

Real-Time Water Quality Annual Report

Northern Harvest Smolt Ltd.

October 13th, 2022 to February 27th, 2023



Government of Newfoundland & Labrador
Department of Environment and 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 joint 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.ECC.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWMW56
NLGWFMW10: https://www.ECC.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW10
NLGWFMW12: https://www.ECC.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW12
- MW5/6 – This 50mm well is one of the thirteen wells which make up the Northern Harvest near field monitoring well network within 500m of the water supply area. This is a relatively shallow well at 2.92 m.
- FMW10 - This 50mm well is one of the five wells which make up the Northern Harvest far-field monitoring network which is set up outside the 500m radius of the hatchery. This well is relatively deep at 22.54 m.
- FMW12 – This 152mm well is one of the thirteen wells which make up the Northern Harvest near-field monitoring well network which is within 500m of the water supply area. This well is relatively deep at 31.16 m.



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

- 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 quarterly and annual deployment reports for 2022. Data is available in near real-time on the ECC's website.
- 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.



(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.

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, 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 also 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
MW5/6	13-OCT-2022	Deployment	19D105281	Marginal	Good
FMW10	13-OCT-2022	Deployment	19E100387	Good	Good
FMW12	13-OCT-2022	Deployment	19D105282	Excellent	Excellent

Data Interpretation

- The following graphs and discussion illustrate water quality and level related events from October 13th, 2022 to February 27th, 2023 at Northern Harvest Smolt.
- 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

- After the initial acclimatization period, water temperature ranged from 4.85°C to 12.28°C within the well network (Table 3).
- During the October 2022 to February 2023 deployment, FMW10 and FMW12 temperatures varied little, maintaining relatively steady temperatures, while MW5/6 temperature was steadily decreasing (Figure 3).
- This change in water temperature at MW5/6 may be related to decreasing air and water temperatures in the surrounding environment as Fall turned into Winter.

