Real-Time Water Quality Annual Report

Outflow of the Steady at FireFly Metals Canada

August 27 to November 1, 2024

Newfoundland Labrador

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

Contents

General

- The Water Resources Management Division, in partnership with FireFly Metals Canada, formerly Rambler Metals and Mining Canada Ltd., maintain one real-time water quality and water quantity station at the Outflow of the Steady.
- This station is situated downstream of the Nugget Pond Mill tailings management facility (Figure 1).
- On August 27, 2024, a real-time water quality monitoring instrument was deployed at the station Outflow of the Steady. The instrument was deployed for a period of 64 days. This was the first and only deployment of water quality instrumentation at this station in 2024. Hydrometric instrumentation is deployed year-round.
- Water Resources Management Division staff monitor the real-time web pages regularly.

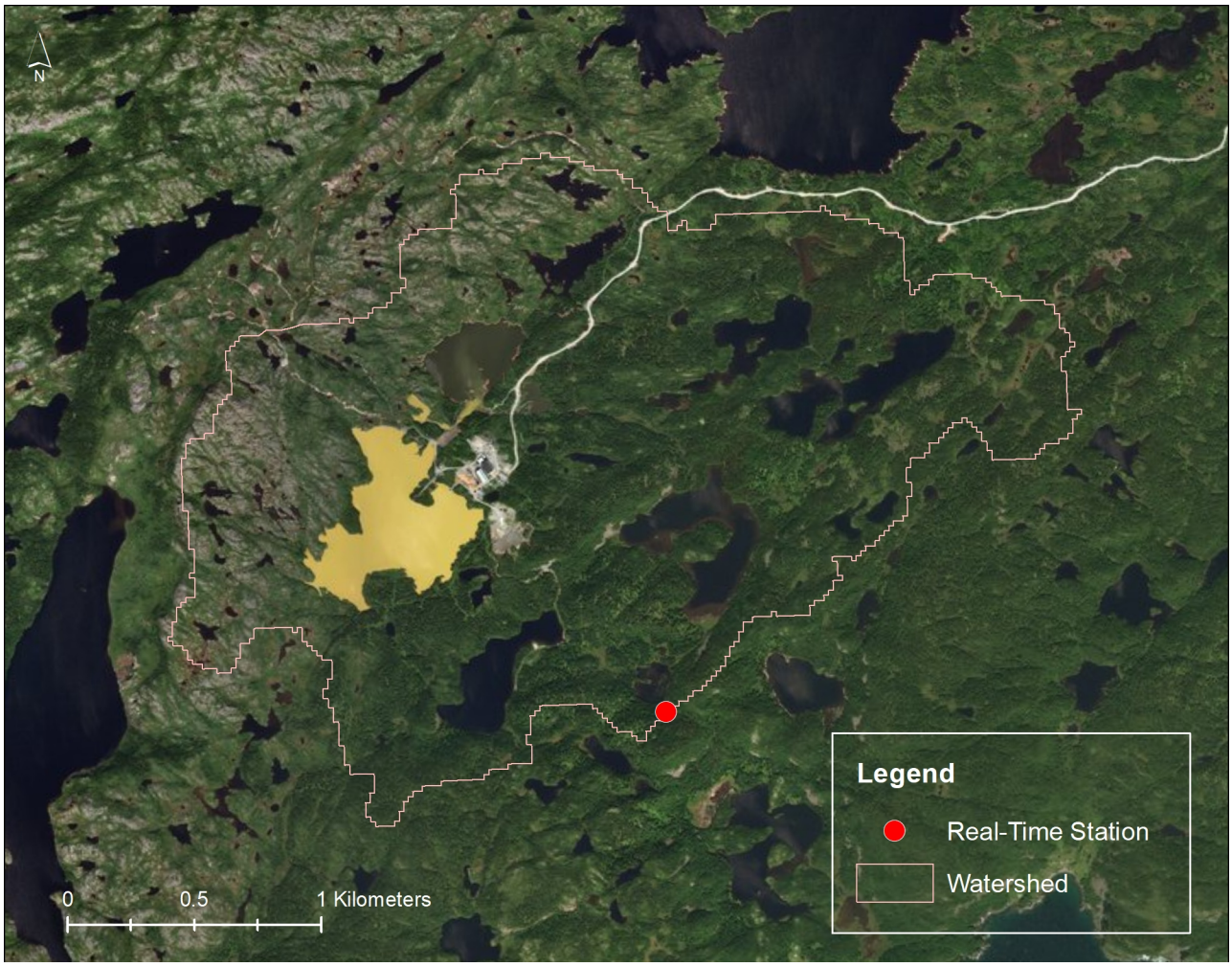

Figure 1: Location of the real-time station downstream of FireFly's Nugget Pond Mill tailings management facility

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 the deployment period. The procedure is based on the approach used by the United States Geological Survey.
  - At deployment and removal, a QA/QC Sonde is temporarily deployed adjacent to the Field Sonde. Values for temperature, pH, conductivity, dissolved oxygen and turbidity are compared between the two instruments**.** Based on the degree of difference between parameters recorded by the Field Sonde and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality (Table 1).

