# Real-Time Water Quality Deployment Report

## Marathon Gold Corp Network

**July 13 to September 6, 2023**

Newfoundland Labrador

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

## General

This report will review the water quality data for the following real-time water quality monitoring stations at Marathon Gold network: Victoria River Outlet, Valentine River Outlet, and Roebucks Brook, for the duration of July 13 to September 6, 2023.

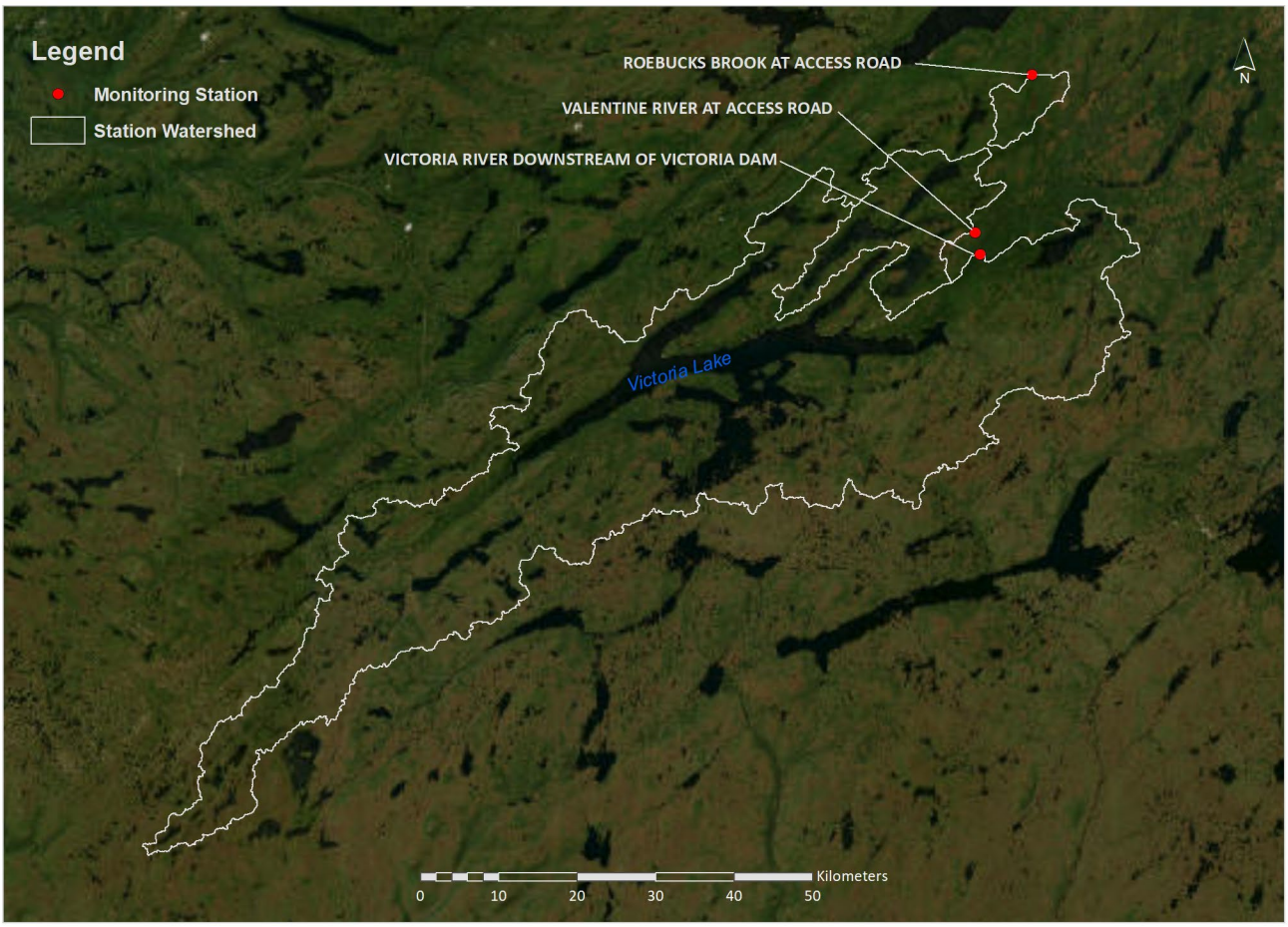



**Figure 1: Location of the Marathon Gold Corp. Real Time Surface Water Quality Network (November 2022)**

## 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 Marathon Gold Corp Surface Water Monitoring Network between July 13th and September 6th , 2023 are summarized in Table 2.

**Table 2: Comparison rankings for Marathon Gold Corp. Surface Water Monitoring Network July 13 – September 6, 2023**

| **Station** | **Date** | **Action** | **Comparison Ranking** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **Temperature** | **pH** | **Conductivity** | **Dissolved Oxygen** | **Turbidity** |
| **Victoria River** | July 13th | Deployment | Excellent | Fair | Excellent | Excellent | Excellent |
| | September 6th | Removal | Excellent | Fair | Excellent | Fair | Excellent |
| **Valentine** | July 13th | Deployment | Excellent | Excellent | Excellent | Good | Excellent |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **River** | September 6th | Removal | Excellent | Good | Excellent | Marginal | Excellent |
| **Roebucks Brook** | July 13th | Deployment | Excellent | Excellent | Excellent | Fair | Fair |
| | September 6th | Removal | Good | Poor | Excellent | Poor | Excellent |

- 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.
- At deployment, most rankings were Good or Excellent with the exception of Roebucks Brook dissolved oxygen and turbidity which were Fair, and Victoria River's pH which was Fair. This may be due to the sondes not having acclimated before values were read.
- At removal, the rankings ranged from Excellent to Poor. This is again likely due to the sensors not having fully acclimated to the environment before readings were recorded, or possibly sensor drift.

## Data Interpretation

- The following graphs and discussion illustrate water quality related events from July 13 to September 6, 2023 at the three surface water quality/quantity real time monitoring stations in the Marathon Gold Corp Network.

### Victoria River

- Water temperature ranged from 13.05 to 26.28ºC during this deployment period (Figure 2).
- Water temperature showed a decreasing trend throughout deployment, corresponding to ambient air temperatures as the season progressed into late summer.