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

	MW5/6	FMW10	FMW12
MIN.	4.85	6.55	6.82
MAX.	12.28	7.22	6.84
MEDIAN	6.65	6.72	6.93

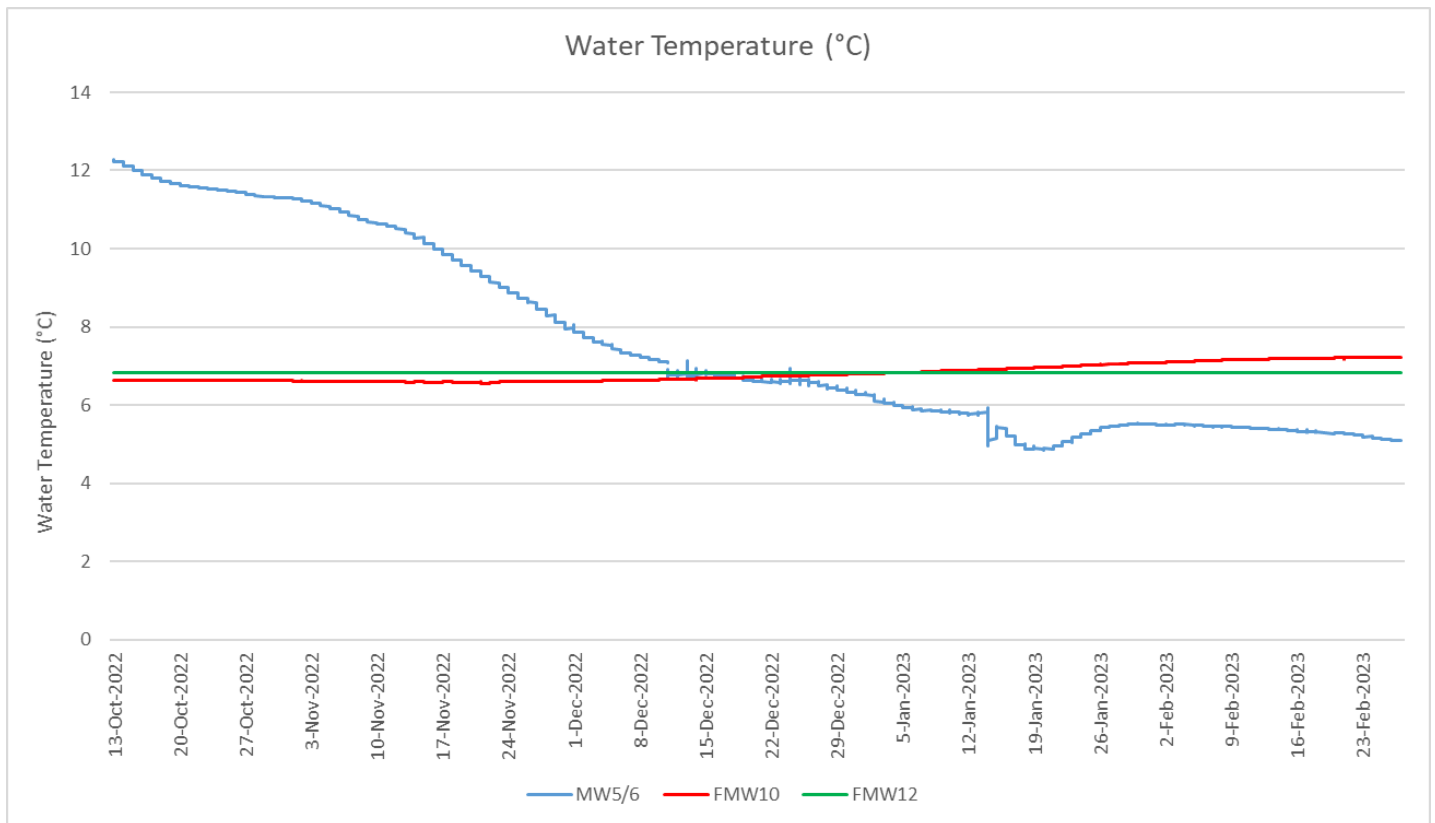


Figure 3: Water Temperature (°C) – Northern Harvest Smolt Ltd. Network

Water Depth

- During the deployment, MW5/6 and FMW12 were relatively stable while FMW10 showed a slight increasing trend (Table 4). Slight variations in level were noticeable concurrently at all wells at the same time (Figure 4). Manganese

Table 4: Water Depth (MASL) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	1.69	6.44	6.43
MAX.	2.29	8.03	7.14
RANGE	0.60	1.59	0.71
MEDIAN	1.98	7.29	6.82