Table 1: Ranking classifications for deployment and removal

	Rank				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (°C)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	<+/-1
pH (unit)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Sp. Conductance (µS/cm)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Sp. Conductance > 35 µS/cm (%)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Dissolved Oxygen (mg/L) (% Sat)	<=+/-0.3	>+/-0.3 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Turbidity <40 NTU (NTU)	<=+/-2	>+/-2 to 5	>+/-5 to 8	>+/-8 to 10	>+/-10
Turbidity > 40 NTU (%)	<=+/-5	>+/-5 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20

- It should be noted that the temperature sensor on any sonde is the most important. All other parameters can be broken down into three groups: temperature dependant, temperature compensated and temperature independent. Because the temperature sensor is not isolated from the rest of the sonde the entire sonde must be at the same temperature before the sensor will stabilize. The values may take some time to climb to the appropriate reading; if a reading is taken too soon it may not accurately portray the water body.

Deployment and removal comparison rankings for the station Outflow of the Steady deployed between August 27 and November 1, 2024, are summarized in Table 2.

Table 2: Comparison rankings for Outflow of the Steady station August 27 – November 1, 2024.

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Outflow of the Steady	August 27, 2024	Deployment	Excellent	Excellent	Poor	Excellent	Excellent
	November 1, 2024	Removal	Excellent	Excellent	Excellent	Good	Excellent

- Deployment rankings ranged from ‘excellent’ to ‘poor’. The ‘poor’ ranking was related to a faulty conductivity sensor on the QA/QC sonde. When compared to the collected grab sample data, conductivity ranked ‘good’ upon deployment.
- At removal, all parameters ranked ‘excellent’ or ‘good’.
- There are a few circumstances which may cause less than ideal QA/QC rankings to be obtained. These include: the placement of the QA/QC sonde in relation to the field sonde; the amount of time each sonde was given to stabilize before readings were recorded; and deteriorating performance of one of the sensors.

Data Interpretation

- The following graphs and discussion illustrate water quality related events from August 27 to November 1, 2024 at the station Outflow of the Steady.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Corrected data can be obtained upon request.

Outflow of the Steady

- Water temperature ranged from 5.56 to 21.76°C during this deployment period (Figure 2).
- Water temperature steadily decreased during the deployment. These fluctuations in water temperature correspond with ambient air temperatures as late summer progresses into fall (Figure 2).

