



Real-Time Water Quality Annual Report

Northern Harvest Smolt Ltd.

January 1st to December 31st, 2023



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

Introduction

- The Real-Time Water Quality (RTWQ) Monitoring Network near Stephenville, NL consists of three groundwater well monitoring stations funded by Northern Harvest Smolt Ltd. The program is a partnership between Northern Harvest and the Newfoundland & Labrador Department of Environment and Climate Change (ECC).
- Each of the three stations consists of groundwater water quality and quantity monitoring equipment (water level) which transmits data in near real-time every 2-3 hours.
- The well stations are known as: MW5/6; FMW10 and FMW12. They were installed in November 2019 by ECC staff and first deployed on November 6th, 2019. The instruments remain in the monitoring wells year-round unless removed temporarily for maintenance and calibration.
- These stations measure the following water parameters: temperature, pH, specific conductivity, total dissolved solids (TDS), oxidation-reduction potential (ORP) and water quantity (depth). Parameters are recorded on an hourly basis during the deployment period and are available in real-time online:

NLGWMW5/6: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWMW56

NLGWFMW10: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW10

NLGWFMW12: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW12

- MW5/6 – This 50mm well is one of the thirteen wells that make up the Northern Harvest near field monitoring well network within 500m of the water supply area. This is a relatively shallow well at 2.92m.
- FMW10 - This 50mm well is one of the five wells that make up the Northern Harvest far-field monitoring network set up outside the 500m radius of the hatchery. This well is relatively deep at 22.54m.
- FMW12 – This 152mm well is one of the thirteen wells that make up the Northern Harvest near-field monitoring network within 500m of the water supply area. This well is relatively deep at 29.25m.
- The purpose of this network is to monitor, process, and distribute water quality/quantity data to Northern Harvest Smolt Ltd. and ECC for assessment and management of water resources, as well as to provide an early warning for any potential or emerging water issues, allowing mitigative measures to be implemented in a timely manner.
- ECC will provide Northern Harvest Smolt Ltd. with deployment and annual reports. Data is also available in near real-time on ECC's website.



Figure 1: Map of Northern Harvest Smolt Ltd. Real Time Water Monitoring Network

- Gaps in the water quality data are the result of transmission loss by the stations or the removal of inaccurate data due to ongoing station maintenance during that time period.
- The first deployment for 2023 began in October 2022. The instruments were next removed for full maintenance in February 2023, followed by July 2023 and March 2024.



(a) MW5/6

(b) FMW10



(c) FMW12

Figure 2: Northern Harvest Real Time Monitoring Network: (a) MW5/6, (b) FMW10, (c) FMW12

Maintenance and Calibration

- To ensure accurate data collection of the real time groundwater monitoring network, maintenance and calibration of the water quality instrumentation is performed approximately every four months.
- Maintenance includes a thorough cleaning of each instrument and replacement of any small sensor parts that are damaged or unsuitable for reuse. Once the instrument is cleaned, ECC staff carefully calibrate each sensor attachment for pH, specific conductivity and ORP to ensure accurate data collection.
- Installation and removal dates for 2023 are summarized in Table 1 below.

Table 1: Water quality instrument deployment start and end dates for 2022

Station	Installation	Removal	Duration (days)
MW5/6	October 13, 2022	February 27, 2023	137
	February 28, 2023	July 18, 2023	140
	July 19, 2023	March 13, 2024	238
FMW10	October 13, 2022	February 27, 2023	137
	February 28, 2023	July 18, 2023	140
	July 19, 2023	March 13, 2024	238
FMW12	October 13, 2022	February 27, 2023	137
	February 28, 2023	July 18, 2023	140
	July 19, 2023	March 13, 2024	238

Quality Assurance and Quality Control

- As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of each deployment period. The procedure is based on the approach used by the United States Geological Survey.
- During the maintenance phase, water levels are measured manually and a volume equivalent to three well casings is purged from each well prior to re-installation and the collection of grab samples. This process flushes stagnant water from the wells and ensures that the water being observed is aquifer water.

- After full purging of the well, the sonde is deployed and initial field readings are recorded. A grab sample is taken when possible to compare the values of pH and specific conductance against the deployed sonde’s initial values.
- Three instruments are owned by Northern Harvest and will be installed in the wells on a rotating basis to ensure data accuracy.
- Deployment comparison rankings for the stations are summarized in Table 2.