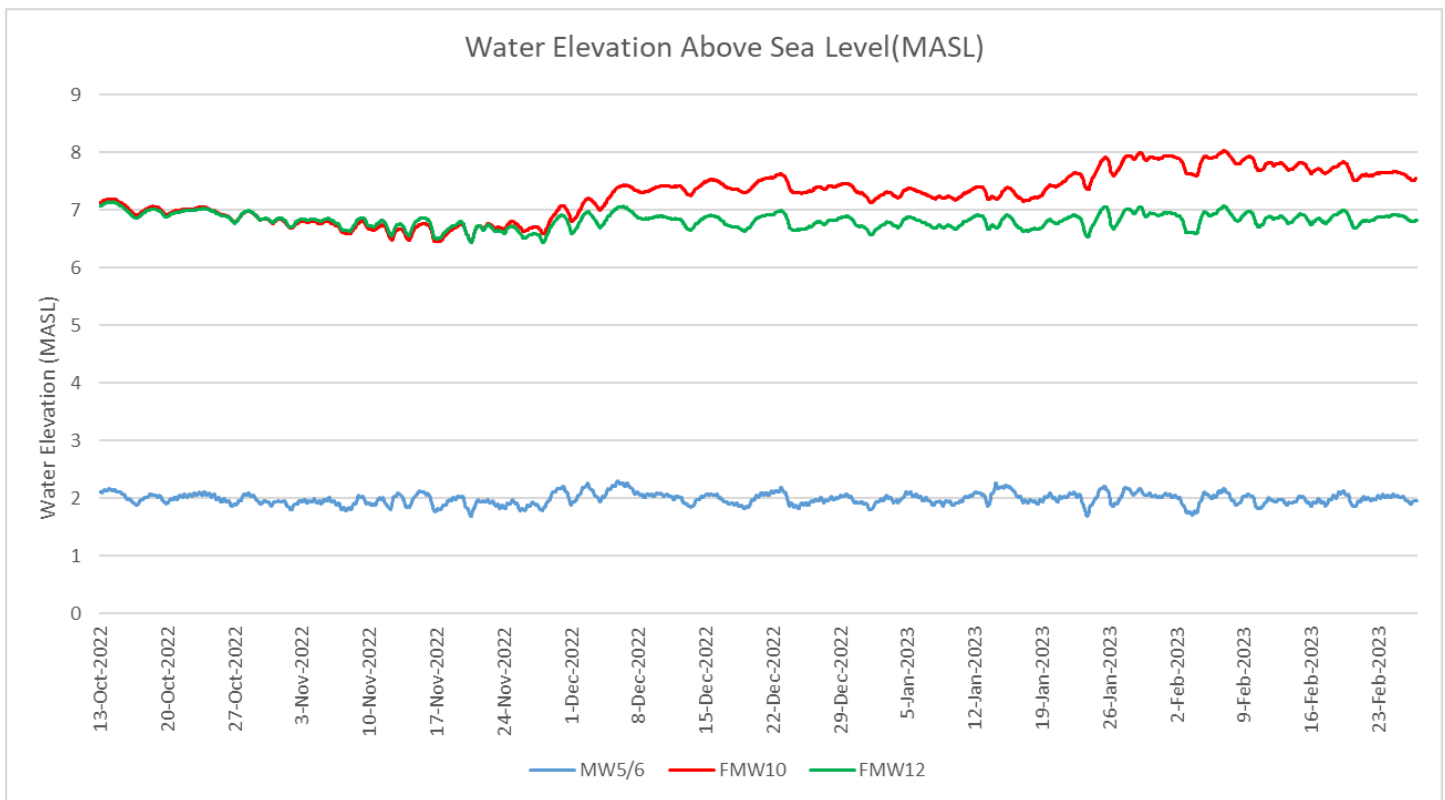


Figure 4: Water Depth (m) – Northern Harvest Smolt Ltd. Network

pH

- After the initial acclimatization period, pH ranged from 5.62 to 7.95 pH units within the well network (Table 5).
- FMW10 & FMW12 were slightly basic for pH while MW5/6 pH levels were slightly more acidic. All three stations were relatively stable with little variation throughout this deployment (Figure 5).

