: Robert Richard Harvey

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
St. John's, NL
CANADA A1B 4J6

Your C.O.C. #: N/A, 2024-1904-00-SI-SP, 2024-1905-00-SI-SP, 2024-1906-00-SI-SP

Report Date: 2024/07/22
Report #: R8245148
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4K6104

Received: 2024/07/08, 09:15

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	1	N/A	2024/07/15	ATL SOP 00142	SM 24 2320 B
Alkalinity	2	N/A	2024/07/16	ATL SOP 00142	SM 24 2320 B
Anions (1)	3	N/A	2024/07/11	CAM SOP-00435	SM 23 4110 B m
Colour	3	N/A	2024/07/15	ATL SOP 00020	SM 24 2120C m
Organic carbon - Diss (DOC) (2)	3	N/A	2024/07/12	ATL SOP 00203	SM 24 5310B m
Conductance - water	1	N/A	2024/07/15	ATL SOP 00004	SM 24 2510B m
Conductance - water	2	N/A	2024/07/16	ATL SOP 00004	SM 24 2510B m
Fluoride	1	N/A	2024/07/15	ATL SOP 00043	SM 24 4500-F- C m
Fluoride	2	N/A	2024/07/16	ATL SOP 00043	SM 24 4500-F- C m
Hardness (calculated as CaCO ₃)	1	N/A	2024/07/11	ATL SOP 00048	Auto Calc
Hardness (calculated as CaCO ₃)	2	N/A	2024/07/12	ATL SOP 00048	Auto Calc
Mercury - Total (CVAA,LL)	3	2024/07/16	2024/07/17	ATL SOP 00026	EPA 245.1 R3 m
Metals Water Total MS	3	2024/07/11	2024/07/11	ATL SOP 00058	EPA 6020B R2 m
Nitrogen Ammonia - water	3	N/A	2024/07/11	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	3	N/A	2024/07/15	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	3	N/A	2024/07/15	ATL SOP 00017	SM 24 4500-NO ₂ - B m
Nitrogen - Nitrate (as N)	3	N/A	2024/07/15	ATL SOP 00018	ASTM D3867-16
pH (3)	1	N/A	2024/07/15	ATL SOP 00003	SM 24 4500-H+ B m
pH (3)	2	N/A	2024/07/16	ATL SOP 00003	SM 24 4500-H+ B m
Calculated TDS (DW Pkg)	1	N/A	2024/07/16	N/A	Auto Calc
Calculated TDS (DW Pkg)	2	N/A	2024/07/17	N/A	Auto Calc
Total Kjeldahl Nitrogen in Water (1)	3	2024/07/18	2024/07/19	CAM SOP-00938	OMOE E3516 m
Organic carbon - Total (TOC) (2)	3	N/A	2024/07/10	ATL SOP 00203	SM 24 5310B m
Total Phosphorus (Colourimetric) (1)	3	2024/07/18	2024/07/19	CAM SOP-00407	SM 24 4500-P I
Total Suspended Solids	3	2024/07/10	2024/07/11	ATL SOP 00007	SM 24 2540D m
Turbidity	3	N/A	2024/07/18	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8