Table 2: QA/QC comparison rankings for Northern Harvest Stations

Station	Date	Action	Instrument #	pH	Specific Conductivity
MW56	13-Oct-22	Deployment	19D105281	Poor	Good
	28-Feb-23	Deployment	19E100387	Marginal	Fair
	19-Jul-23	Deployment	19D105282	Marginal	Fair
FMW10	13-Oct-22	Deployment	19E100387	Good	Good
	28-Feb-23	Deployment	19D105282	Fair	Good
	19-Jul-23	Deployment	19D105281	Fair	Excellent
FMW12	13-Oct-22	Deployment	19D105282	Good	Excellent
	28-Feb-23	Deployment	19E100387	Good	Good
	19-Jul-23	Deployment	19D105282	Good	Fair

Data Interpretation

- The following graphs and discussion illustrate water quality and level related events from January 1st to December 31st, 2023 at Northern Harvest Smolt facility.
- All data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Corrected data can be obtained upon request.

Water Temperature

- In 2023, water temperature ranged from 4.36°C to 14.50°C within the real-time well network (Table 3).
- MW5/6 had the largest range of water temperatures, reaching a low in March and peaking in August, with a range of 10.14°C over the course of 2023.
- At FMW10, water temperature was relatively stable, with a small decrease during the spring/early summer period and notable increase in late summer into fall (Figure 3).
- FMW12 was very stable throughout the year, varying within a small range with a median of 6.84 (Figure 3).

Table 3: Water Temperature (°C) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	4.36	6.8	6.82
MAX.	14.5	8.96	6.90
MEDIAN	7.95	7.21	6.84