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

	MW5/6	FMW10	FMW12
MIN.	5.62	7.34	7.7
MAX.	6.07	7.75	7.95
MEDIAN	5.93	7.57	7.89

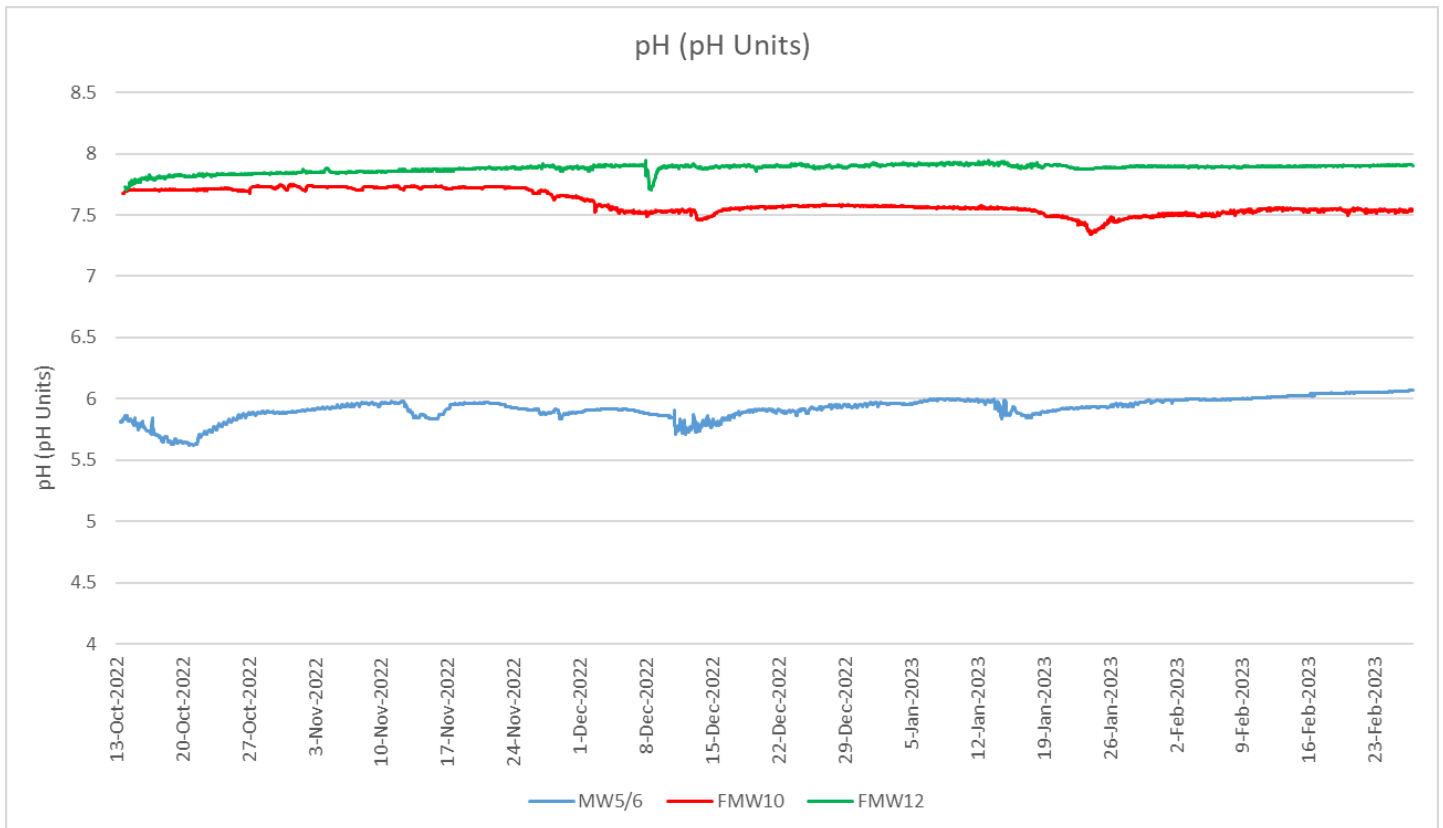


Figure 5: pH – Northern Harvest Smolt Ltd. Network

Specific Conductance and TDS

- After the initial acclimatization period, specific conductance ranged from 110.41 $\mu\text{S}/\text{cm}$ to 632.23 $\mu\text{S}/\text{cm}$ within the well network (Table 6).
- During the deployment, FMW12 displays little variation, FMW10 slowly increases, and MW5/6 displays daily fluctuations (Figure 6).

Daily changes at MW5/6 could also be due to the well being shallower and potentially influenced by climate changes around the well head.

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.	110.41	353.93	358.29	MIN.	0.07	0.23	0.23
MAX.	632.23	519.13	370.35	MAX.	0.41	0.34	0.24
MEDIAN	232.11	417.22	361.80	MEDIAN	0.15	0.27	0.24

