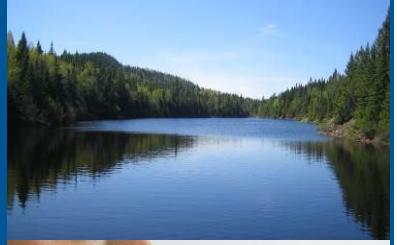
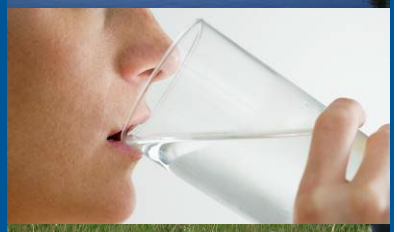






Real-Time Water Quality Report

Grieg NL Nurseries Ltd Monitoring Well

Annual Deployment Period:
February 7, 2022 to November 23, 2022

Newfoundland Labrador

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

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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 started periodically (about once per week). 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 WRMD's monitoring equipment is not removed during the pump test and as a result may disrupt 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. Tara Clinton is ECC's main contact regarding the instrumentation. Tara is responsible for maintaining and calibrating the water quality instrument, as well as grooming, analyzing and reporting on water quality data recorded at the station.

Grab samples are collected at the beginning of each deployment period to compare against the initial in-situ data. Grab samples compliment the real-time data and provide an extra source of water quality data for comparisons when monitoring changes over time at the station (Table 1).

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

Date	Parameter	In-Situ Instrument	Grab Sample Result
Feb 7, 2022	**pH (pH units)**	6.65	7.97
	Specific Conductivity (µS/cm)	311.51	300
May 24th, 2022	**pH (pH units)**	7.48	7.97
	Specific Conductivity (µS/cm)	287.41	290
August 4, 2022	**pH (pH units)**	7.22	7.99
	Specific Conductivity (µS/cm)	299.65	310
September 28, 2022	**pH (pH units)**	7.33	8.08
	Specific Conductivity (µS/cm)	314.36	330
November 23, 2022	**pH (pH units)**	7.25	7.93
	Specific Conductivity (µS/cm)	299.47	300

Grieg Monitoring Well Water Quality Parameters

Water Temperature

From February 2nd, 2022 through to November 23, 2022 the water temperature ranged from 7.25°C to 7.5°C during the deployment period (Figure 6). The annual average water temperature was 7.33°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 isn't a large range between the minimum and maximum values.

The gap in data from September 23rd, 2022 to September 28th, 2022 was due to power issues with the instrument. The instrument lost power for this time frame and was unable to transmit or record data for those days.