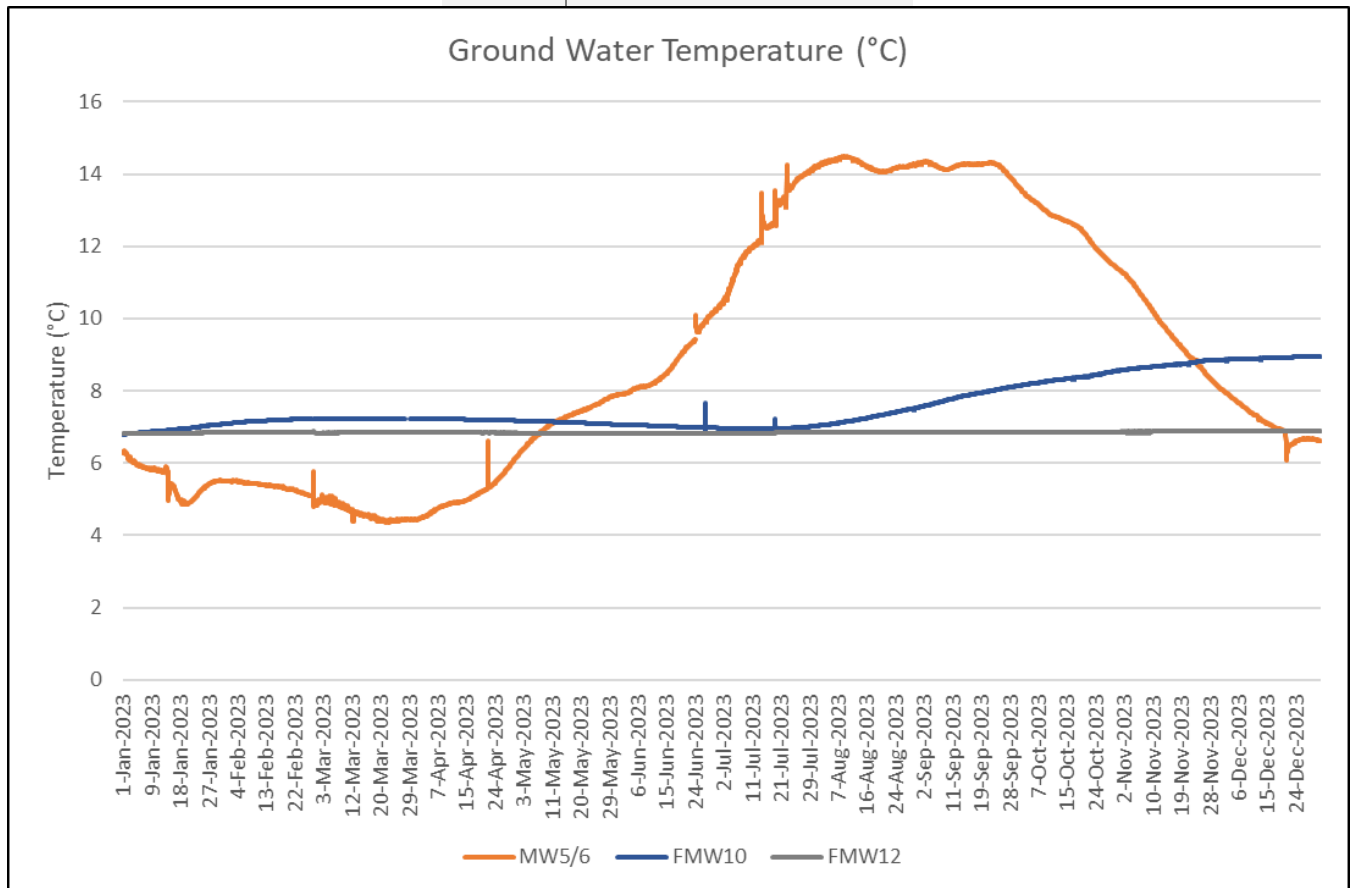


Figure 3: Water Temperature (°C) – Northern Harvest Smolt Ltd. Network

Water Depth

- During the deployment, MW5/6 and FMW12 were relatively stable while FMW10 showed a slight increasing trend throughout 2023 (Table 4).
- FMW10 showed the most variability within the network.

Table 4: Water Elevation (m) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	1.41	5.92	6.04
MAX.	2.53	8.03	7.06
RANGE	1.12	2.11	1.02
MEDIAN	1.99	7.07	6.52