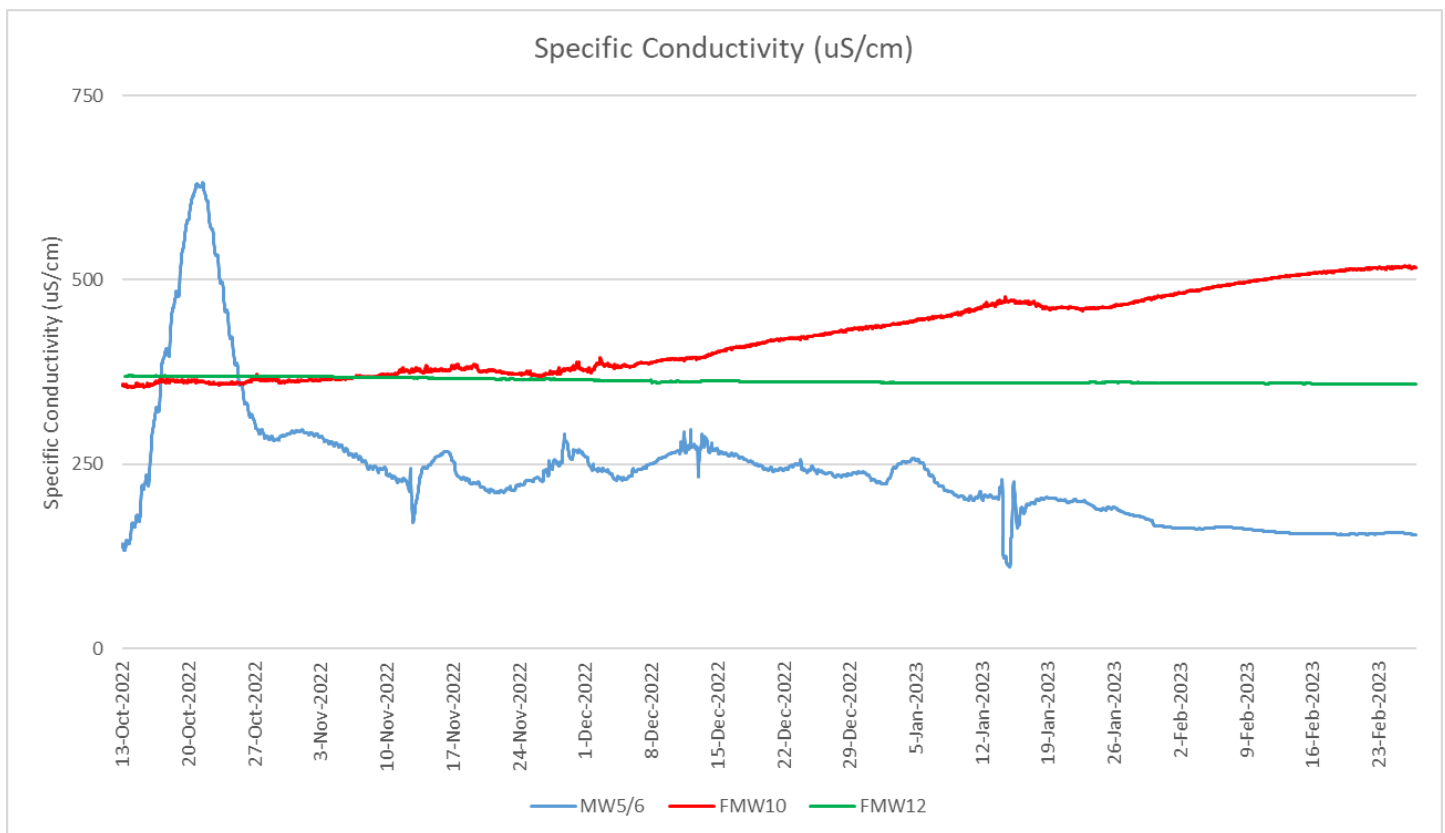


Figure 6: Specific Conductivity – Northern Harvest Smolt Ltd. Network

- After the initial acclimatization period, total dissolved solids (TDS) ranged from 0.07 mg/L to 0.41 mg/L within the well network (Table 6).
- TDS varied little at FMW12, while at FMW10, TDS increased from November onward. At MW5/6 TDS fluctuated daily (Figure 7).