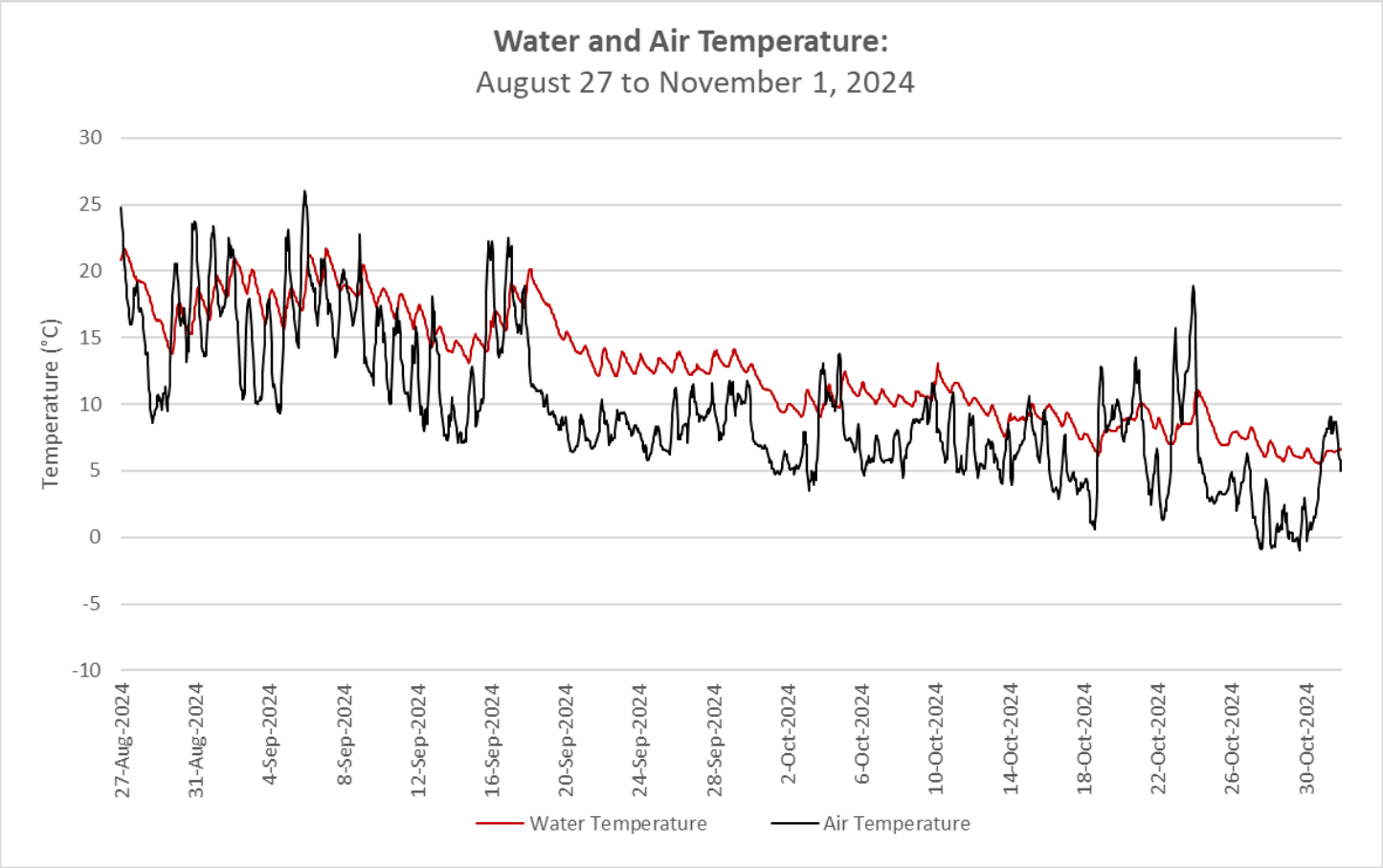

Figure 2: Water and Air Temperature – Outflow of the Steady

(Weather data collected at La Scie)

- pH ranged between 6.75 and 7.18 pH units throughout the deployment period, with a median value of 7.0 units (Figure 3).

Outflow of the Steady at FireFly Metals Canada, NL

- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units). pH fluctuates slightly during the day and night.
- Significant rainfall (evident as a rise in stage levels) can cause a slight dip in pH levels. This is a common occurrence in freshwater as the slightly acidic rain influences the overall pH of the river for a short period of time (Figure 3).
- Overall, pH showed a slight increasing trend throughout the deployment.