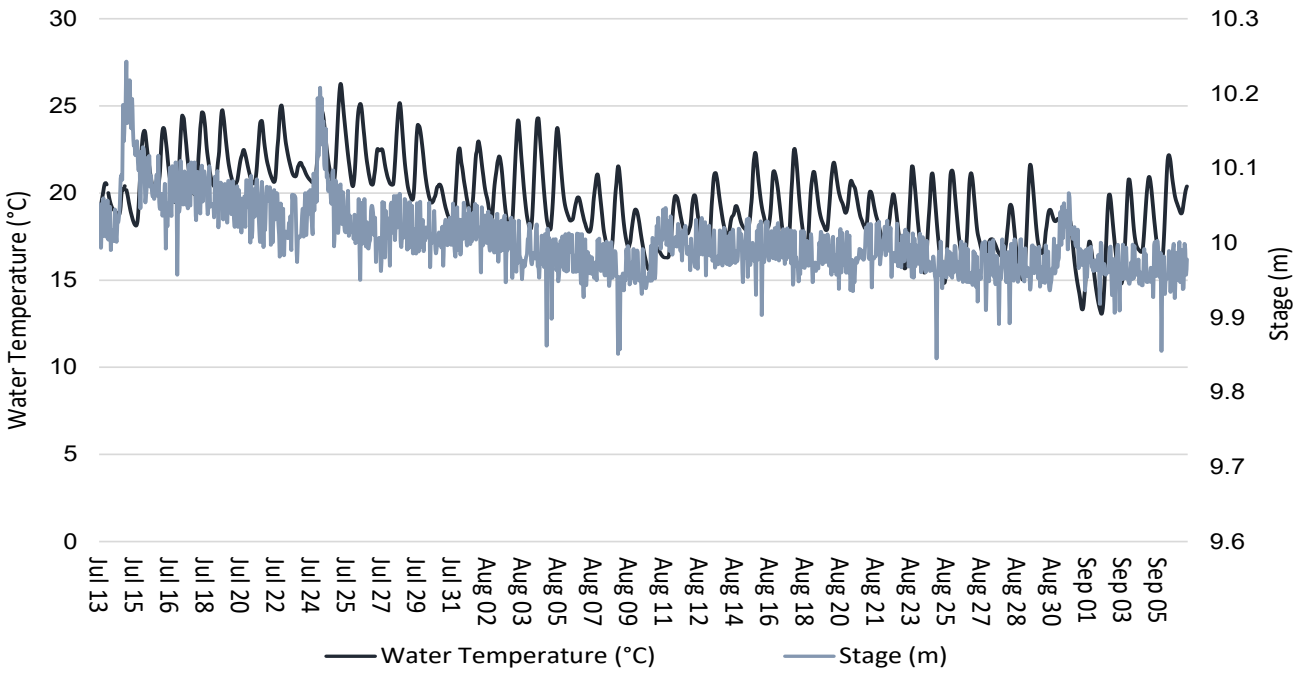



**Figure 2: Water Temperature and Stage**

- pH ranged between 6.78 and 7.43 pH units throughout the deployment period, with a median value of 7.05 units (Figure 3).
- 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.
- There are occasional small increases in pH associated with increased stage.
- Overall, pH was relatively stable for the deployment.

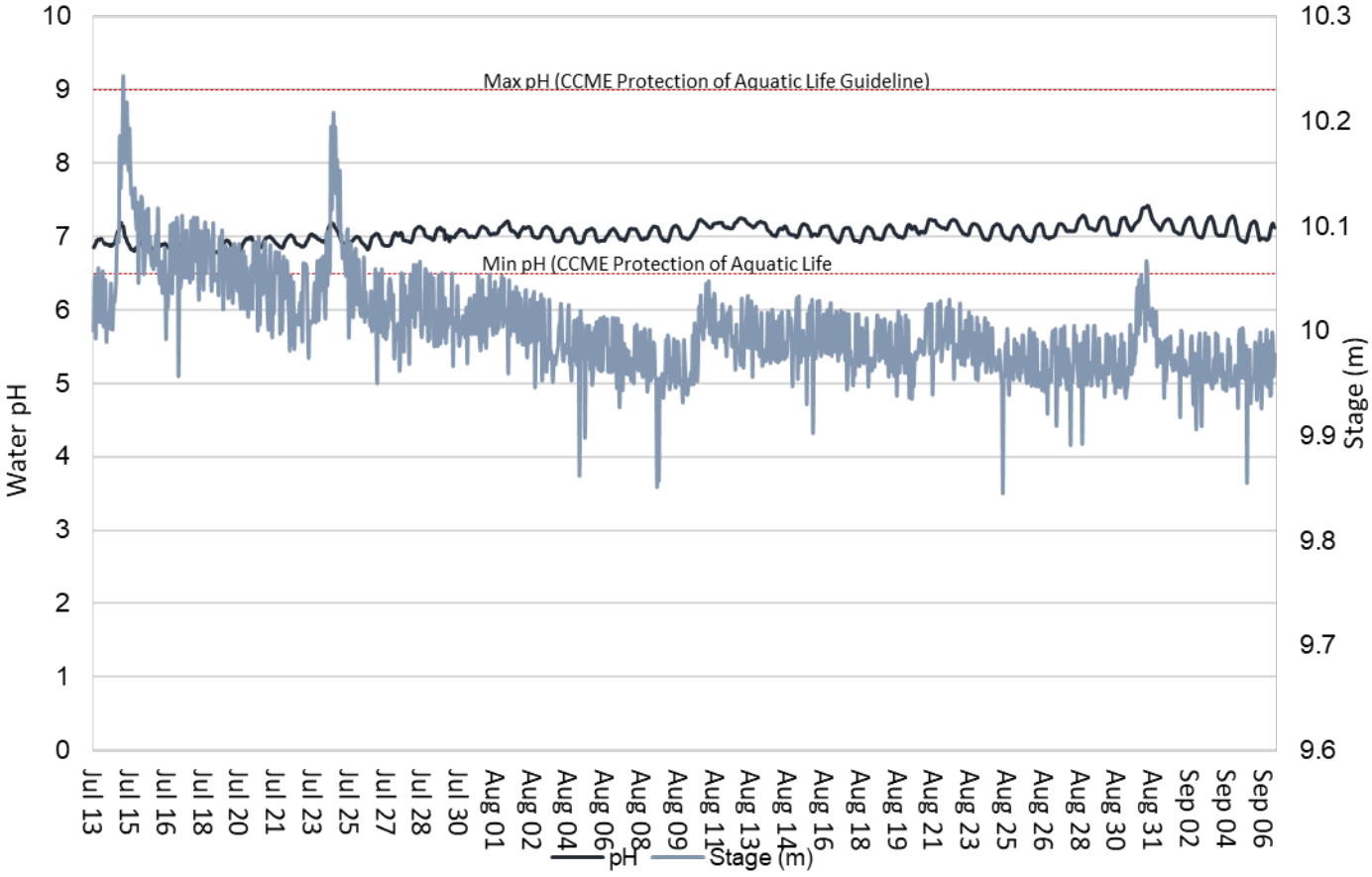



**Figure 3: Water pH and Stage**

- Specific conductivity ranged from 20.7 to 59.7 µs/cm (Figure 4) with a median of 26.1 µs/cm.
- Specific conductivity remained relatively stable over the course of this deployment period, except during periods of high precipitation which caused stage increases and corresponding increases in conductivity for a short time. This indicates the precipitation may cause particulates in the river sediment to re-suspend into the water column, increasing the conductivity for a short period of time before it settles out again.