BUREAU
VERITAS

Bureau Veritas Job #: C4K6104
Report Date: 2024/07/22

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 220028978-13

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZQR689 GRIEG NL MONITORING WELL								
Sampling Date 2024/07/04 12:35								
Matrix W								
Sample # 2024-1904-00-SI-SP								
Registration # SA-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO ₃)	-	160	1.0	mg/L	N/A	2024/07/11		9502346
Nitrate (N)	-	0.26	0.050	mg/L	N/A	2024/07/15		9502349
Total dissolved solids (calc., EC)	-	200	1.0	mg/L	N/A	2024/07/17		9502457
Inorganics								
Conductivity	-	360	1.0	uS/cm	N/A	2024/07/16	LJV	9516480
Dup.Conductivity	-	370	1.0	uS/cm	N/A	2024/07/16	LJV	9516480
Chloride (Cl ⁻)	-	35	1.0	mg/L	N/A	2024/07/11	LKH	9507040
Bromide (Br ⁻)	-	ND	1.0	mg/L	N/A	2024/07/11	LKH	9507040
Sulphate (SO ₄)	-	3.9	1.0	mg/L	N/A	2024/07/11	LKH	9507040
Total Alkalinity (Total as CaCO ₃)	-	120	2.0	mg/L	N/A	2024/07/16	LJV	9516481
Dup.Total Alkalinity (Total as CaCO ₃)	-	120	2.0	mg/L	N/A	2024/07/16	LJV	9516481
Colour	-	6.9	5.0	TCU	N/A	2024/07/15	EMT	9510724
Dissolved Fluoride (F ⁻)	-	0.12	0.10	mg/L	N/A	2024/07/16	LJV	9516482
Dup.Dissolved Fluoride (F ⁻)	-	0.12	0.10	mg/L	N/A	2024/07/16	LJV	9516482
Total Kjeldahl Nitrogen (TKN)	-	0.12	0.10	mg/L	2024/07/18	2024/07/19	RTY	9523765
Nitrate + Nitrite (N)	-	0.26	0.050	mg/L	N/A	2024/07/15	EMT	9510735
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/07/15	MCN	9510743
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507865
Dissolved Organic Carbon (C)	-	ND	0.50	mg/L	N/A	2024/07/12	MKY	9510476
Total Organic Carbon (C)	-	0.88	0.50	mg/L	N/A	2024/07/10	MKY	9505151
pH	-	7.99		pH	N/A	2024/07/16	LJV	9516479
Dup.pH	-	8.00		pH	N/A	2024/07/16	LJV	9516479
Total Phosphorus	-	ND	0.004	mg/L	2024/07/18	2024/07/19	SPC	9523923
Total Suspended Solids	-	5.2	1.0	mg/L	2024/07/10	2024/07/11	DME	9505070
Turbidity	-	0.72	0.10	NTU	N/A	2024/07/18	LJV	9522096
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/16	2024/07/17	JEP	9516917
Dup.Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/16	2024/07/17	JEP	9516917
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.017	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Barium (Ba)	-	0.12	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Boron (B)	-	ND	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Calcium (Ca)	-	42	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Copper (Cu)	-	0.0013	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507631



BUREAU
VERITAS

Bureau Veritas Job #: C4K6104
Report Date: 2024/07/22

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 220028978-13

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZQR689 GRIEG NL MONITORING WELL								
Sampling Date 2024/07/04 12:35								
Matrix W								
Sample # 2024-1904-00-SI-SP								
Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Iron (Fe)	-	0.33	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Magnesium (Mg)	-	12	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Manganese (Mn)	-	0.0066	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Potassium (K)	-	0.57	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Sodium (Na)	-	33	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Strontium (Sr)	-	0.54	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Uranium (U)	-	0.00026	0.00010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Zinc (Zn)	-	0.035	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507631



Your P.O. #: 224006869-3
Your C.O.C. #: N/A

Attention: Robert Richard Harvey

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
St. John's, NL
CANADA A1B 4J6

Report Date: 2024/08/19
Report #: R8283965
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C404783