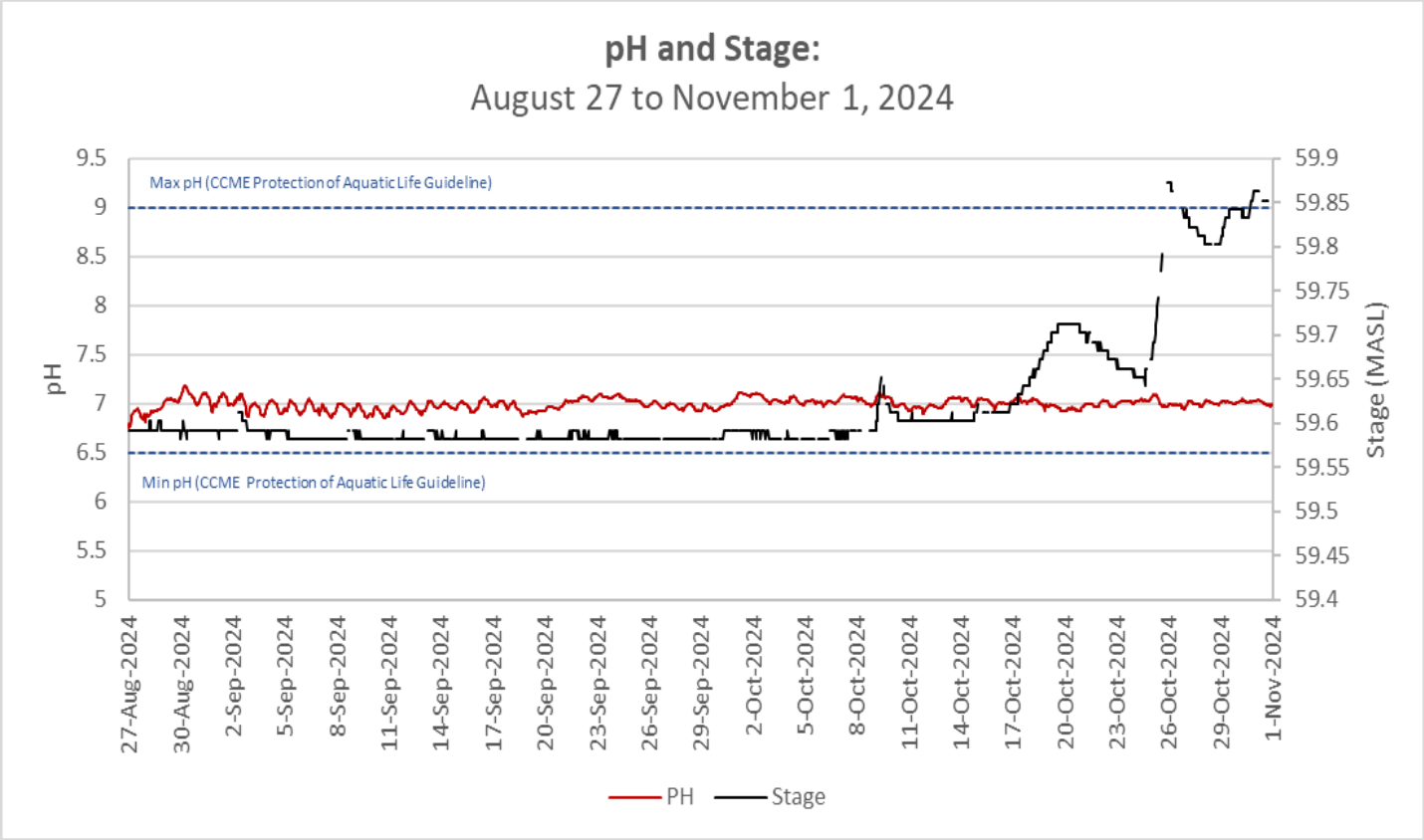

Figure 3: Water pH– Outflow of the Steady

- Specific conductivity ranged from 103.1 to 121.2 µs/cm (Figure 4).
- Specific conductivity was relatively stable until October, at which point it began to decrease. The decrease corresponds to an increase in precipitation observed throughout the remainder of the deployment.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Corrected data can be obtained upon request.