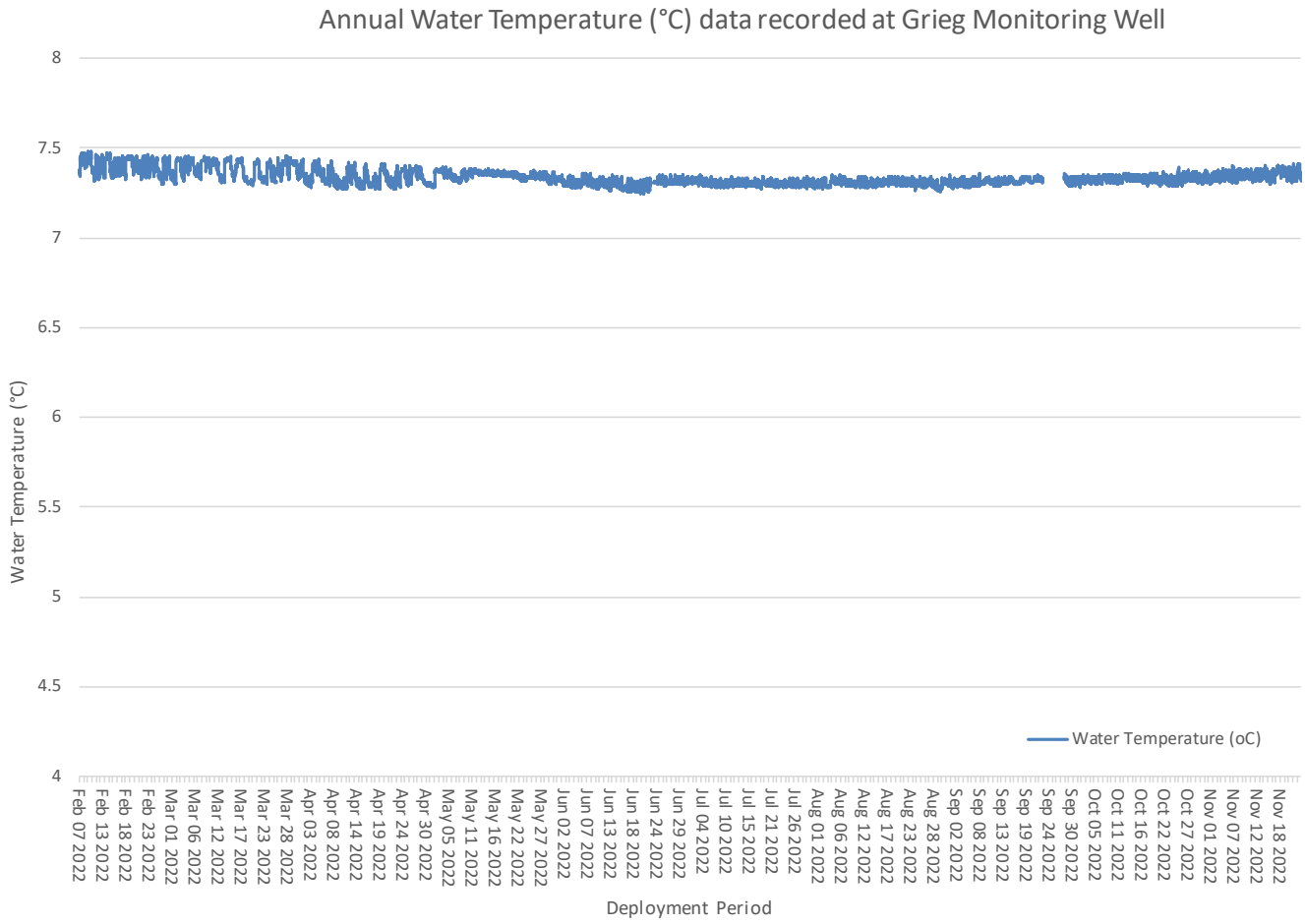

Figure 6: Water temperature (°C) values

pH

From February 7th 2022 to 23rd November 2022, pH values ranged between 7.28 pH units and 7.8 pH units. Across the year of deployment the pH was reasonably consistent and had a median of 7.33 pH units.

Small changes in pH were likely the result of pumping within the aquifer. As the well refills and the level adjusts, there will be movement in the pH levels for a short period of time (Figure 7). pH was slightly higher toward the end of the deployment, indicating a slight possible shift in the pH range over the course of the year.

The red points on the graph represent the grab sample results for pH. Grab samples compliment the in situ monitoring by the water quality instrument (Table 1). Slight differences between pH values of the grab sample and water quality instrument are normal, variables such as, the analysis of the grab sample not occurring for several days, can influence the data.