Received: 2024/08/09, 11:00

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	3	N/A	2024/08/15	ATL SOP 00142	SM 24 2320 B
Anions (1)	3	N/A	2024/08/13	CAM SOP-00435	SM 23 4110 B m
Colour	3	N/A	2024/08/15	ATL SOP 00020	SM 24 2120C m
Organic carbon - Diss (DOC) (2)	3	N/A	2024/08/15	ATL SOP 00203	SM 24 5310B m
Conductance - water	3	N/A	2024/08/15	ATL SOP 00004	SM 24 2510B m
Fluoride	3	N/A	2024/08/15	ATL SOP 00043	SM 24 4500-F- C m
Hardness (calculated as CaCO3)	3	N/A	2024/08/13	ATL SOP 00048	Auto Calc
Mercury - Total (CVAA,LL)	3	2024/08/15	2024/08/15	ATL SOP 00026	EPA 245.1 R3 m
Metals Water Total MS	2	2024/08/12	2024/08/12	ATL SOP 00058	EPA 6020B R2 m
Metals Water Total MS	1	2024/08/12	2024/08/13	ATL SOP 00058	EPA 6020B R2 m
Nitrogen Ammonia - water	3	N/A	2024/08/13	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	3	N/A	2024/08/15	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	3	N/A	2024/08/15	ATL SOP 00017	SM 24 4500-NO2- B m
Nitrogen - Nitrate (as N)	3	N/A	2024/08/15	ATL SOP 00018	ASTM D3867-16
pH (3)	3	N/A	2024/08/15	ATL SOP 00003	SM 24 4500-H+ B m
Calculated TDS (DW Pkg)	3	N/A	2024/08/16	N/A	Auto Calc
Total Kjeldahl Nitrogen in Water (1)	3	2024/08/14	2024/08/16	CAM SOP-00938	OMOE E3516 m
Organic carbon - Total (TOC) (2)	3	N/A	2024/08/15	ATL SOP 00203	SM 24 5310B m
Total Phosphorus (Colourimetric) (1)	3	2024/08/14	2024/08/15	CAM SOP-00407	SM 24 4500-P I
Total Suspended Solids	3	2024/08/13	2024/08/16	ATL SOP 00007	SM 24 2540D m
Turbidity	3	N/A	2024/08/15	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8

(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

(3) The APHA Standard Method requires pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.



**BUREAU
VERITAS**

Bureau Veritas Job #: C4O4783
Report Date: 2024/08/19

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 224006869-3
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZYM128 GRIEG MONITORING WELL								
Sampling Date 2024/08/06 11:30								
Matrix W								
Sample # 2024-1912-00-SI-SP								
Registration # SA-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO ₃)	-	90	1.0	mg/L	N/A	2024/08/13		9565929
Nitrate (N)	-	0.23	0.050	mg/L	N/A	2024/08/15		9565932
Total dissolved solids (calc., EC)	-	170	1.0	mg/L	N/A	2024/08/16		9566665
Inorganics								
Conductivity	-	300	1.0	uS/cm	N/A	2024/08/15	LJV	9577564
Chloride (Cl ⁻)	-	18	1.0	mg/L	N/A	2024/08/13	LKH	9573348
Bromide (Br ⁻)	-	ND	1.0	mg/L	N/A	2024/08/13	LKH	9573348
Sulphate (SO ₄)	-	3.6	1.0	mg/L	N/A	2024/08/13	LKH	9573348
Total Alkalinity (Total as CaCO ₃)	-	120	2.0	mg/L	N/A	2024/08/15	LJV	9577565
Colour	-	ND	5.0	TCU	N/A	2024/08/15	EMT	9575121
Dissolved Fluoride (F ⁻)	-	0.10	0.10	mg/L	N/A	2024/08/15	LJV	9577566
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2024/08/14	2024/08/16	RTY	9576134
Nitrate + Nitrite (N)	-	0.23	0.050	mg/L	N/A	2024/08/15	EMT	9575137
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/08/15	EMT	9575141
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/08/13	MCN	9572157
Dissolved Organic Carbon (C)	-	ND	0.50	mg/L	N/A	2024/08/15	KMC	9576029
Total Organic Carbon (C)	-	0.77	0.50	mg/L	N/A	2024/08/15	KMC	9577758
pH	-	8.02		pH	N/A	2024/08/15	LJV	9577562
Total Phosphorus	-	0.009	0.004	mg/L	2024/08/14	2024/08/15	VKH	9576443
Total Suspended Solids	-	4.4	1.0	mg/L	2024/08/13	2024/08/16	ZZH	9571925
Turbidity	-	14	0.10	NTU	N/A	2024/08/15	LJV	9577591
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/08/15	2024/08/15	JEP	9574996
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.035	0.0050	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Arsenic (As)	-	0.0034	0.0010	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Barium (Ba)	-	0.089	0.0010	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Boron (B)	-	0.054	0.050	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Calcium (Ca)	-	25	0.10	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Copper (Cu)	-	0.0012	0.00050	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Iron (Fe)	-	0.59	0.050	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Magnesium (Mg)	-	6.8	0.10	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Manganese (Mn)	-	0.035	0.0020	mg/L	2024/08/12	2024/08/12	MTZ	9570029