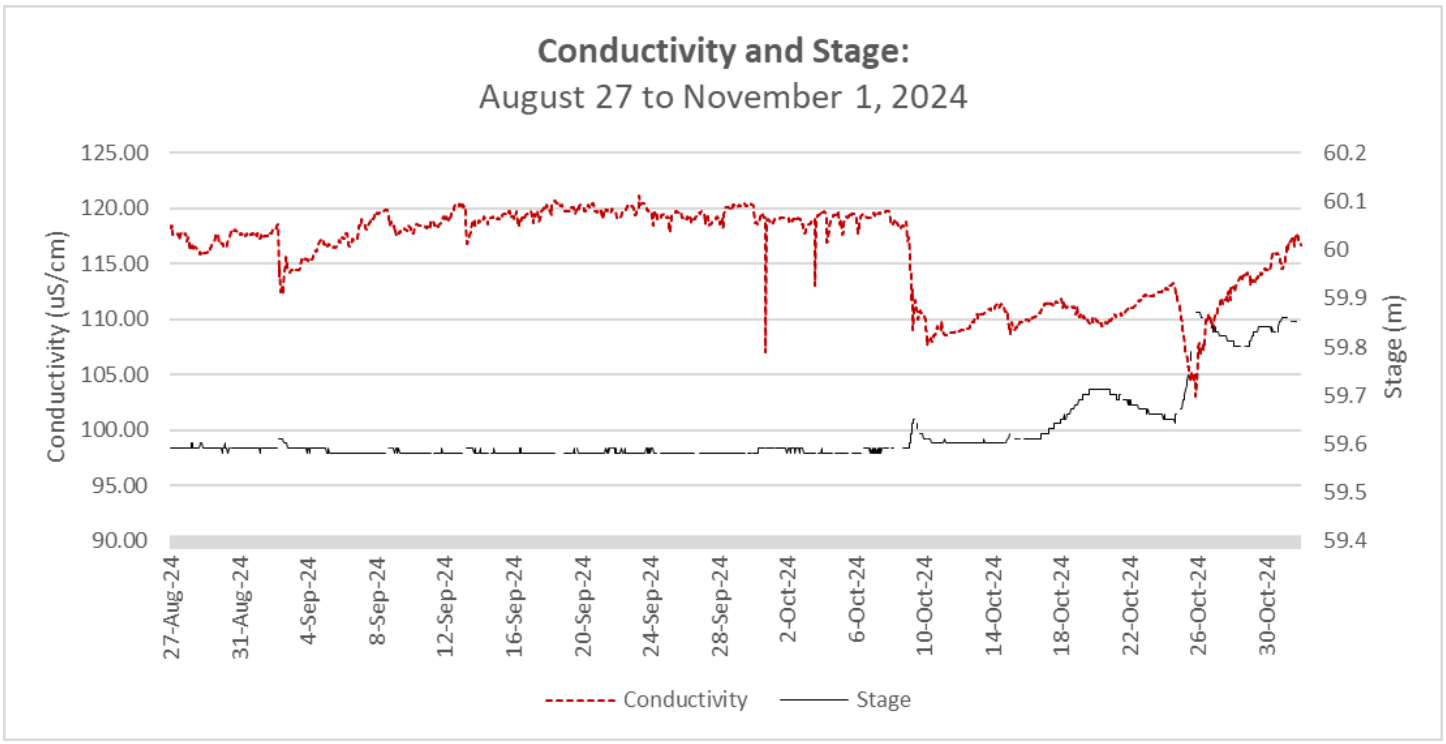

Figure 4: Specific Conductivity of Water - Outflow of the Steady

Outflow of the Steady at FireFly Metals Canada, NL

- The saturation of dissolved oxygen ranged from 82.5 to 104.3% and a range of 7.63 to 12.65 mg/l was recorded for the concentration of dissolved oxygen with a median value of 10.01 mg/l (Figure 5).
- All values were above the minimum CCME Guideline for the Protection of Other Life Stages of Cold Water Biota of 6.5 mg/l. The majority of values were above the minimum CCME Guideline for the Protection of Early Life Stages of Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in dark blue on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen gradually climbed throughout the deployment period as water temperatures cooled into Fall, corresponding closely to air temperature trends.

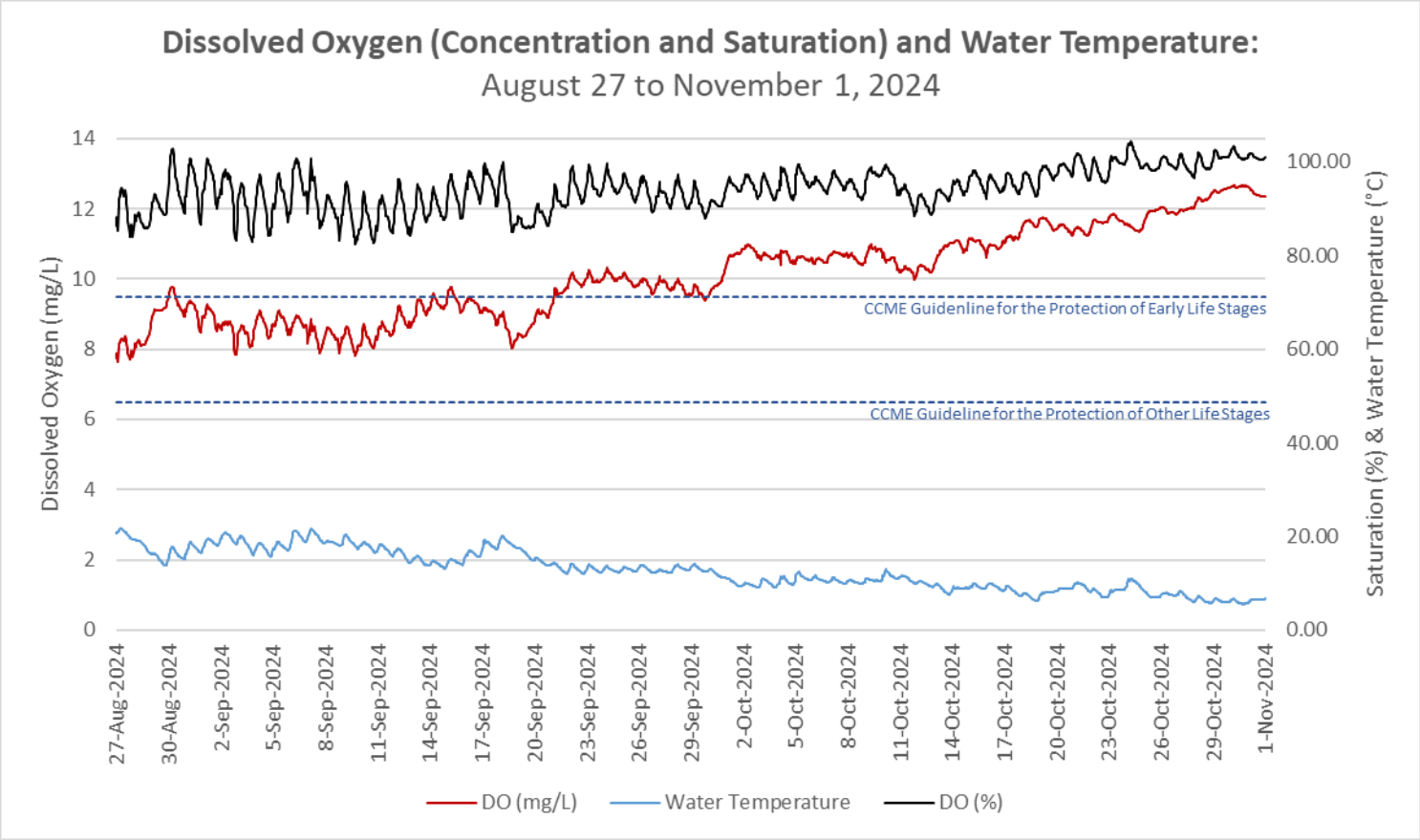

Figure 5: Dissolved Oxygen and Water Temperature – Outflow of the Steady

- Turbidity values range from 0.34 NTU to 13.25 NTU with a median of 1.15, indicating very clear background turbidity.
- Turbidity increased during periods of precipitation, indicating either sediment was washed into the river with the precipitation, or the increased stage level and turbulence caused sediment in the river to suspend within the water column, increasing turbidity values until the sediment settled out again (Figure 6).