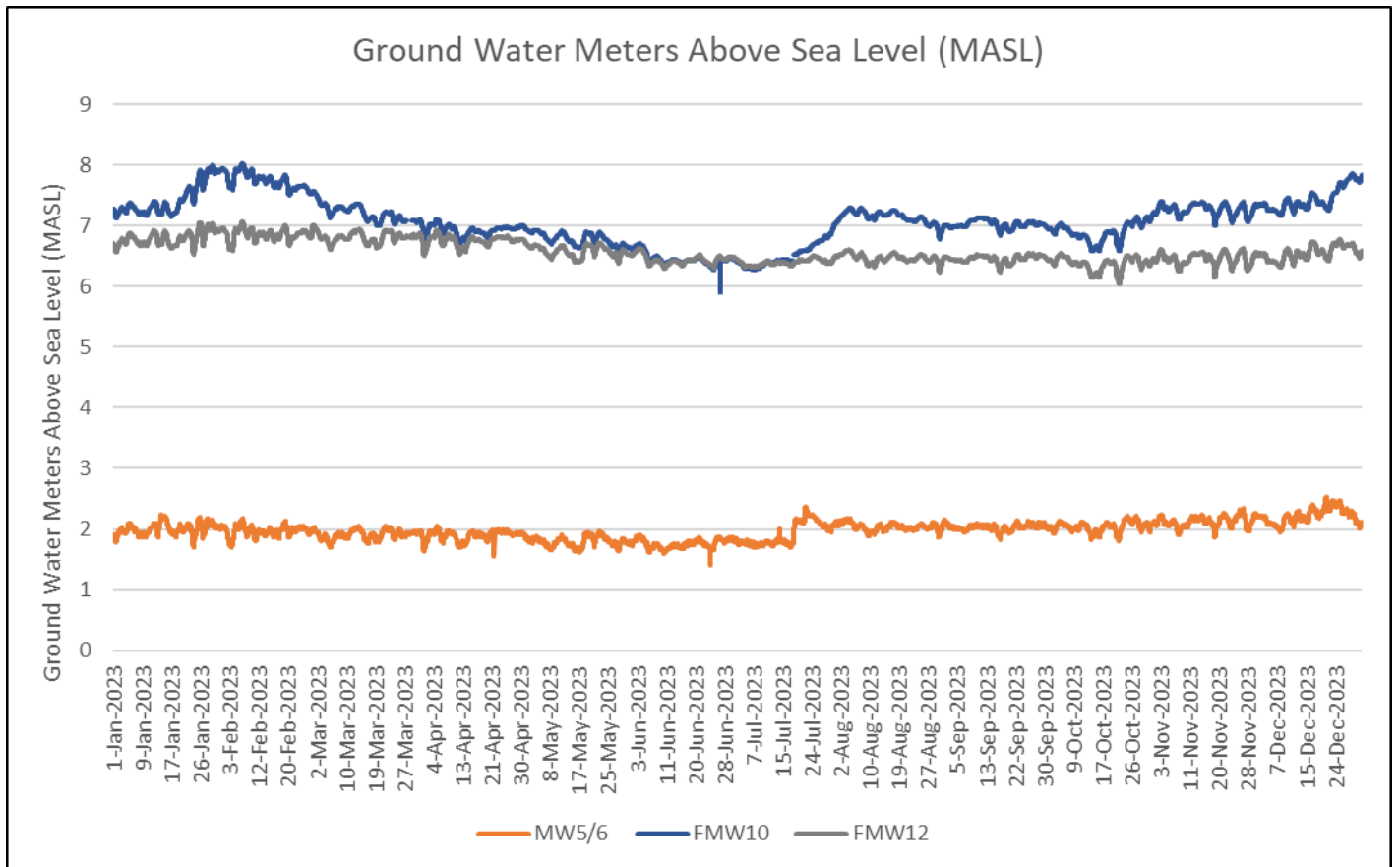


Figure 4: Water Elevation (masl) – Northern Harvest Smolt Ltd. Network

pH

- In 2023, pH ranged from 5.79 (at MW5/6) to 8.19 (at FMW12) pH units within the real-time well network (Table 5).
- All wells in the network displayed similar variability throughout the 2023 deployments (Figure 5).

Table 5: pH (pH units) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	5.79	7.17	7.47
MAX.	6.43	7.75	8.19
MEDIAN	6.05	7.54	7.91