BUREAU
VERITAS

Bureau Veritas Job #: C4O4783
Report Date: 2024/08/19

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 224006869-3
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZYM128 GRIEG MONITORING WELL								
Sampling Date 2024/08/06 11:30								
Matrix W								
Sample # 2024-1912-00-SI-SP								
Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Potassium (K)	-	0.48	0.10	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Sodium (Na)	-	61	0.10	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Strontium (Sr)	-	0.46	0.0020	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Uranium (U)	-	0.00012	0.00010	mg/L	2024/08/12	2024/08/12	MTZ	9570029
Total Zinc (Zn)	-	0.0076	0.0050	mg/L	2024/08/12	2024/08/12	MTZ	9570029

Your P.O. #: 224006869-3

Attention: Robert Richard Harvey

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
St. John's, NL
CANADA A1B 4J6

Your C.O.C. #: N/A, 2024-1960-00-SI-SP, 2024-1961-00-SI-SP, 2024-1962-00-SI-SP

Report Date: 2024/12/13
Report #: R8445045
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4AY064

Received: 2024/12/05, 13:30

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	3	N/A	2024/12/11	ATL SOP 00142	SM 24 2320 B
Anions (1)	3	N/A	2024/12/11	CAM SOP-00435	SM 23 4110 B m
Colour	3	N/A	2024/12/11	ATL SOP 00020	SM 24 2120C m
Organic carbon - Diss (DOC)-Lab Filtered (2)	3	N/A	2024/12/12	ATL SOP 00203	SM 24 5310B m
Conductance - water	3	N/A	2024/12/11	ATL SOP 00004	SM 24 2510B m
Fluoride	3	N/A	2024/12/11	ATL SOP 00043	SM 24 4500-F- C m
Hardness (calculated as CaCO ₃)	3	N/A	2024/12/11	ATL SOP 00048	Auto Calc
Mercury - Total (CVAA,LL)	3	2024/12/12	2024/12/12	ATL SOP 00026	EPA 245.1 R3 m
Metals Water Total MS	3	2024/12/10	2024/12/10	ATL SOP 00058	EPA 6020B R2 m
Nitrogen Ammonia - water	3	N/A	2024/12/10	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	3	N/A	2024/12/11	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	3	N/A	2024/12/11	ATL SOP 00017	SM 24 4500-NO2- B m
Nitrogen - Nitrate (as N)	3	N/A	2024/12/12	ATL SOP 00018	ASTM D3867-16
pH (3)	3	N/A	2024/12/11	ATL SOP 00003	SM 24 4500-H+ B m
Calculated TDS (DW Pkg)	3	N/A	2024/12/12	N/A	Auto Calc
Total Kjeldahl Nitrogen in Water (1)	3	2024/12/11	2024/12/12	CAM SOP-00938	SM 4500-N B m
Organic carbon - Total (TOC) (2)	2	N/A	2024/12/11	ATL SOP 00203	SM 24 5310B m
Organic carbon - Total (TOC) (2)	1	N/A	2024/12/12	ATL SOP 00203	SM 24 5310B m
Total Phosphorus (Colourimetric) (1)	3	2024/12/11	2024/12/11	CAM SOP-00407	SM 24 4500-P I
Total Suspended Solids	3	2024/12/09	2024/12/10	ATL SOP 00007	SM 24 2540D m
Turbidity	3	N/A	2024/12/11	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8

(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

(3) The APHA Standard Method requires pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.