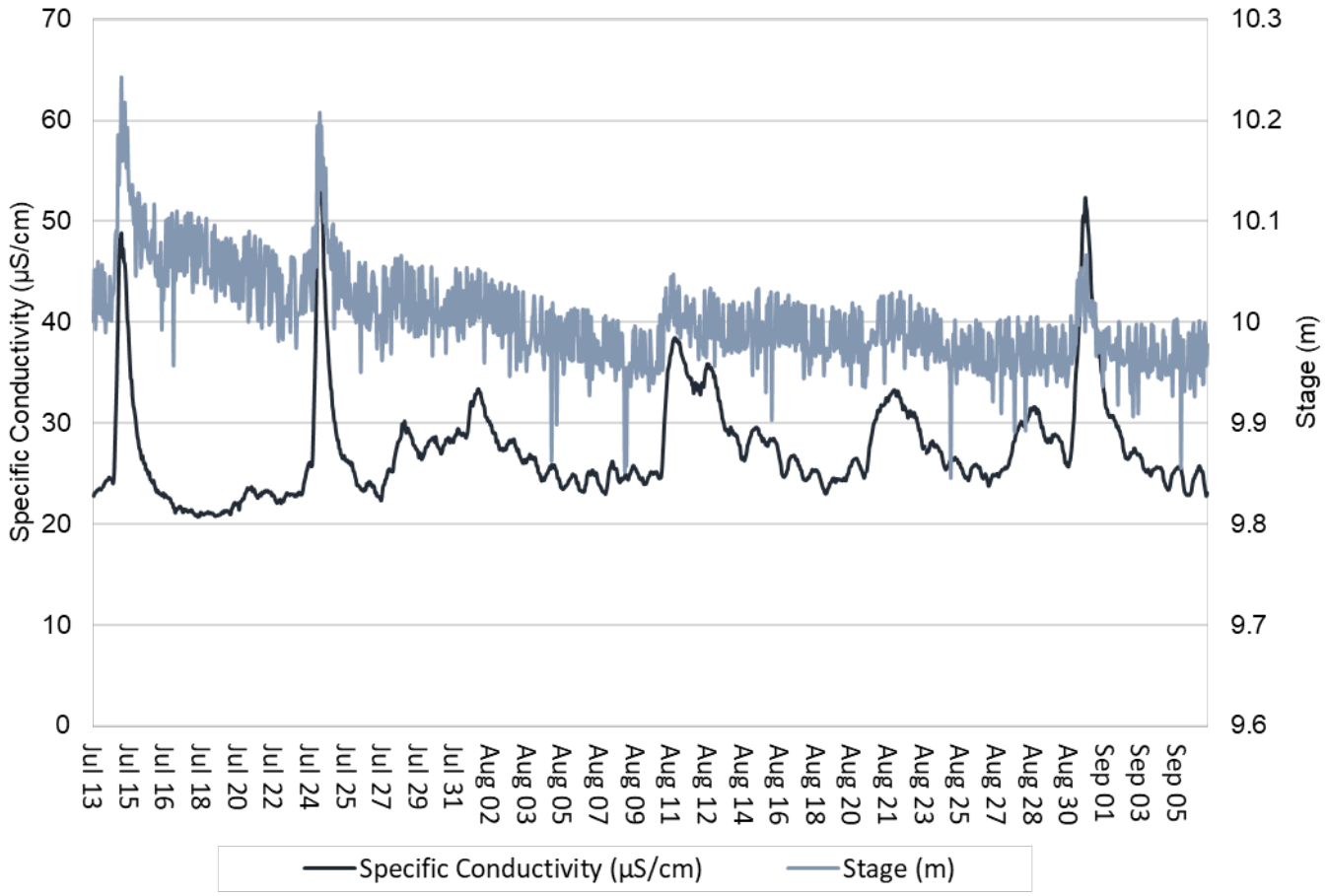



**Figure 4: Specific Conductivity of Water and Stage**

- The saturation of dissolved oxygen ranged from 87.2% to 110.8% and a range of 8.04 to 10.80 mg/l was found for the concentration of dissolved oxygen with a median value of 9.18 mg/l (Figure 5).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages but hovered around the Guidelines for Early Life Stage of Cold Water Biota. The guidelines are indicated in red on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen increased steadily during the deployment period as water temperatures cooled into late summer.

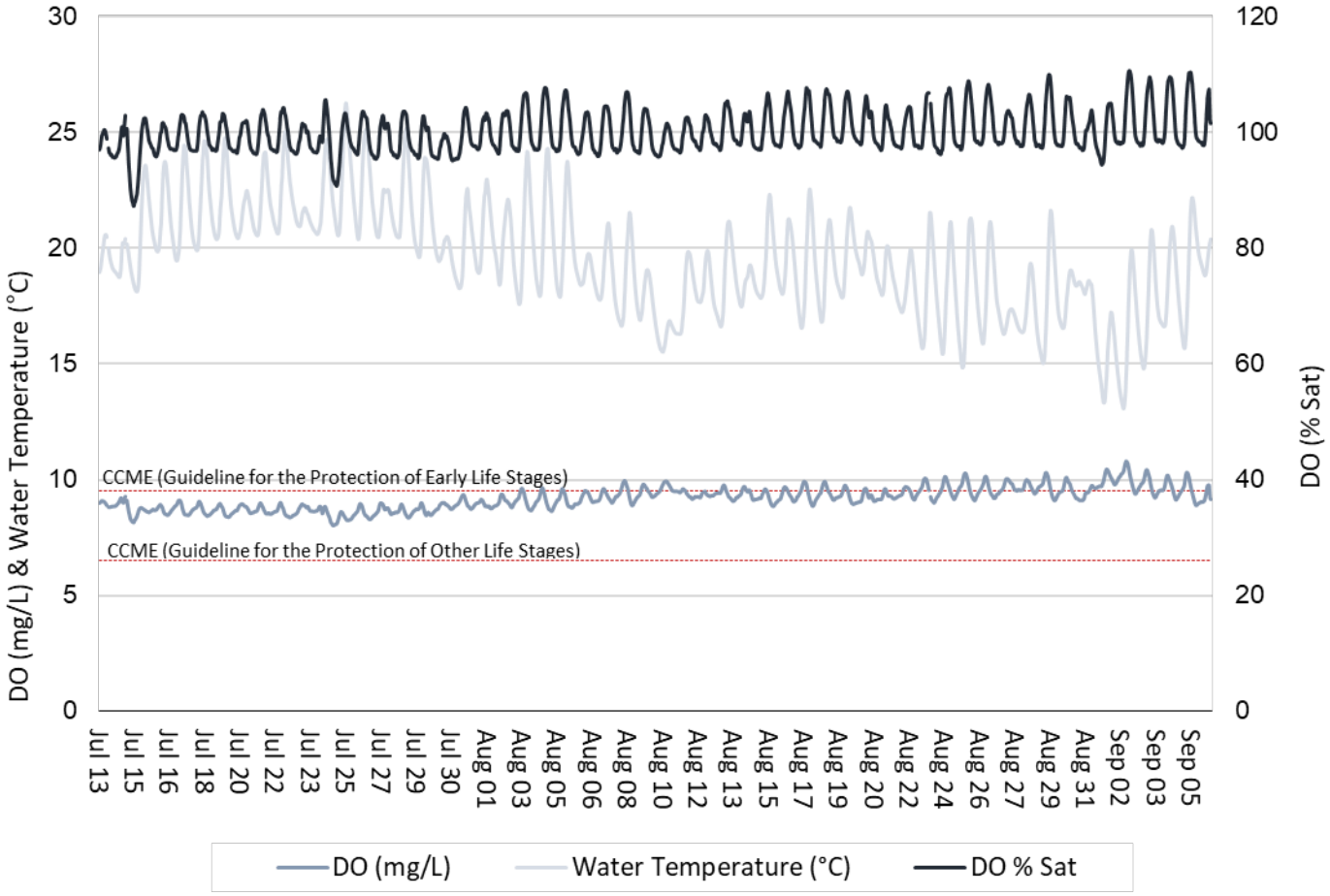



**Figure 5: Dissolved Oxygen and Water Temperature**

- Turbidity values range from -0.1 NTU to 2.8 NTU with a median of 0.0, indicating very clear background turbidity.
- Turbidity remained very low throughout deployment with a slight increasing trend. Turbidity increased temporarily during stage events associated with precipitation. (Figure 6). This indicates rainfall associated with stage increases may stir up sediments in the area for a brief period of time before returning to background levels.