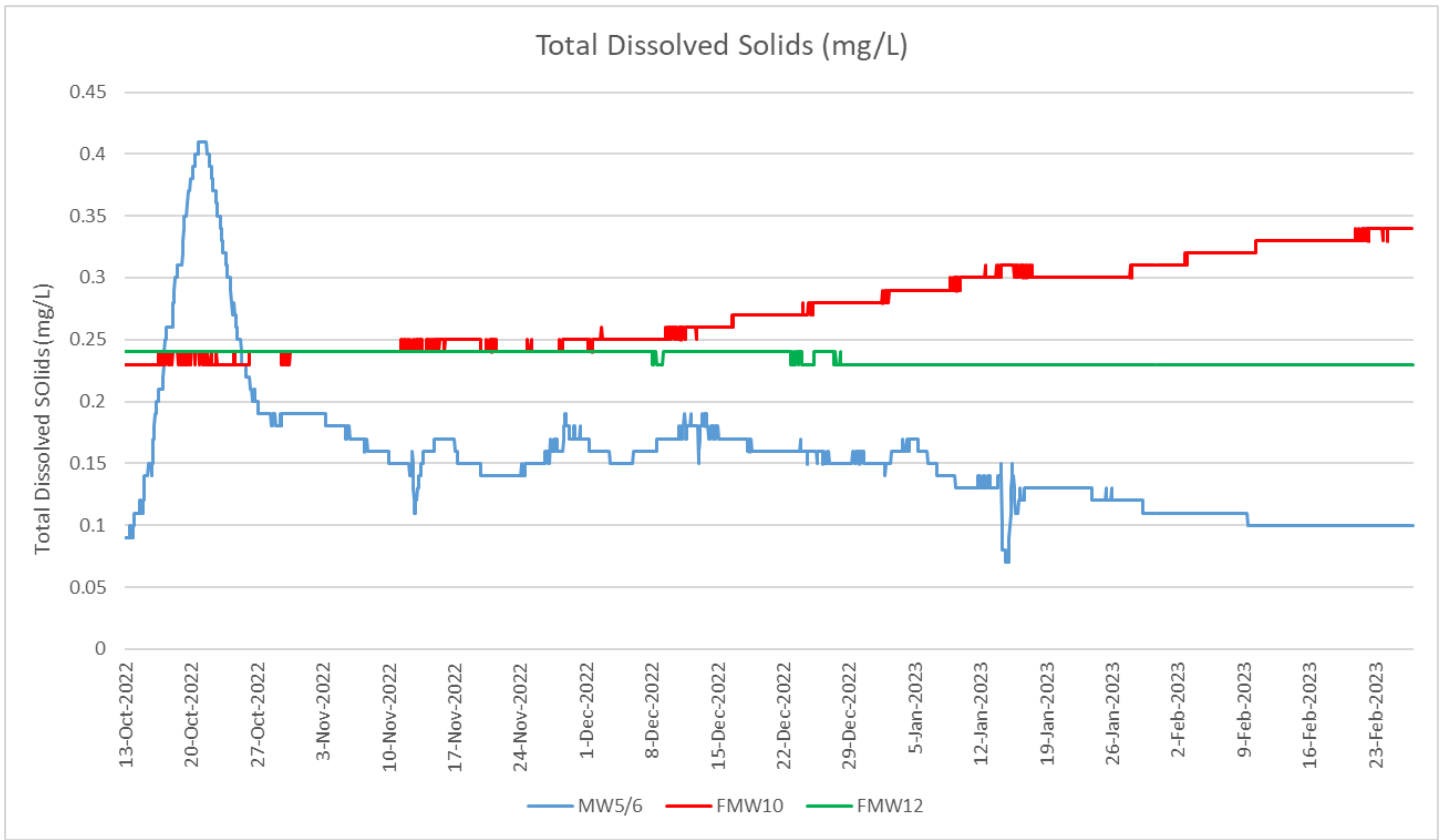


Figure 7: Total Dissolved Solids – Northern Harvest Smolt Ltd. Network

Oxidation – Reduction Potential (ORP)

- After the initial acclimatization period, oxidation-reduction potential (ORP) ranged from 5.41 mV to 456.18 mV within the well network (Table 7).
- Over the duration of this deployment, MW5/6, FMW10 and FMW12 were oxidative in nature with MW5/6 showing the greatest variation (Figure 8).