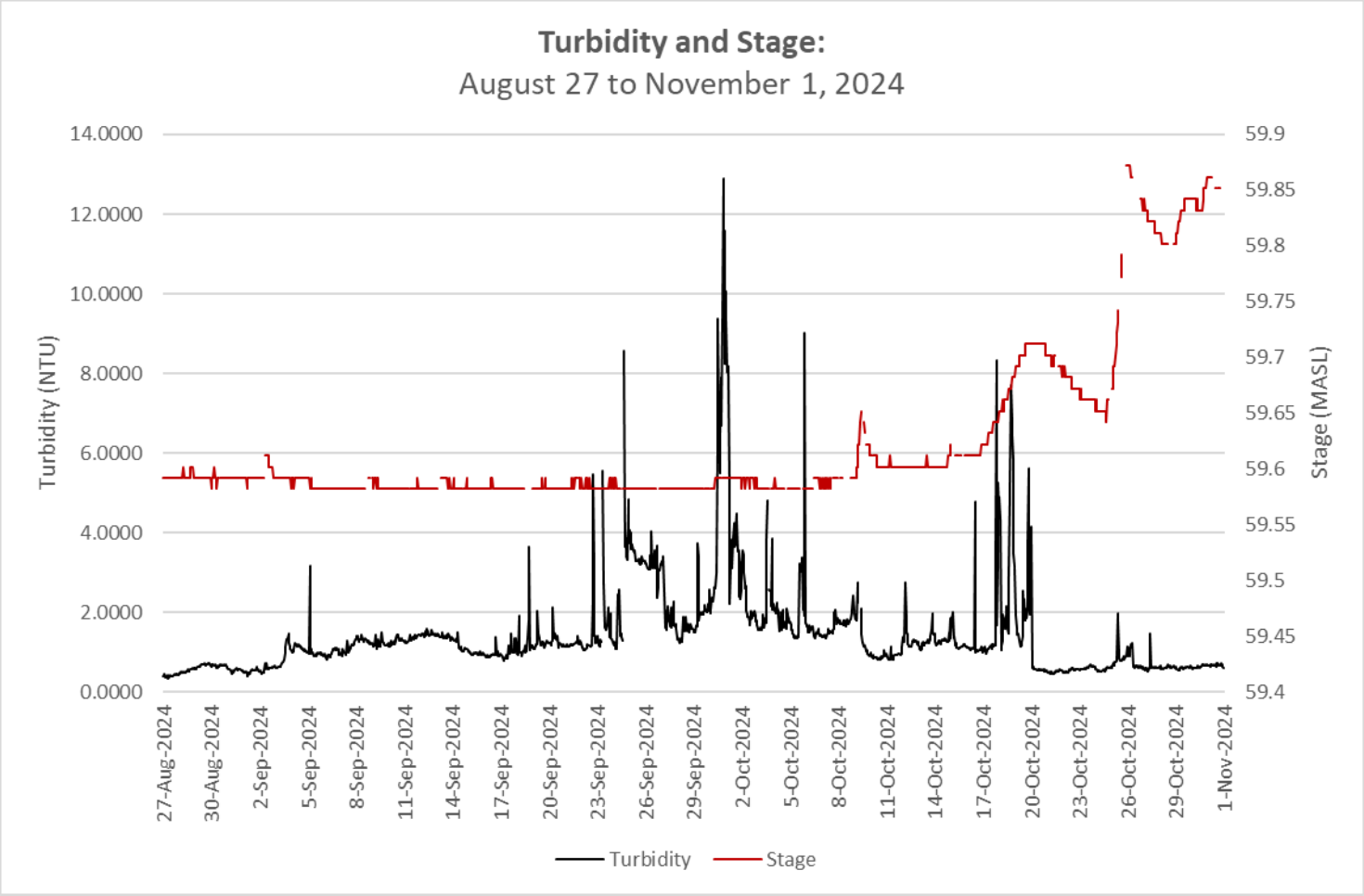

Figure 6: Turbidity – Outflow of the Steady

- Precipitation during the deployment period is graphed below (Figure 7).
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Corrected data can be obtained upon request.