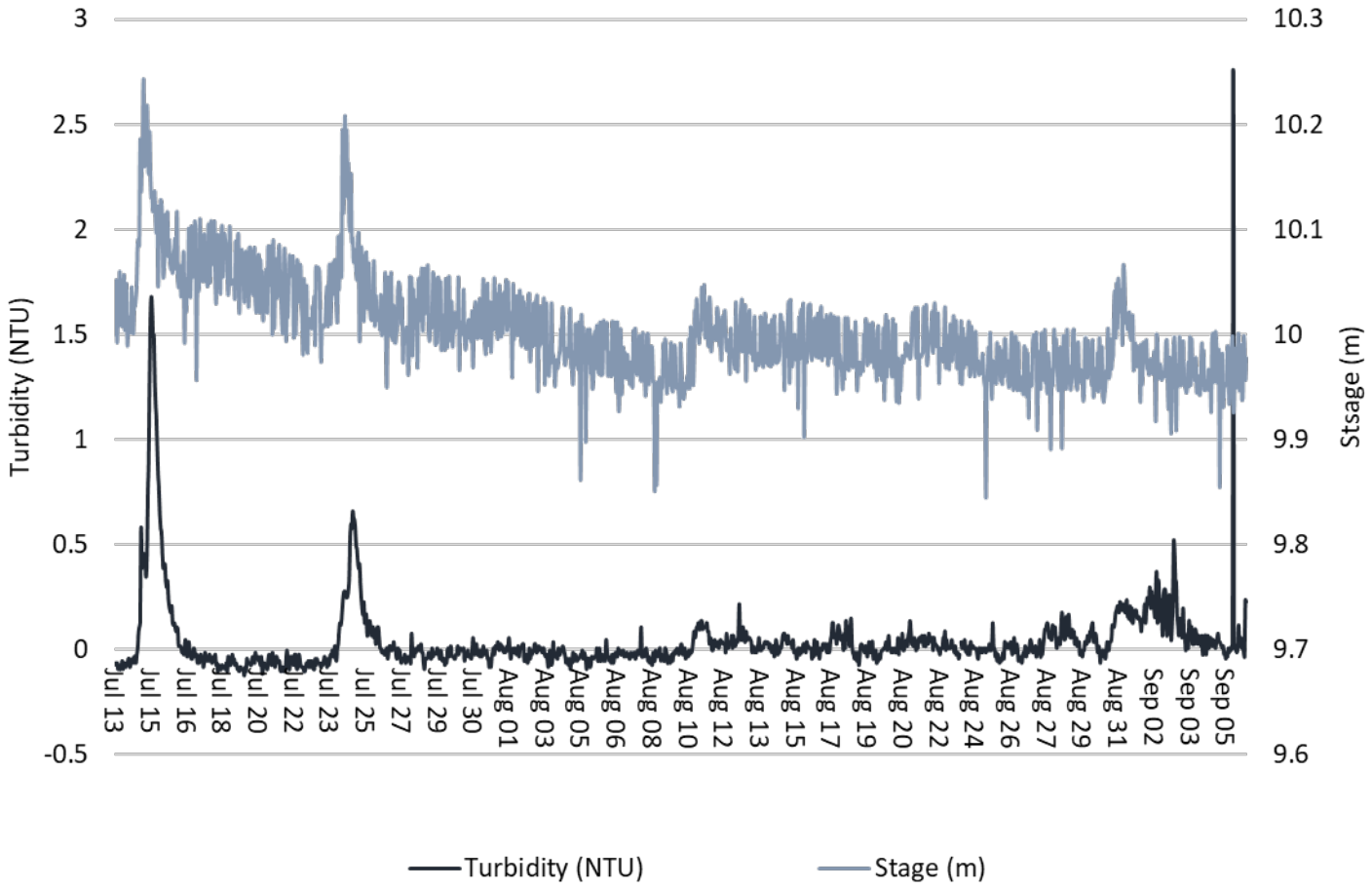



**Figure 6: Turbidity and Stage**

- Precipitation and stage during the deployment period are graphed below (Figure 7). Stage was decreasing gradually throughout deployment.
- It is notable from the data that smaller precipitation events did not always lead to an increase in stage at this location.

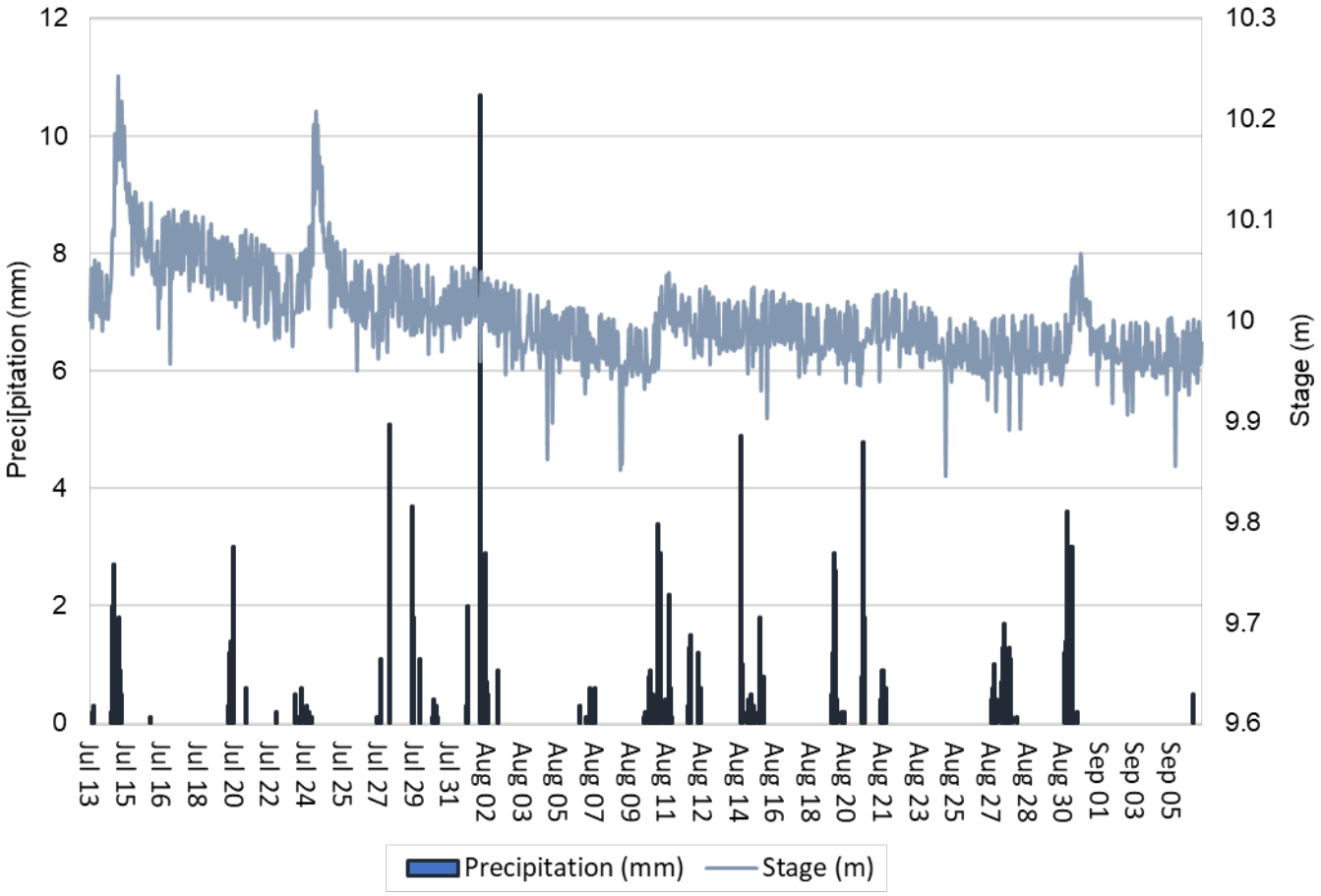



**Figure 7: Precipitation and Stage**

**Valentine River**

- Water temperature ranged from 13.58 to 26.88ºC during this deployment period (Figure 8).
- Water temperature showed a decreasing trend throughout deployment, corresponding to ambient air temperatures as the season progressed into late summer (Figure 8).