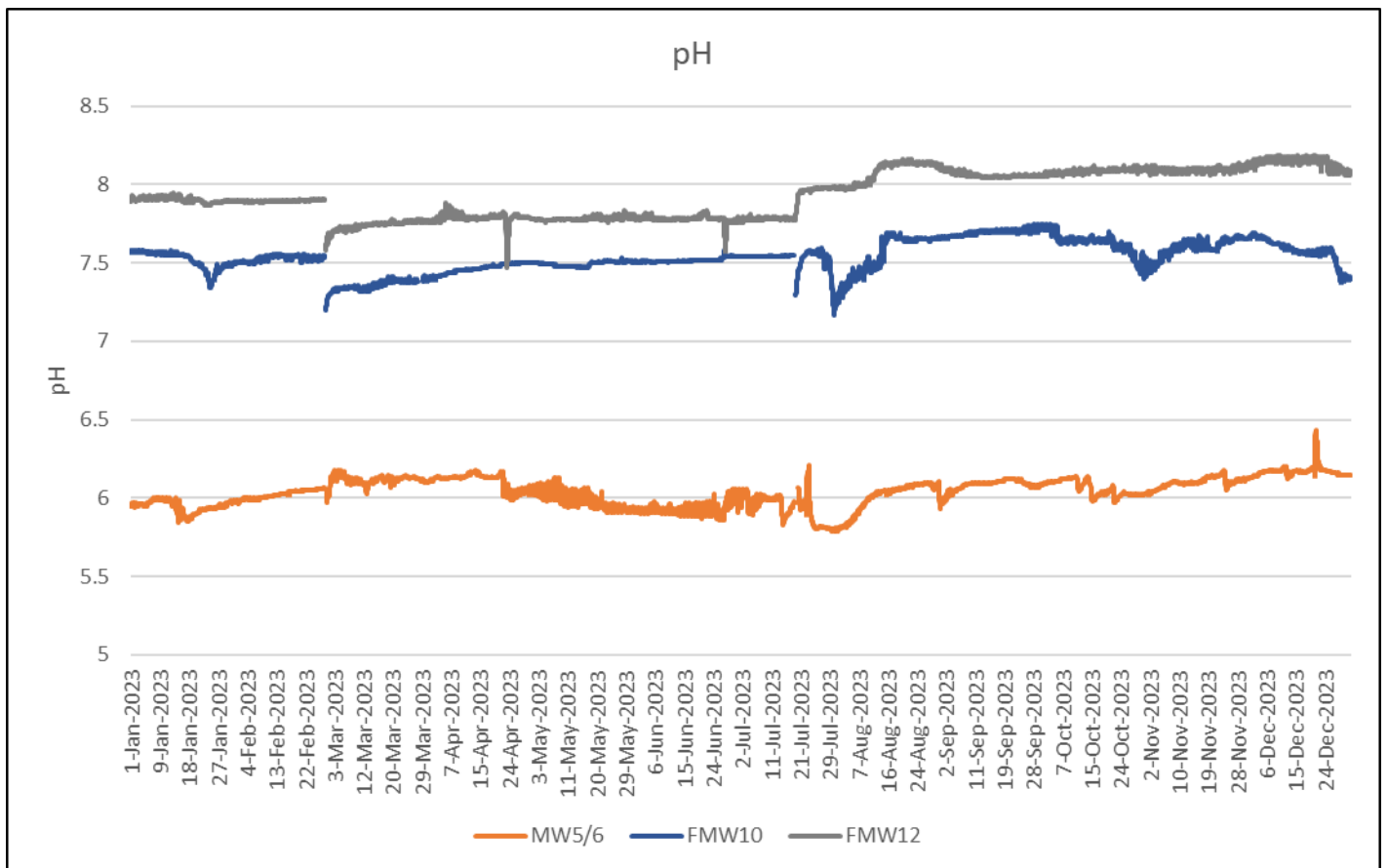


Figure 5: pH – Northern Harvest Smolt Ltd. Network

Specific Conductance and TDS

- In 2023, specific conductance ranged from 60.7 $\mu\text{S}/\text{cm}$ to 521.85 $\mu\text{S}/\text{cm}$ within the real-time well network (Table 6).
- Specific conductance at FMW12 shows little variation while MW5/6 and FMW10 fluctuate frequently and decrease overall during the 2023 deployments (Figure 6).

Table 6: Specific Conductance ($\mu\text{S}/\text{cm}$) & TDS (g/L) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12		MW5/6	FMW10	FMW12
	SPECIFIC CONDUCTANCE			TOTAL DISSOLVED SOLIDS			
MIN.	60.7	376.41	335.05	MIN.	0.04	0.24	0.22
MAX.	258.74	521.85	370.9	MAX.	0.17	0.34	0.24
MEDIAN	129.19	462.14	359.72	MEDIAN	0.08	0.30	0.23