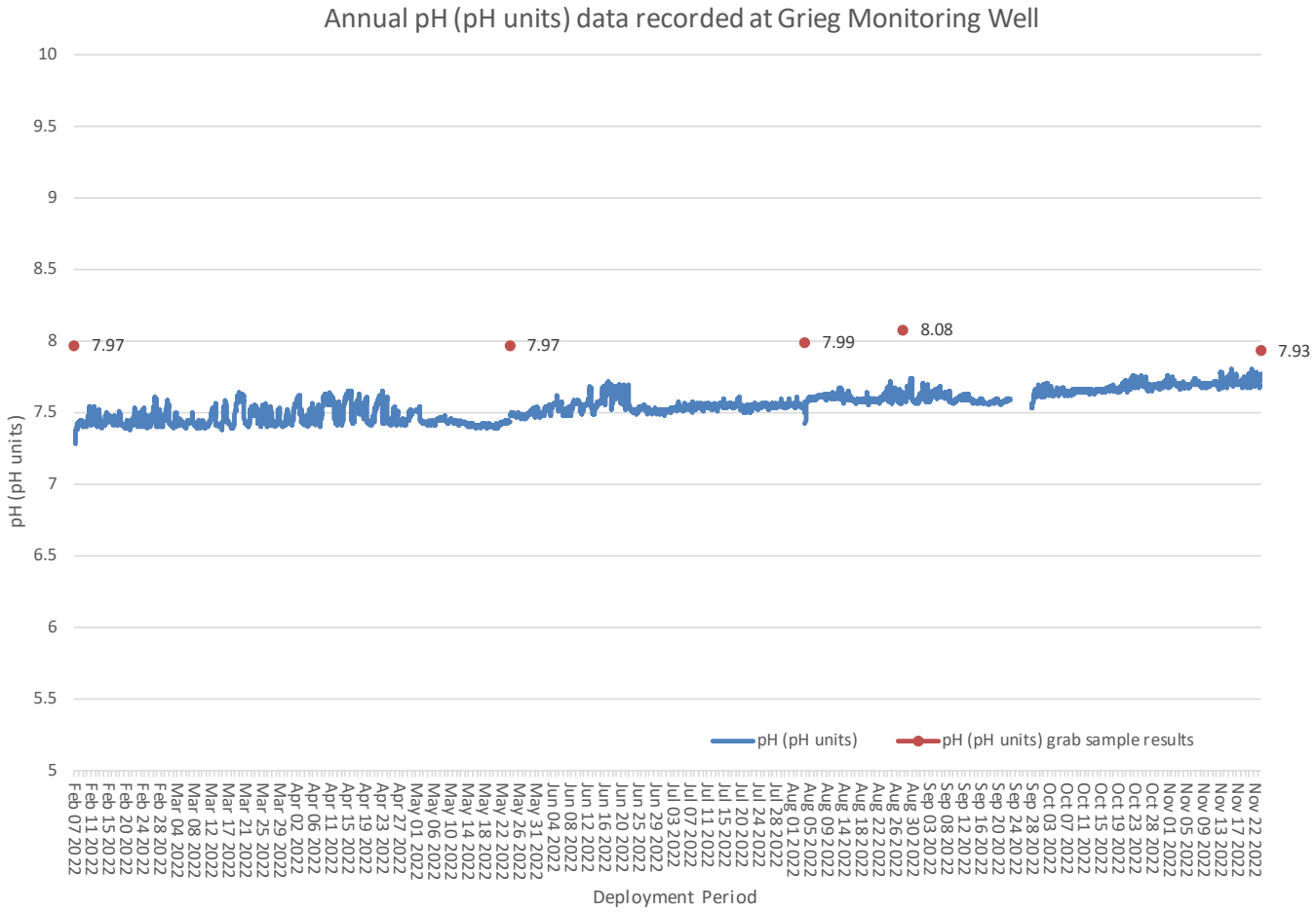

Figure 7: pH (pH units) values

Specific Conductivity & Total Dissolved Solids (TDS)

The specific conductivity probe measures the presence of diluted salts and inorganic materials in a water source. During the deployment, conductivity levels were within 265.03 µS/cm and 376.23 µS/cm (Figure 8).

TDS 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 period, TDS ranged within 0.17 g/L to 0.24 g/L.

The red points on the graph represent the specific conductivity results from the grab samples taken during the beginning of a deployment (Table 1). Due to the nature of this well the grab samples are taken from an inside tap within the station. It is expected that there would be some differences between the in situ data and the grab sample data.

When there is minimal or no influence from an outside source, the conductivity in the groundwater well is relatively stable and fluctuates minimally. Any significant fluctuations in the conductivity data at this site are likely due to pumping the water from the well or any movement of the equipment in the well casing (Figure 9).