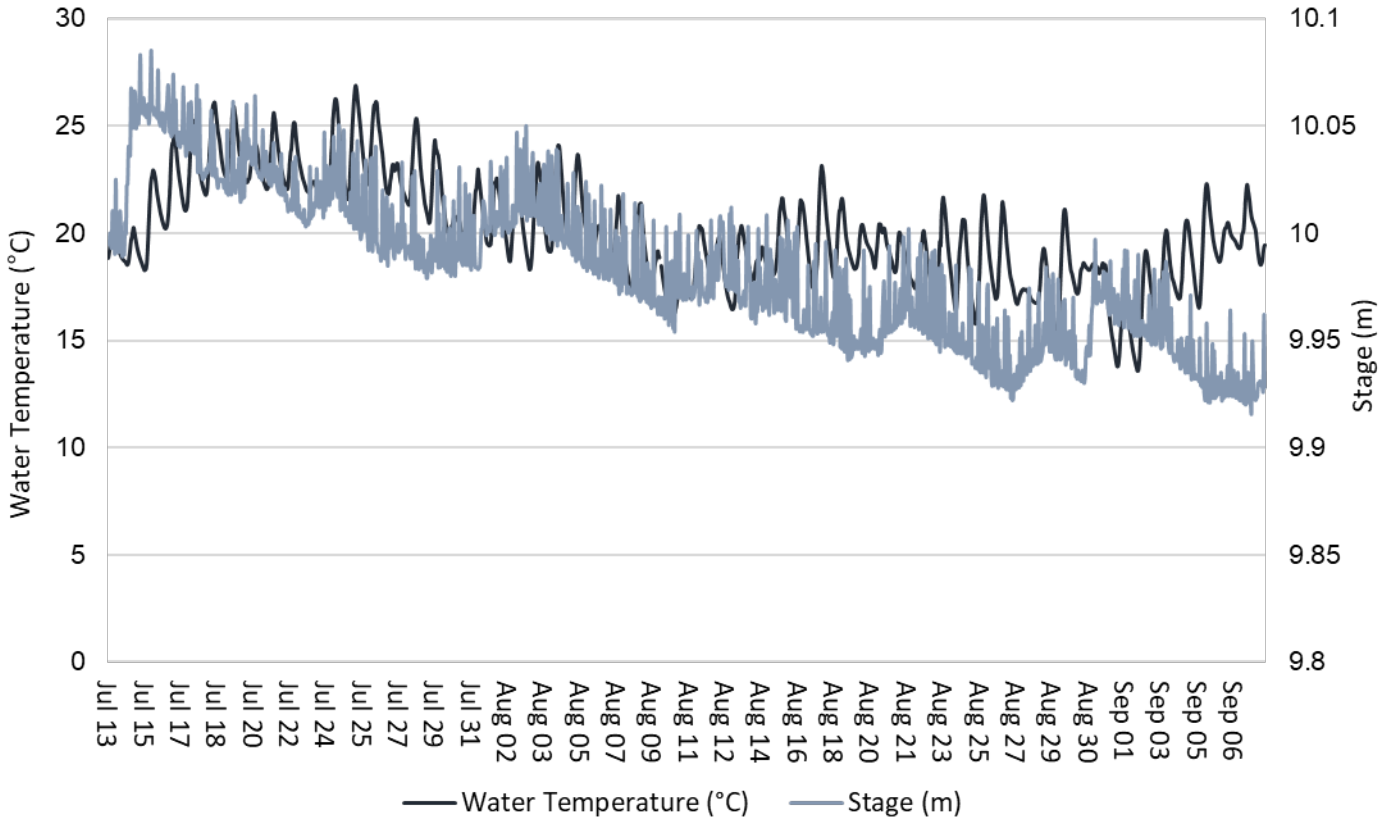



**Figure 8: Water Temperature and Stage**

- pH ranged between 6.86 and 7.35 pH units throughout the deployment period, with a median value of 7.08 units (Figure 9).
- 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.
- Overall, pH was relatively stable for the deployment, but was influenced by large precipitation events.