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

	MW5/6	FMW10	FMW12
MIN.	5.41	338.04	115.99
MAX.	456.18	400.45	383.59
MEDIAN	29.49	389.62	367.3

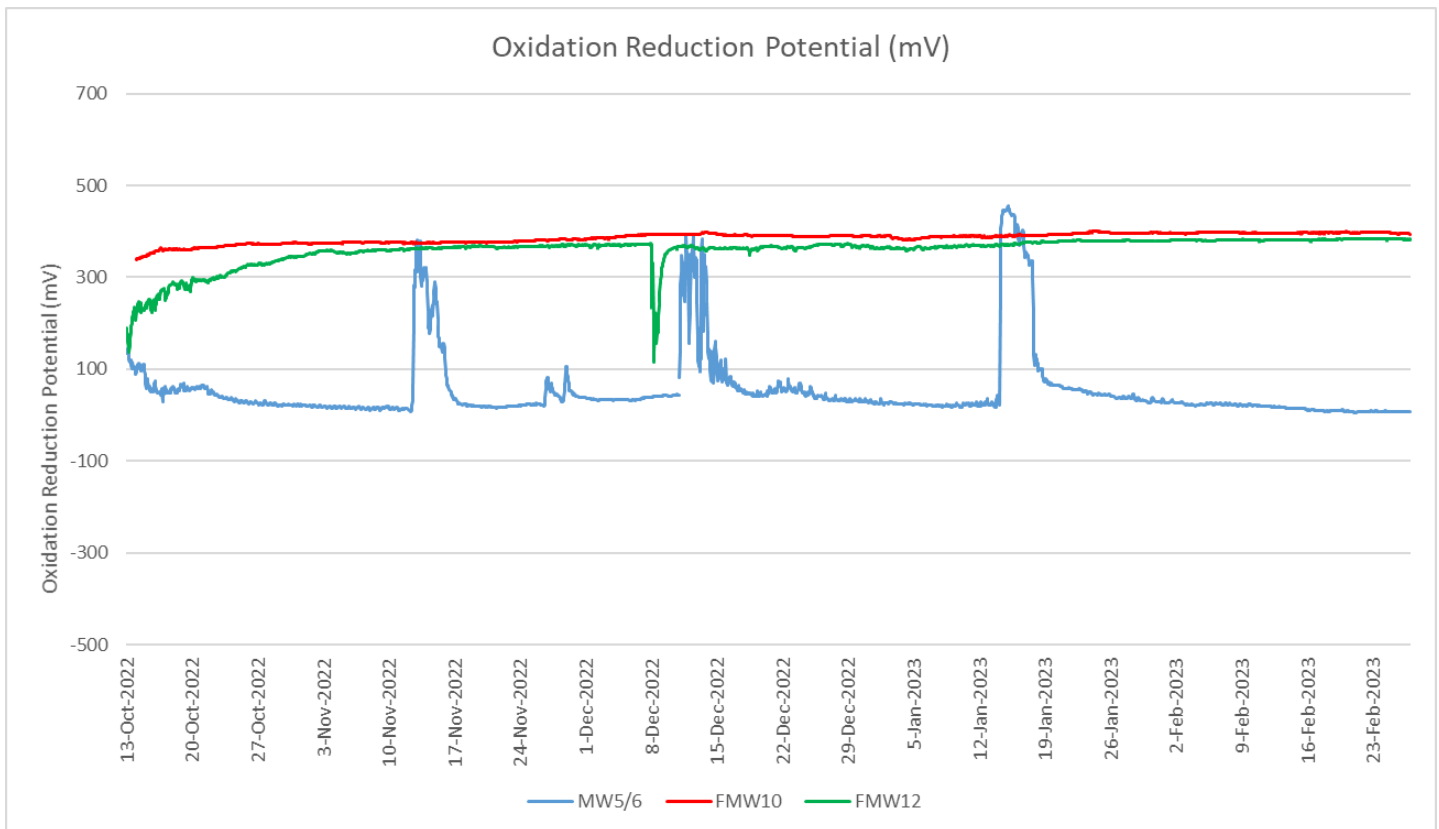


Figure 8: Oxidation-Reduction Potential (ORP) – Northern Harvest Smolt Ltd. Network

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.
- During this third deployment of 2022, data was monitored closely to determine if the instruments were accurately placed in the well casings and if there were other issues such as sensor errors.
- QAQC rankings were either “Marginal”, “Good” or “Excellent” for the well network. The “Marginal” ranking is likely due to exceeding the hold time of the MW5/6 grab sample.
- Water temperature at FMW10 and FMW12 were stable, while temperatures at MW5/6 steadily decreased and showed daily fluctuations.
- Water depth was relatively stable at MW5/6 and FMW12, while FMW10 showed a slight increasing trend.
- pH at FMW10 and FMW12 was slightly basic while MW5/6 was slightly acidic.
- Specific conductivity at FMW12 displays little variation, FMW10 slowly increases, and MW5/6 displays daily fluctuations.
- ORP at MW5/6, FMW10 and FMW12 was oxidative in nature with MW5/6 showing the greatest variation.
- For this deployment, the instruments performed well with few issues.

Path Forward

- Staff will continue to monitor the data daily 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 quarterly 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