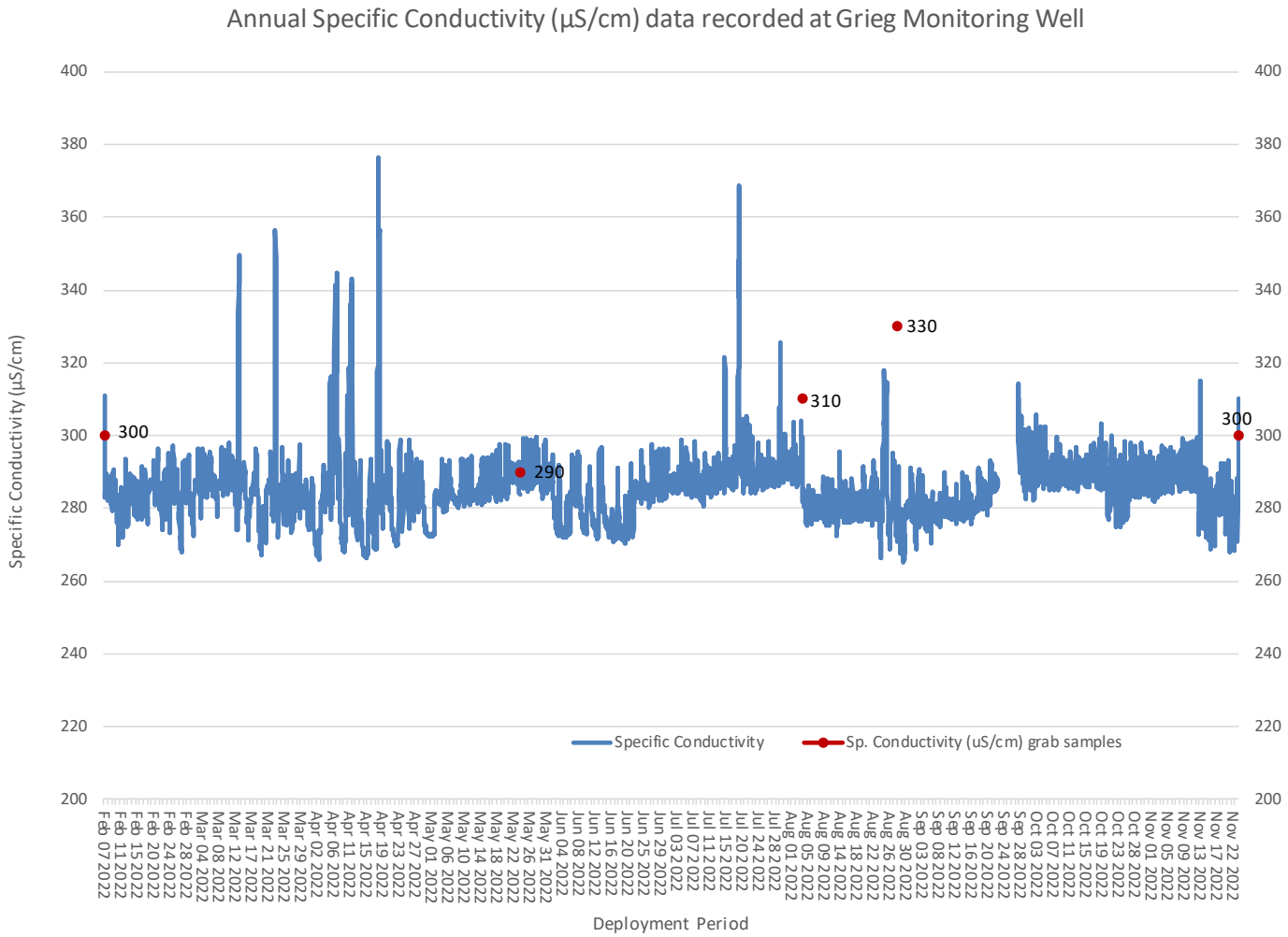

Figure 8: Specific conductivity (µS/cm) values