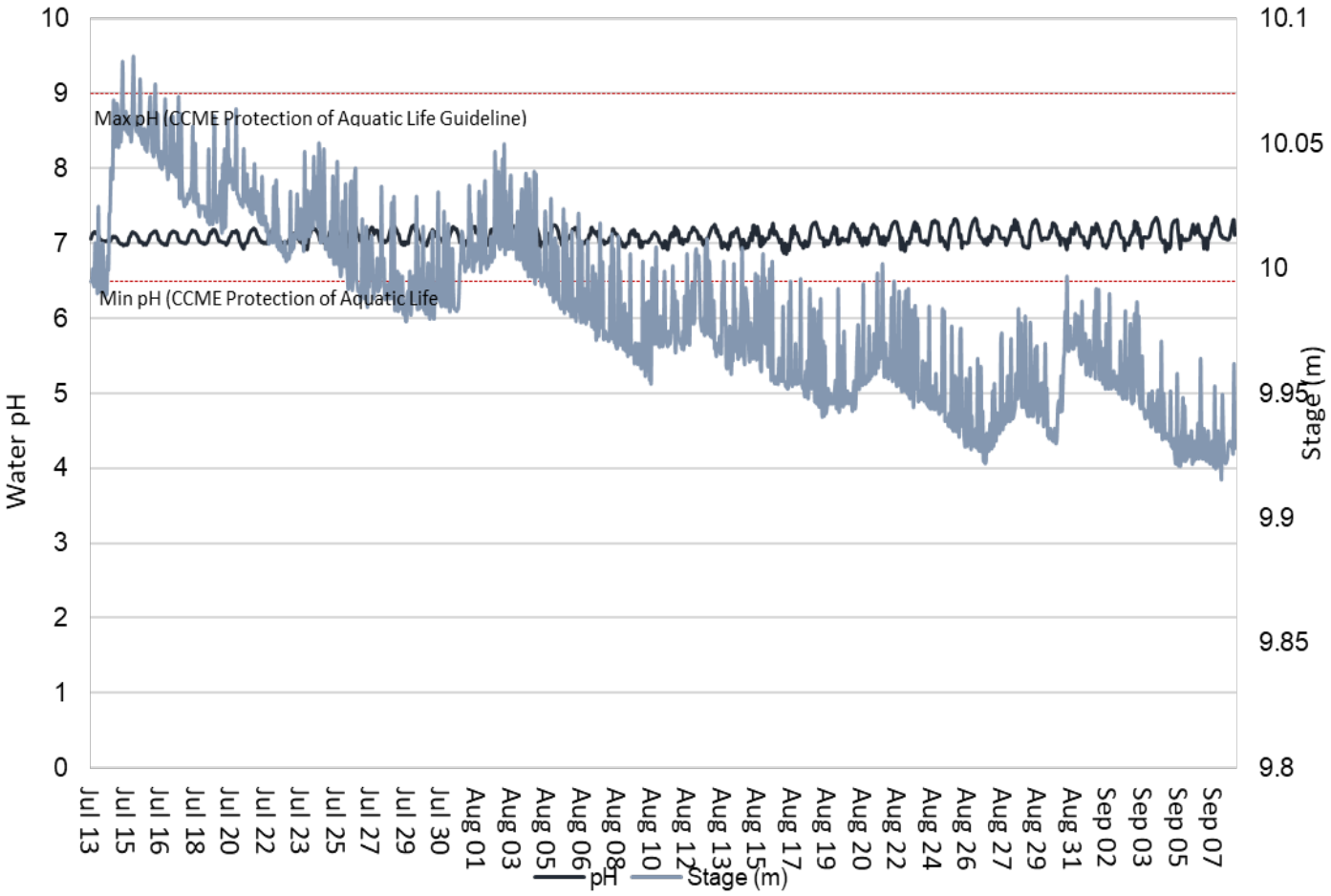



**Figure 9: Water pH and Stage**

- Specific conductivity ranged from 23.7 to 27.0 µs/cm (Figure 10) with a median of 25.3 µs/cm (Figure 10).
- Specific conductivity is trending upward over the course of this deployment period as stage decreases. This suggests the conductivity increase may be due to solutes in the water column becoming increasingly concentrated as there is less water added to the system from precipitation.

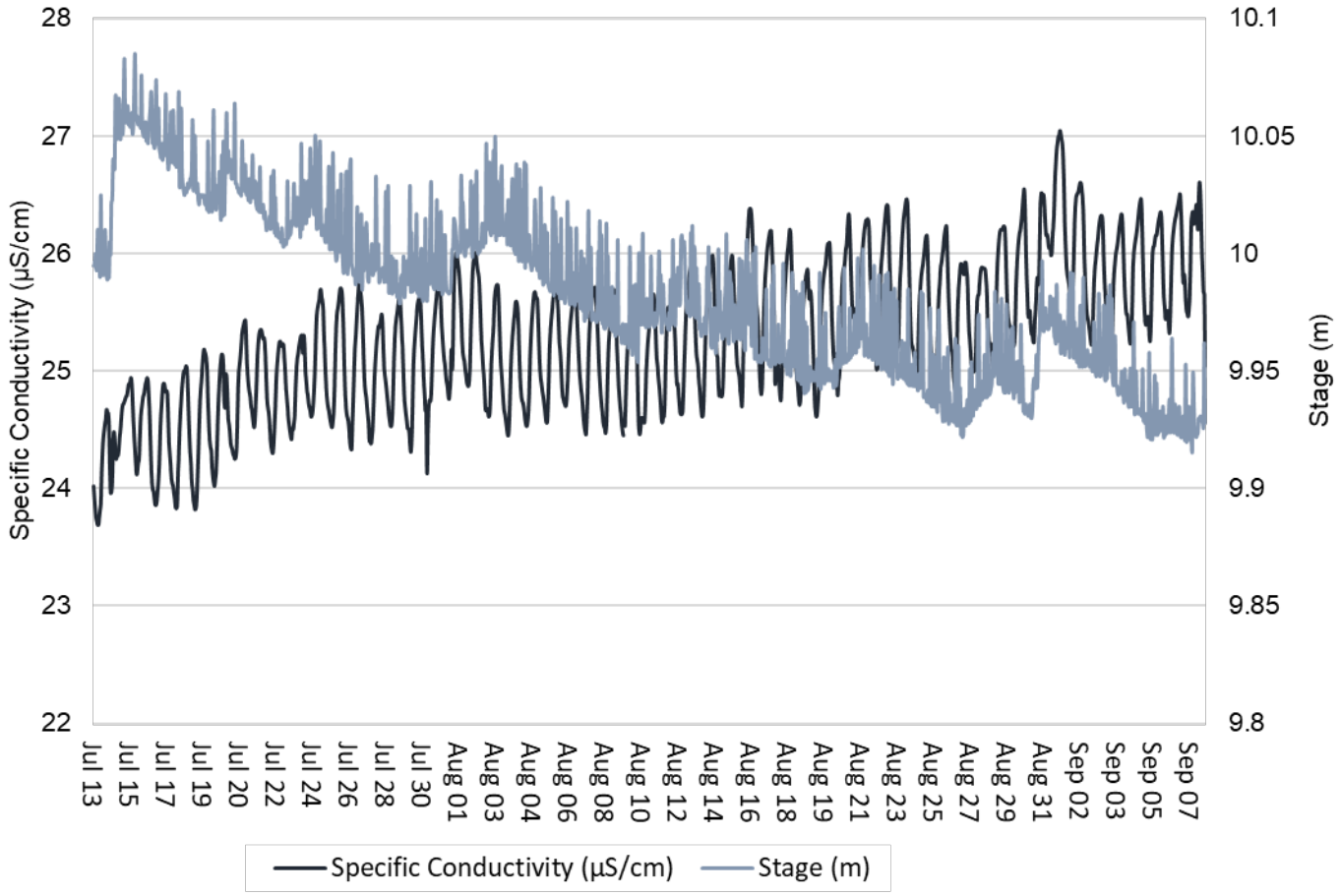



**Figure 10: Specific Conductivity of Water and Stage**

- The saturation of dissolved oxygen ranged from 99.9% to 107.7% and a range of 8.32 to 10.95 mg/l was found for the concentration of dissolved oxygen with a median value of 9.54 mg/l (Figure 11).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages while the majority of values were above the Guidelines for Early Life Stages. The guidelines are indicated in red on Figure 11.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen increased steadily during the deployment period as water temperatures cooled into late summer.