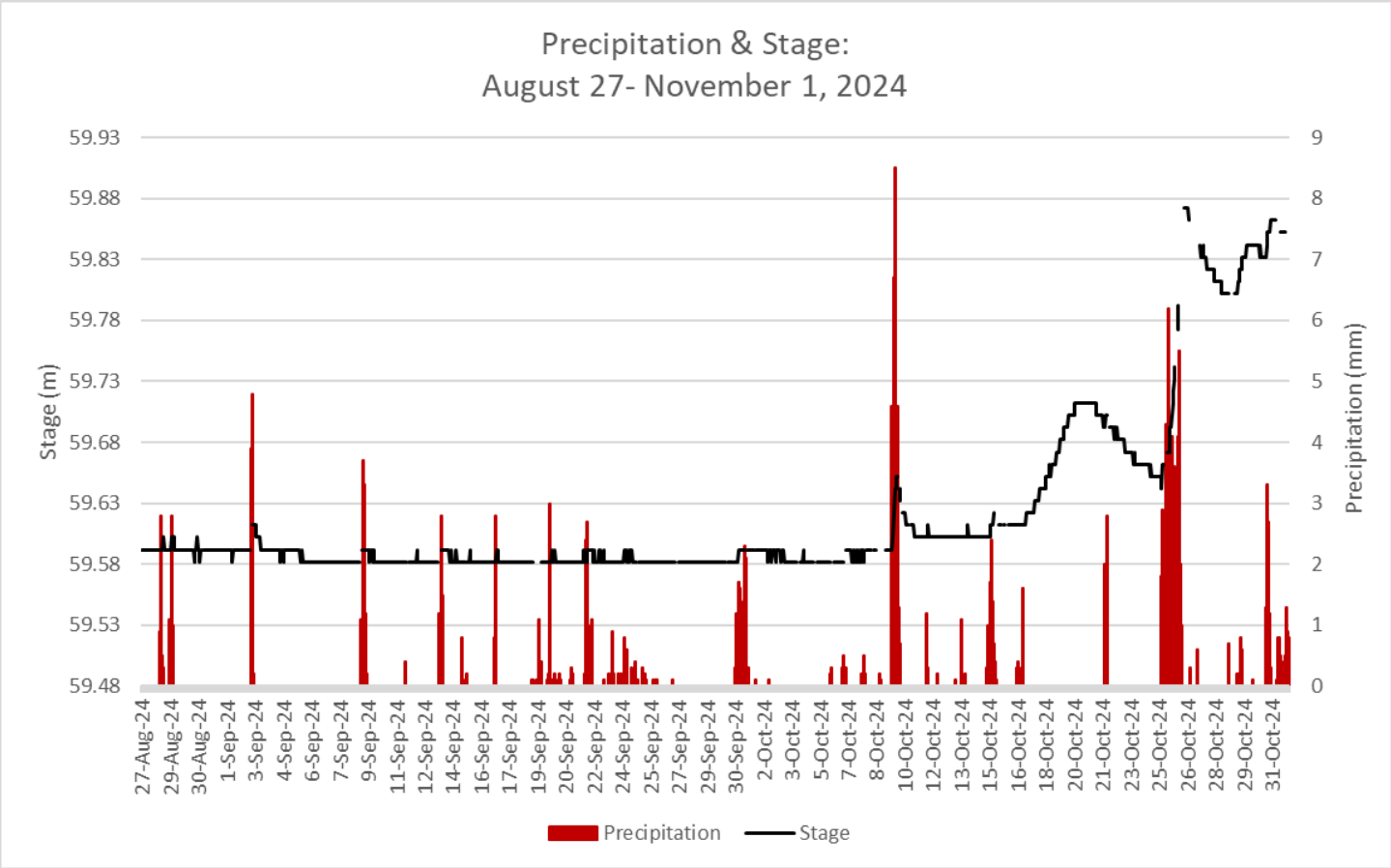

Figure 7: Precipitation – Outflow of the Steady

Conclusions

- An instrument was deployed at the Outflow of the Steady water quality monitoring station on August 27 and removed on November 1, 2024. This was the first and only deployment of water quality instrumentation during the 2024 season. Hydrometric instrumentation is deployed year-round.
- In most cases, weather related events (precipitation) explain parameter fluctuations.
- Water temperature steadily decreased during the deployment period, ranging from 5.56 to 21.76°C. This is expected due to the influence of the ambient air temperature as the late summer season transitions to fall.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 6.75 and 7.18. The brook is influenced by high precipitation events which decrease pH values for a short time before recovering.
- Specific conductivity ranged from 103.1 to 121.2 µs/cm, showing a stable trend during the deployment, with fluctuations due to precipitation.
- Dissolved oxygen values were steadily increasing into Fall and remained above the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l. The majority of values were above the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l. The values below this guideline correspond to periods of warmer water temperatures.
- Turbidity values of 0.34 NTU to 13.25 NTU with a median of 1.15 NTU indicated low background turbidity, influenced by precipitation events.
- Stage was relatively stable until an increase in precipitation in October led to an increase in stage.
- All data used in the preparation of the graphs and subsequent discussion adhere to stringent QA/QC protocol. Corrected data can be obtained upon request.