BUREAU
VERITAS

Bureau Veritas Job #: C4AY064

Report Date: 2024/12/13

NL Department of Environment, Climate Change and

Municipalities

Your P.O. #: 224006869-3

Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
AKZB48 GRIEG MONITORING WELL								
Sampling Date 2024/12/03 12:15								
Matrix W								
Sample # 2024-1962-00-SI-SP								
Registration # SA-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO ₃)	-	110	1.0	mg/L	N/A	2024/12/11		9811495
Nitrate (N)	-	0.16	0.050	mg/L	N/A	2024/12/12		9811386
Total dissolved solids (calc., EC)	-	190	1.0	mg/L	N/A	2024/12/12		9811005
Inorganics								
Conductivity	-	340	1.0	uS/cm	N/A	2024/12/11	M2C	9819470
Chloride (Cl ⁻)	-	19	1.0	mg/L	N/A	2024/12/11	SUR	9817970
Bromide (Br ⁻)	-	ND	1.0	mg/L	N/A	2024/12/11	SUR	9817970
Sulphate (SO ₄)	-	3.1	1.0	mg/L	N/A	2024/12/11	SUR	9817970
Total Alkalinity (Total as CaCO ₃)	-	110	2.0	mg/L	N/A	2024/12/11	M2C	9819475
Colour	-	ND	5.0	TCU	N/A	2024/12/11	EMT	9819413
Dissolved Fluoride (F ⁻)	-	0.16	0.10	mg/L	N/A	2024/12/11	M2C	9819476
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2024/12/11	2024/12/12	RTY	9820882
Nitrate + Nitrite (N)	-	0.16	0.050	mg/L	N/A	2024/12/11	EMT	9819415
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/12/11	EMT	9819416
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/12/10	MCN	9817432
Dissolved Organic Carbon (C)	-	0.53	0.50	mg/L	N/A	2024/12/12	ACK	9820718
Total Organic Carbon (C)	-	0.77	0.50	mg/L	N/A	2024/12/12	ACK	9820547
pH	-	7.99		pH	N/A	2024/12/11	M2C	9819464
Total Phosphorus	-	0.013	0.004	mg/L	2024/12/11	2024/12/11	VKH	9820382
Total Suspended Solids	-	6.6	1.0	mg/L	2024/12/09	2024/12/10	ISM	9814678
Turbidity	-	13	0.10	NTU	N/A	2024/12/11	M2C	9820239
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/12/12	2024/12/12	JEP	9820362
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.072	0.0050	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Barium (Ba)	-	0.077	0.0010	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Boron (B)	-	ND	0.050	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Calcium (Ca)	-	30	0.10	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Copper (Cu)	-	0.0012	0.00050	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Iron (Fe)	-	1.3	0.050	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Magnesium (Mg)	-	8.8	0.10	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Manganese (Mn)	-	0.019	0.0020	mg/L	2024/12/10	2024/12/10	JHY	9816631



BUREAU
VERITAS

Bureau Veritas Job #: C4AY064
Report Date: 2024/12/13

NL Department of Environment, Climate Change and
Municipalities
Your P.O. #: 224006869-3
Sampler Initials: VH

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
AKZB48 GRIEG MONITORING WELL								
Sampling Date 2024/12/03 12:15								
Matrix W								
Sample # 2024-1962-00-SI-SP								
Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Potassium (K)	-	0.37	0.10	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Sodium (Na)	-	19	0.10	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Strontium (Sr)	-	0.25	0.0020	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Uranium (U)	-	0.00011	0.00010	mg/L	2024/12/10	2024/12/10	JHY	9816631
Total Zinc (Zn)	-	0.014	0.0050	mg/L	2024/12/10	2024/12/10	JHY	9816631