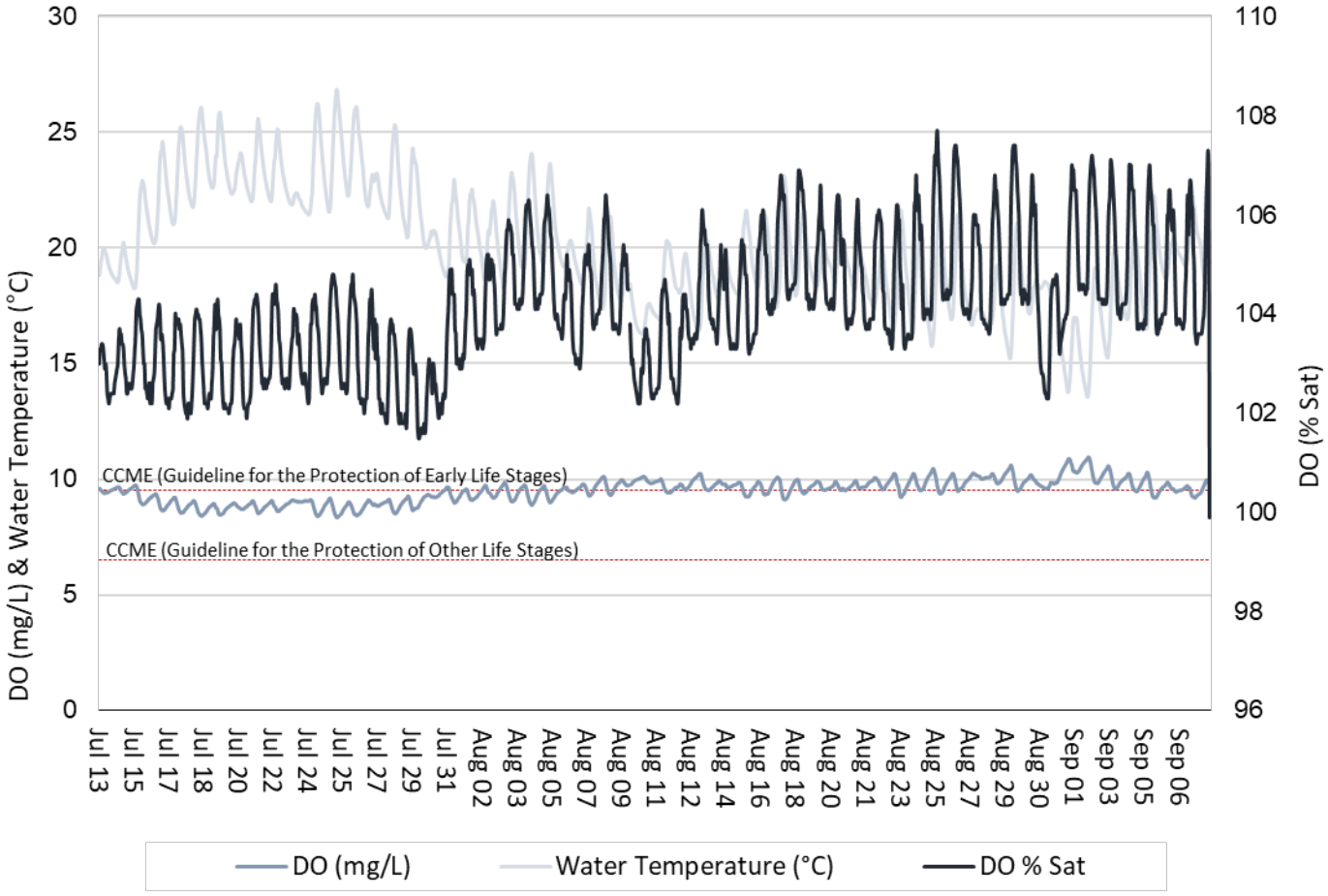



**Figure 11: Dissolved Oxygen and Water Temperature**

- Turbidity values range from -0.4 NTU to 0.1 NTU with a median of -0.3, indicating very clear background turbidity.
- Turbidity remained very low throughout deployment with a slight increasing trend. Turbidity increased temporarily during stage events associated with precipitation (Figure 12). This indicates rainfall associated with stage increases may stir up sediments in the area for a brief period of time before returning to background levels.

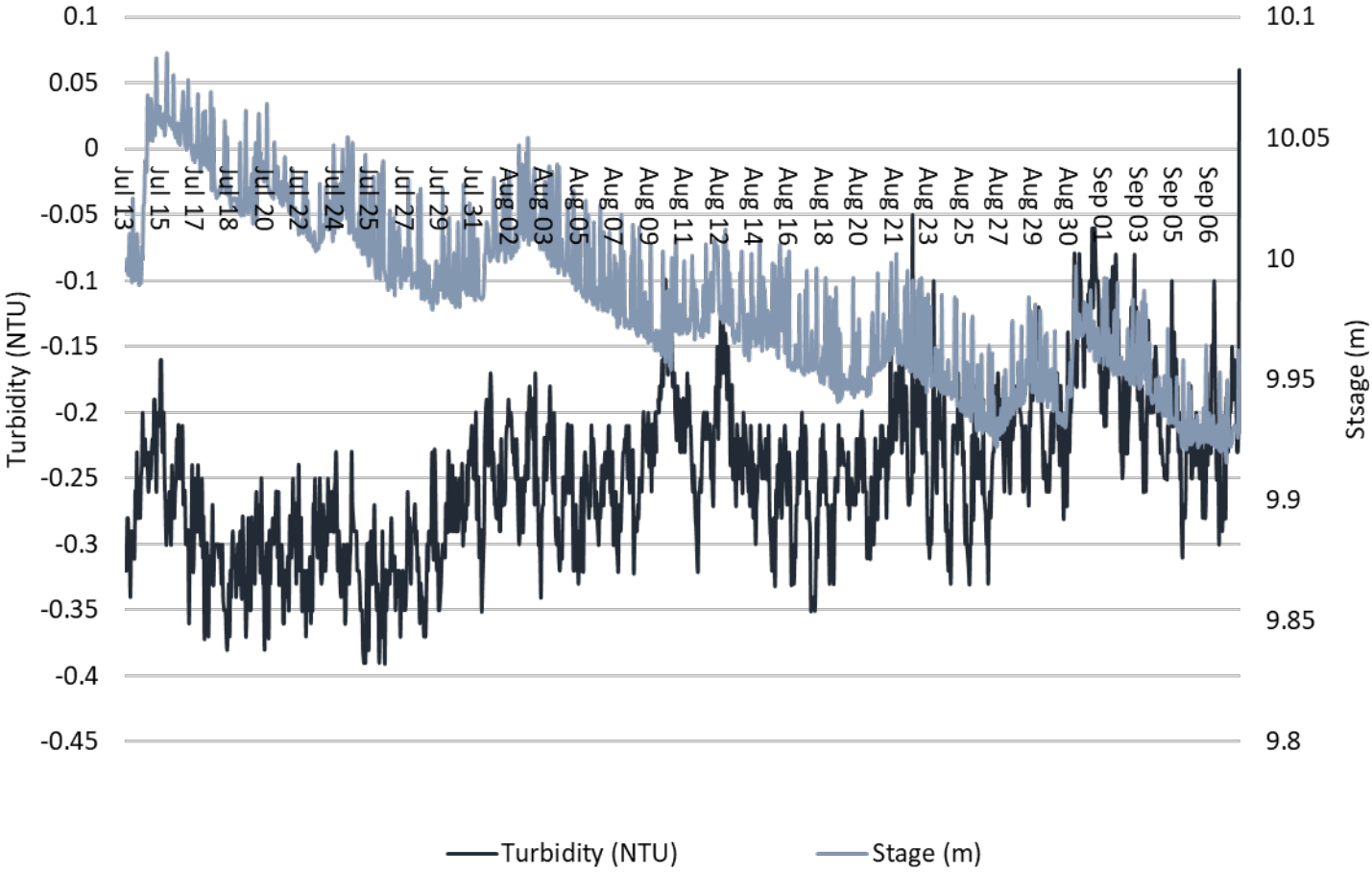



**Figure 12: Turbidity and Stage**

- Precipitation and stage during the deployment period are graphed below (Figure 13). Stage was decreasing gradually throughout deployment, influenced by several precipitation events.
- It is notable from the data that smaller precipitation events had more of an effect on this river than they did in Victoria River.