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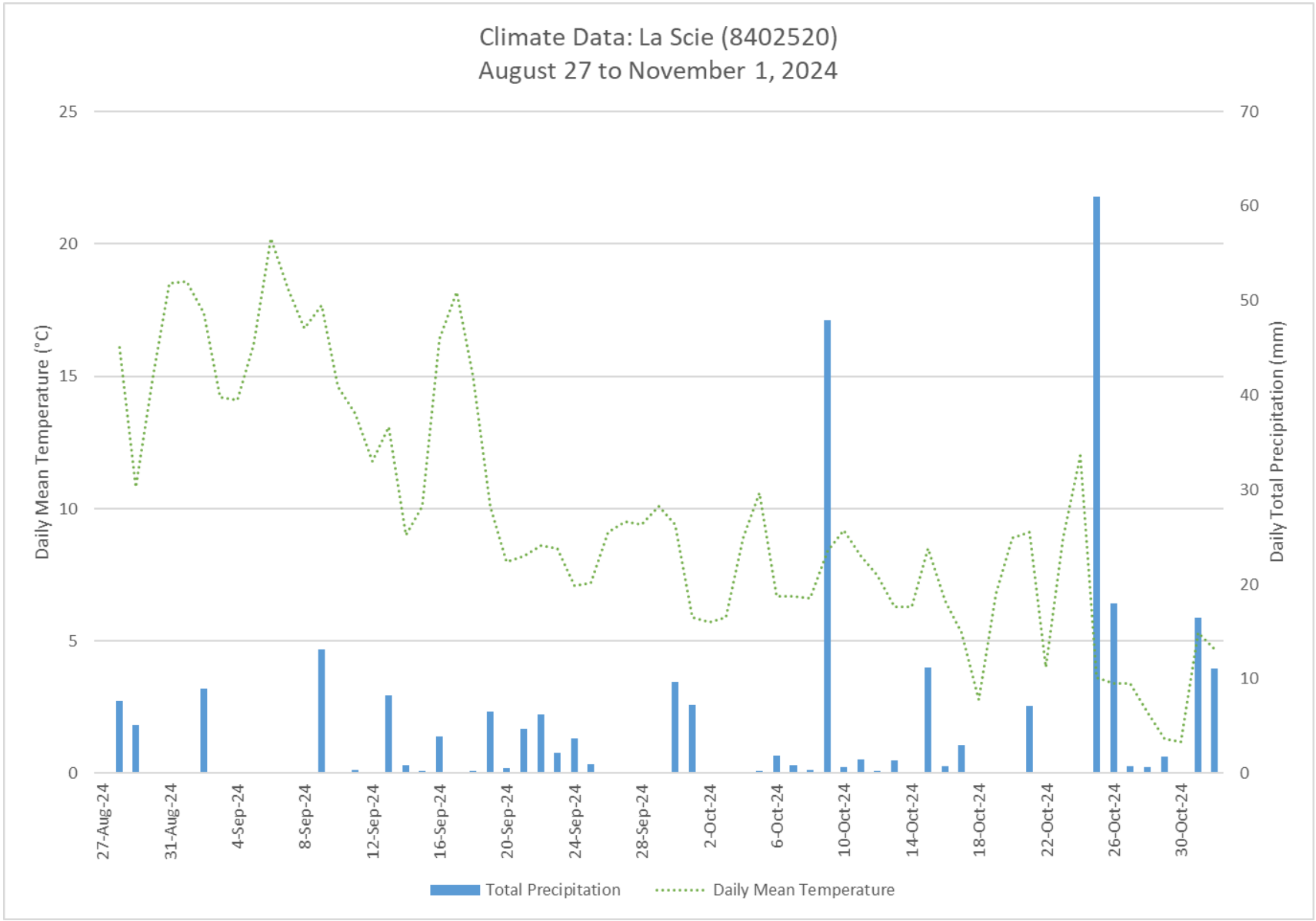
Appendix 1


Climate Data: La Scie (8402520)
August 27 to November 1, 2024
Daily Mean Temperature (°C)
Daily Total Precipitation (mm)
25
20
15
10
5
0
70
60
50
40
30
20
10
0
27-Aug-24
31-Aug-24
4-Sep-24
8-Sep-24
12-Sep-24
16-Sep-24
20-Sep-24
24-Sep-24
28-Sep-24
2-Oct-24
6-Oct-24
10-Oct-24
14-Oct-24
18-Oct-24
22-Oct-24
26-Oct-24
30-Oct-24
Total Precipitation
Daily Mean Temperature