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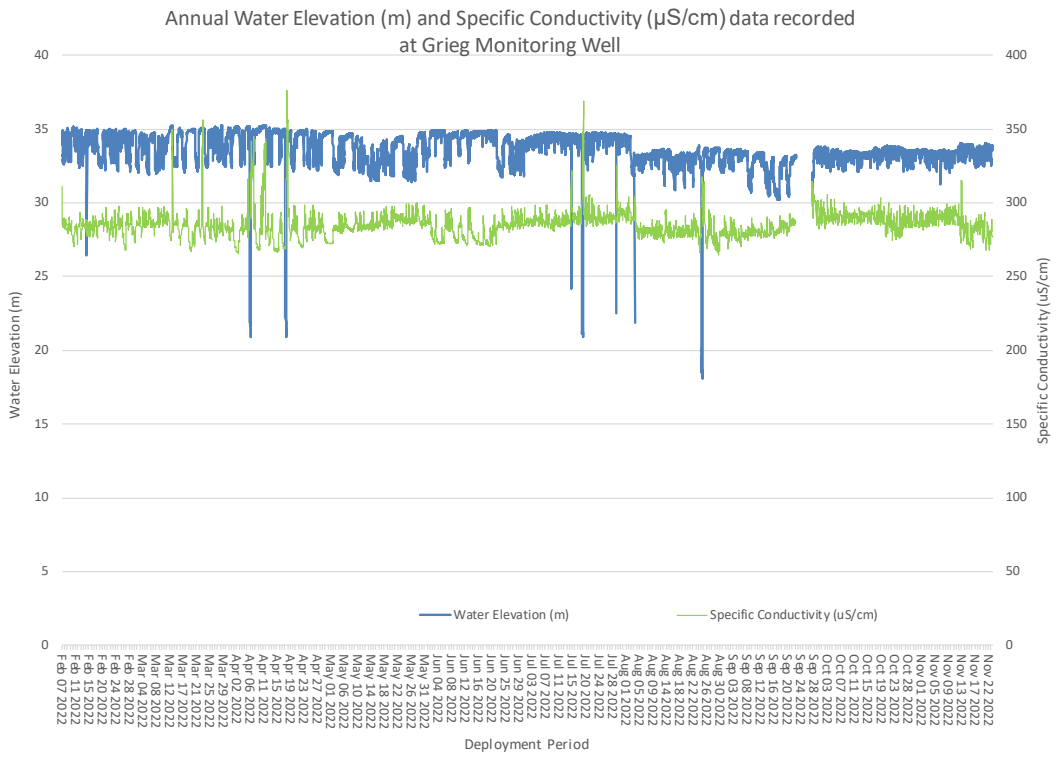