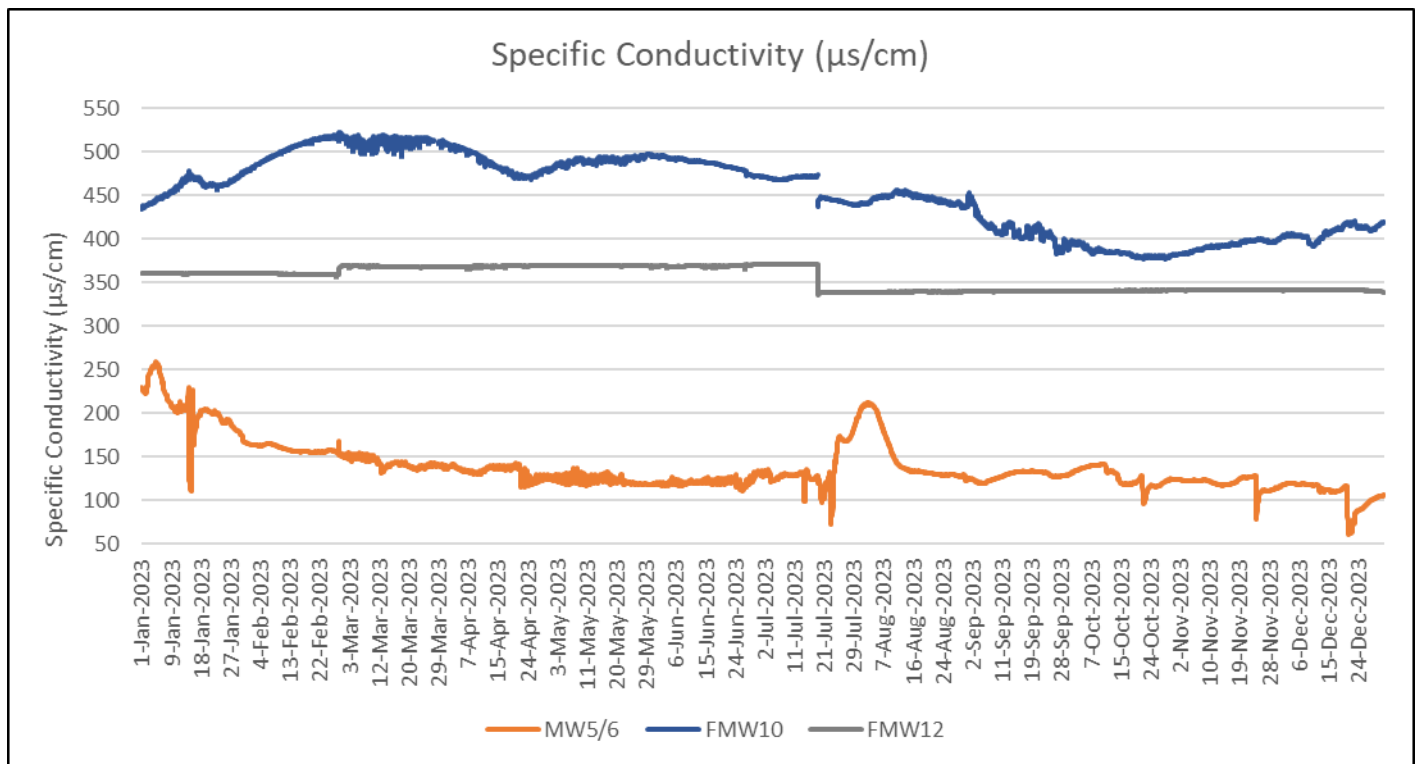


Figure 6: Specific Conductance – Northern Harvest Smolt Ltd. Network

- During 2023, total dissolved solids (TDS) ranged from 0.04 mg/L to 0.34 mg/L within the real time well network (Table 6).
- TDS varied minimally at FMW12 with an overall decrease in 2023. At FMW10 and MW5/6, TDS varied frequently with an overall decrease at both wells during the 2023 deployments. (Figure 7).