Figure 9: Annual Specific Conductivity & Water Elevation

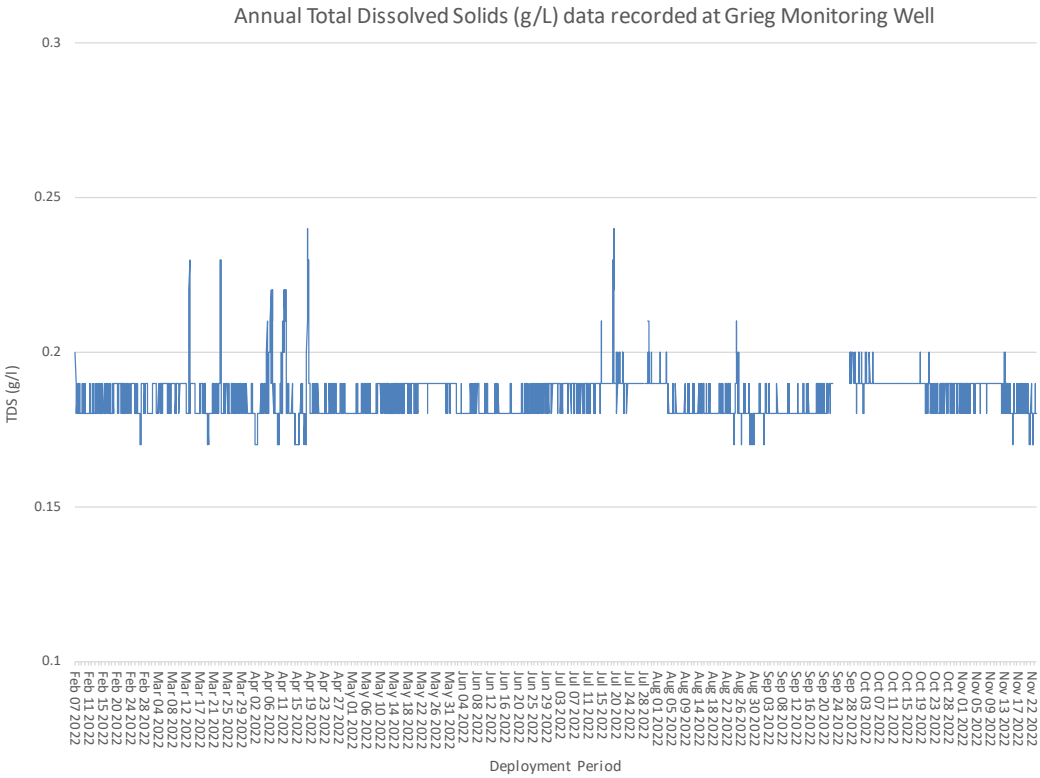

Figure 10: Total Dissolved Solids (TDS)

Oxidation-Reduction Potential (ORP)

Oxidation-Reduction Potential is used to determine the oxidizing-reduction potential of the groundwater. Monitoring the ORP in a groundwater well is important, it can identify the mobility and persistence of contaminates that can affect the quality of the water. Natural aquifer material can release specific chemicals changing the concentrations overtime. ORP is individual and specific to each water body and gathering background data is essential in understanding what the changes in the data represent.

ORP levels during the deployment ranged within 32.2 mV to 341.9 mV (Figure 11). The dataset had a median of 275.4 mV. Due to periodic pumping of the well, it was expected that the ORP levels fluctuate. The changes across the deployment are evident on Figure 11, as the ORP values dip and increase.

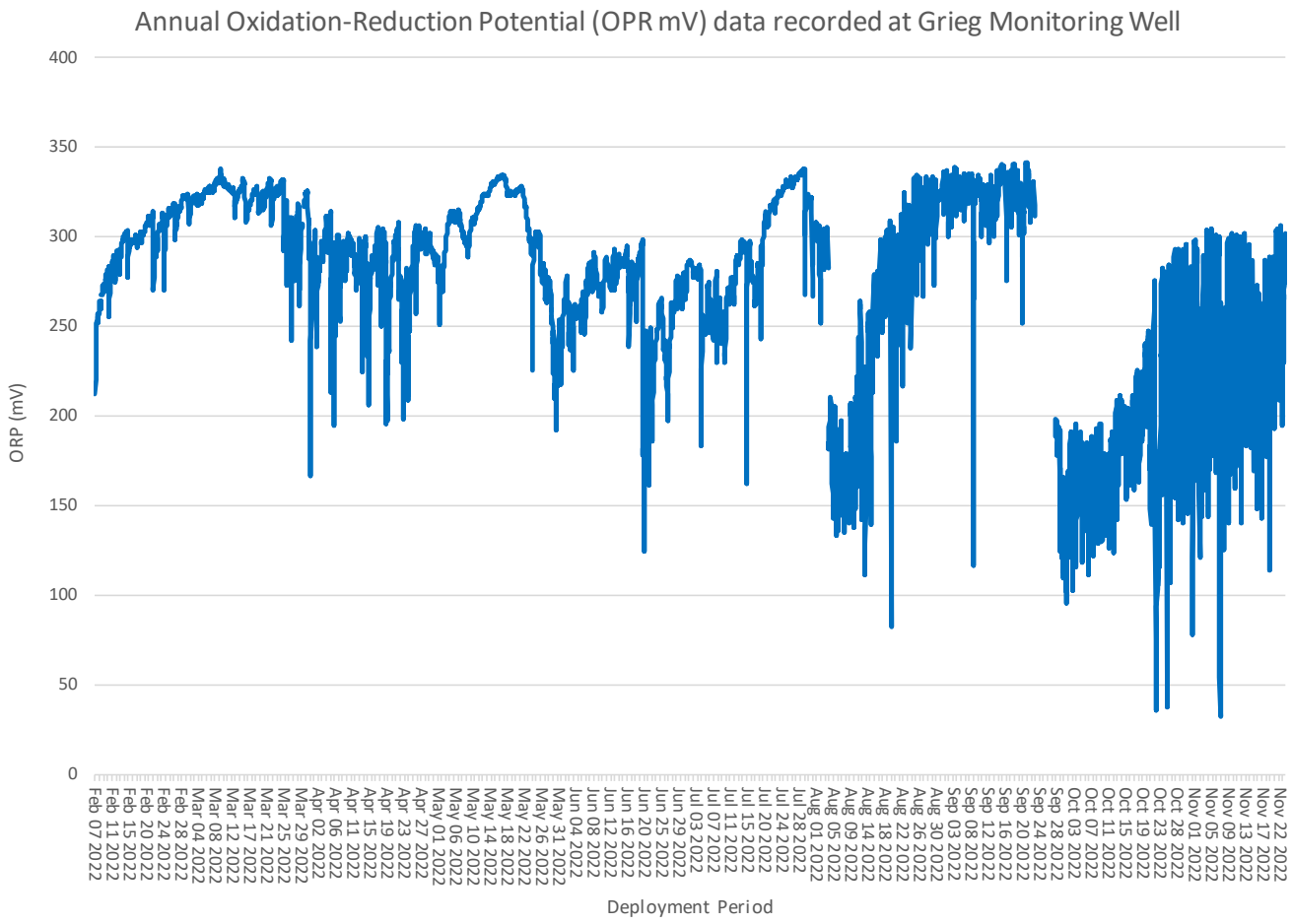

Figure 11: ORP values (mV)

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 18.1 m to 35.25 m for 2022. The data set had a median of 33.5 m and a mean of 33.5 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 12). Notwithstanding the larger dips in water elevation, the range of the elevation was reasonably consistent across deployment.