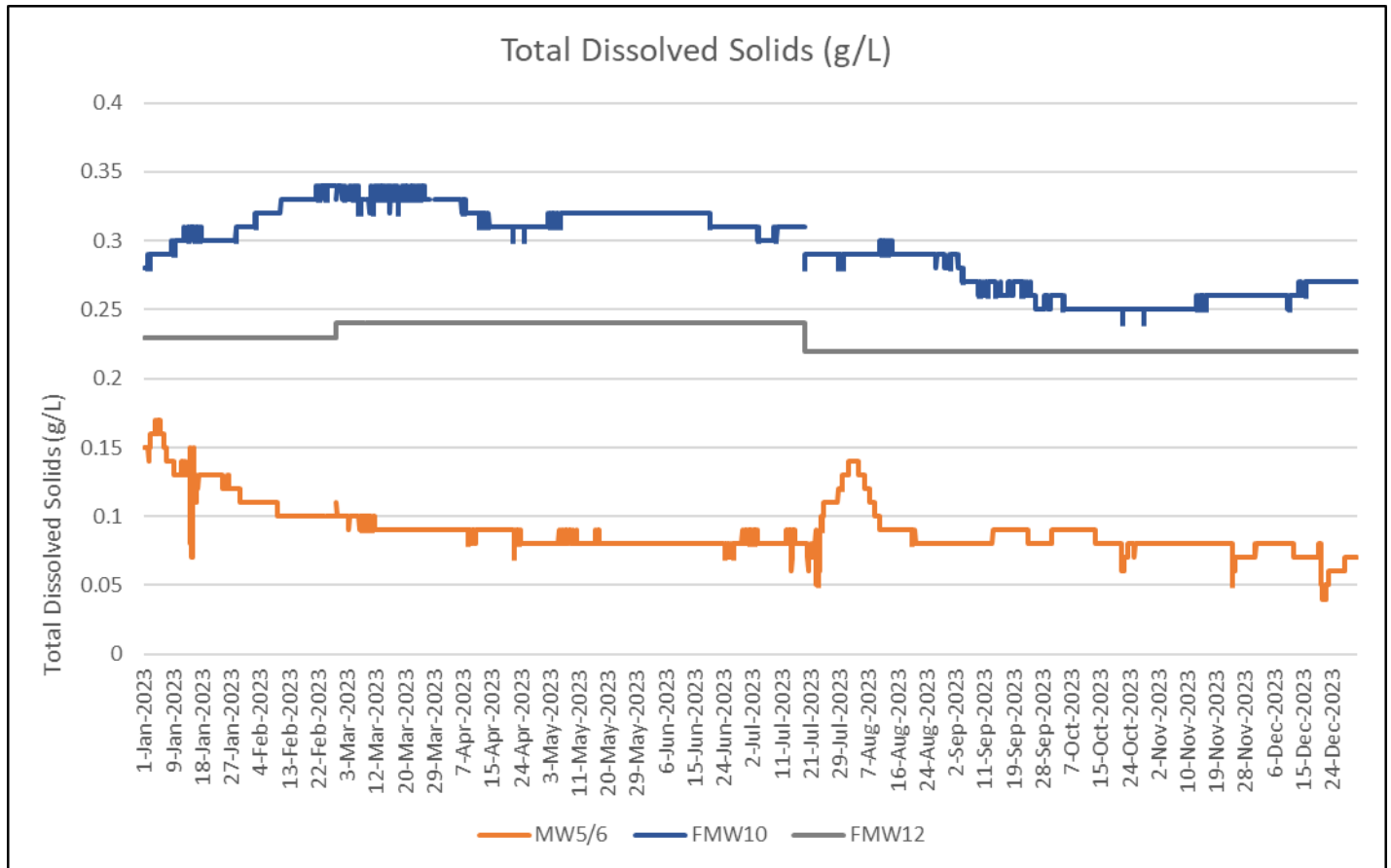


Figure 7: Total Dissolved Solids – Northern Harvest Smolt Ltd. Network

Oxidation – Reduction Potential (ORP)

- During 2023, oxidation-reduction potential (ORP) ranged from -219.06 mV to 456.18 mV within the real time well network (Table 7).
- During the 2023 deployment year, FMW10 and FMW12 appeared to be oxidative in nature. MW5/6 exhibited large fluctuations and was both reductive and oxidative. Both FMW10 and FMW12 were very slow to readjust after the July maintenance/calibration.

Table 7: Oxidation-Reduction Potential (ORP) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	-219.06	170.09	12.49
MAX.	456.18	426.57	391.26
MEDIAN	37.09	393.38	376.06