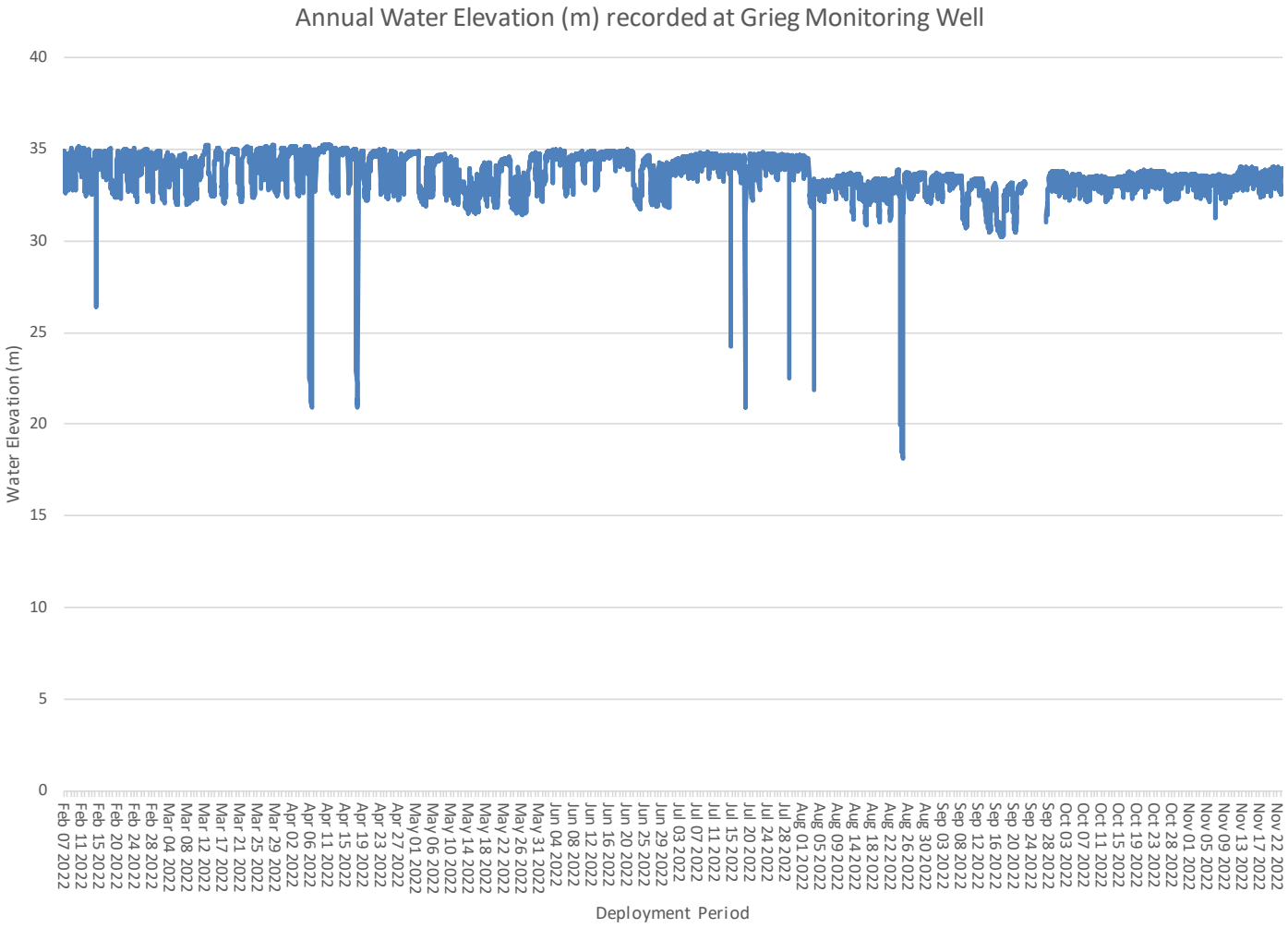

Figure 12: Water Elevation (m)

Conclusion

Background data is essential for identifying potential issues to a water body. Many water bodies have specific parameters that are natural to that areas but may seem out of the norm for others. Therefore it is so important to monitor and document the background of water bodies that are implemented in any type of anthropogenic activity.

This station is only two years old, and while there is a good range of data being recorded there is still a lot more to learn about what is normal for this site. Currently, the data indicates that there is sporadic pumping from the aquifer, which is likely the main reason for the changes in the water parameters for 2022.

Water temperature in this well remains steady throughout deployment even across changes in the seasons, which is to be expected at the depth that the instrument is in this well. pH remains steady within a range of 7.2 to 7.8 pH units. Conductivity data displayed variation and spikes, however many of the larger spikes corresponded with water elevation decreasing for a period of time before the data returned to baseline levels.

The oxidizing-reduction potential (ORP) appears to be influenced by any disruption in the ground water. The large peaks and valleys in the ORP data do indicate a response from this parameter, however determining the ORP norm for this waterbody will require more data at this point.

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. As the monitoring of this site continues, a better baseline dataset for water quality parameters will be determined.

Appendix I

Water Quality Statistics of Grieg Groundwater Well

February 7, 2022 to November 23, 2022

Parameter	Min	Max	Median	Mean
Water Temperature (°C)	7.246	7.481	7.334	7.325
pH (pH units)	7.28	7.8	7.55	7.55
Specific Conductivity (µS/cm)	265.03	376.23	285.23	284.95
Total Dissolved Solids (g/L)	0.17	0.24	0.185	0.19
ORP (mV)	32.2	341.9	275.36	288.7
Water Elevation (m)	18.083	35.23	33.57	33.59