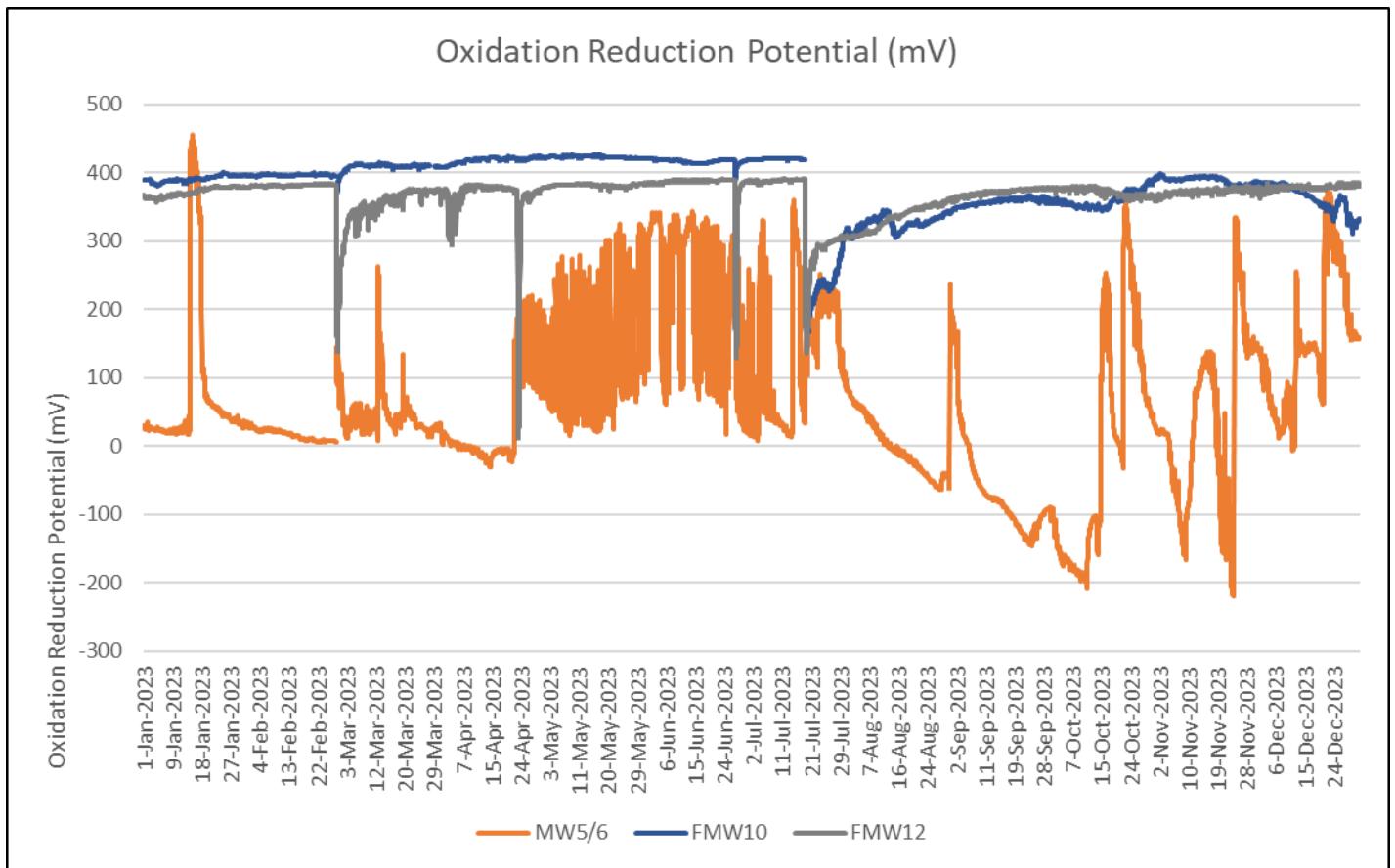


Figure 8: Oxidation-Reduction Potential (ORP) – Northern Harvest Smolt Ltd. Network

Conclusions

- The real-time water quality and quantity monitoring network at Northern Harvest Smolt Ltd was established on November 6, 2019, when instruments were initially deployed at each of the three wells in the network: MW5/6, FMW10, and FMW12.
- Since initial deployment, data has been monitored closely to determine if the instruments are accurately placed in the well casings and if there are other issues such as sensor errors.
- QA/QC rankings were obtained when grab samples could be collected.
- Water temperature at MW5/6 showed the most variability in the network due to seasonal temperature changes, while temperatures at FMW10 showed an increase and FMW12 was stable throughout 2023.
- Over the course of the year, water depth was relatively stable at both MW5/6 and FMW12, while the data illustrates a slight increase at FMW10. All wells in the network displayed a similar variability throughout the 2023 deployments.
- pH at MW5/6 was slightly acidic and showed the most variability in the network. pH values at FMW10 and FMW12 were relatively similar: stable and slightly basic.
- Specific conductivity was generally lowest at MW5/6. Levels at FMW10 peaked in late February before slowly decreasing for the remainder of the year. FMW12 were relatively stable throughout the year.
- ORP for FMW10 and FMW12 stations was generally oxidative, except at MW5/6 which was both oxidative and reductive. There were numerous fluctuations throughout the year at all three stations, but MW5/6 experienced fluctuations more frequently and to a higher degree.
- During 2023, the instruments performed well with few issues.

Path Forward

- Staff will continue to monitor the data for issues.
- If necessary, deployment techniques will be evaluated and modified, ensuring secure and suitable conditions for RTWQ monitoring.
- ECC will continue to work on its Automatic Data Retrieval System (ADRS), to incorporate new capabilities in data management and data display.
- Open communication lines will continue to be maintained between ECC and Northern Harvest Smolt Ltd in order to respond to emerging issues on a proactive basis. Northern Harvest Smolt Ltd. will receive deployment reports and an annual report summarizing the events of the deployment season.

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Appendix 1: Air Temperature and Precipitation at Stephenville, NL