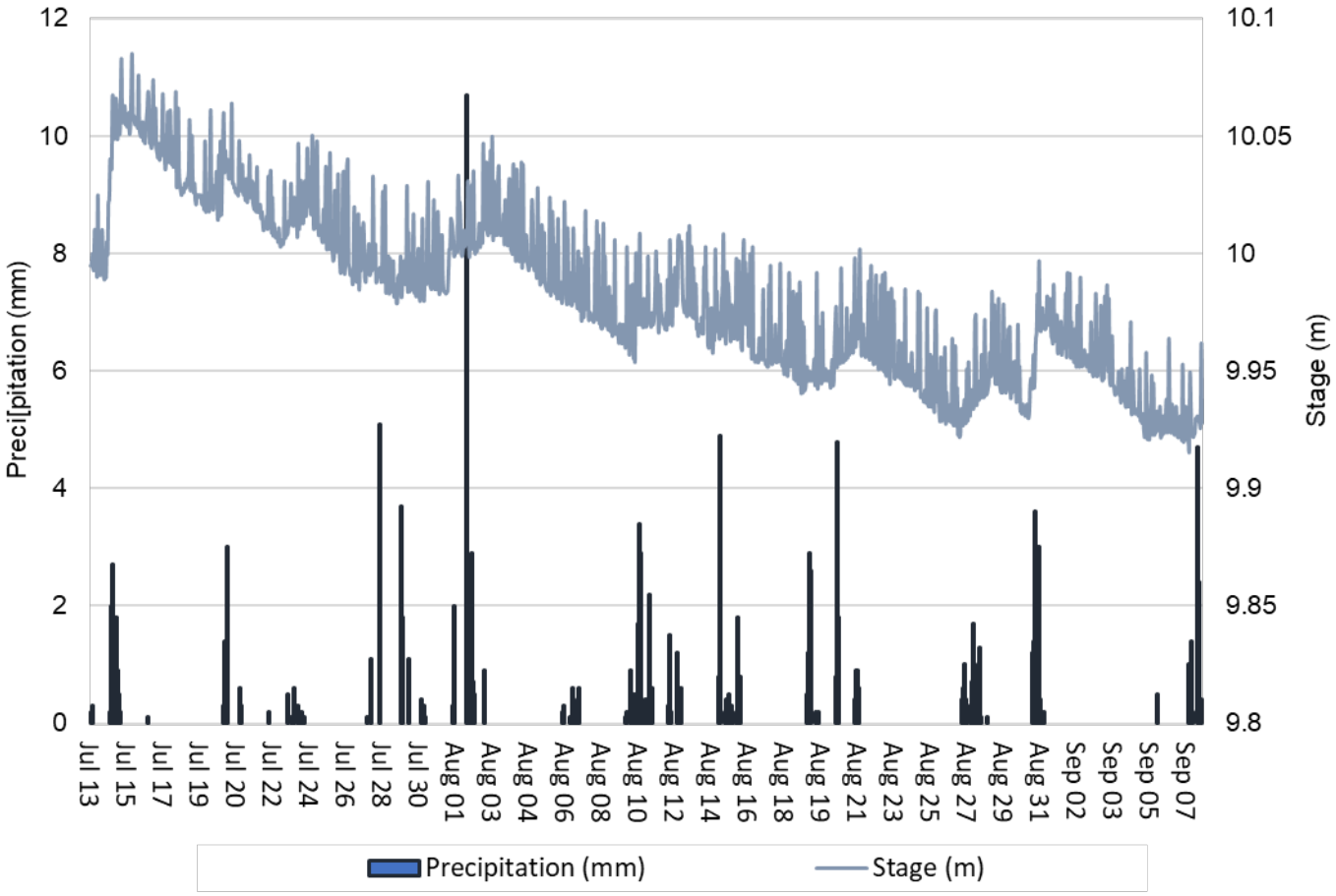



**Figure 13: Precipitation and Stage**

**Roebucks Brook**

- Water temperature ranged from 13.23 to 27.11°C during this deployment period (Figure 14).
- Water temperature showed an overall decreasing trend throughout deployment, corresponding to ambient air temperatures as the season progressed to late summer. This trend was also observed at Victoria and Valentine Rivers.

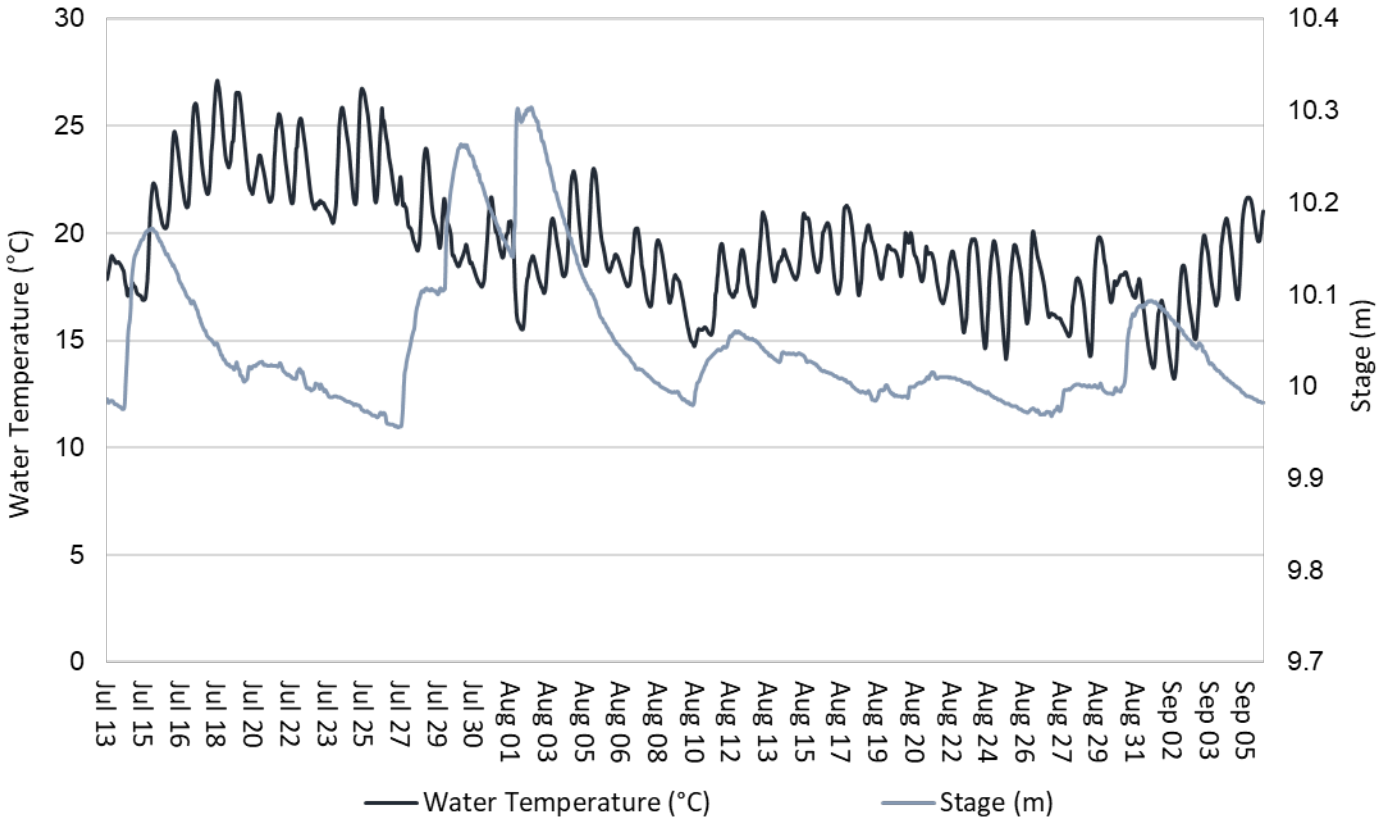



**Figure 14: Water Temperature and Stage**

- pH ranged between 6.07 and 7.22 pH units throughout the deployment period, with a median value of 6.97 units (Figure 15).
- The majority of values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units). Values drop below the minimum threshold periodically during high stage events. pH fluctuates slightly during the day and night.
- Significant rainfall on July 29th and August 3rd (evident as rises in stage levels) caused a slight dip in pH. 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.
- Overall, pH was relatively stable for the deployment, but was influenced by large precipitation events.

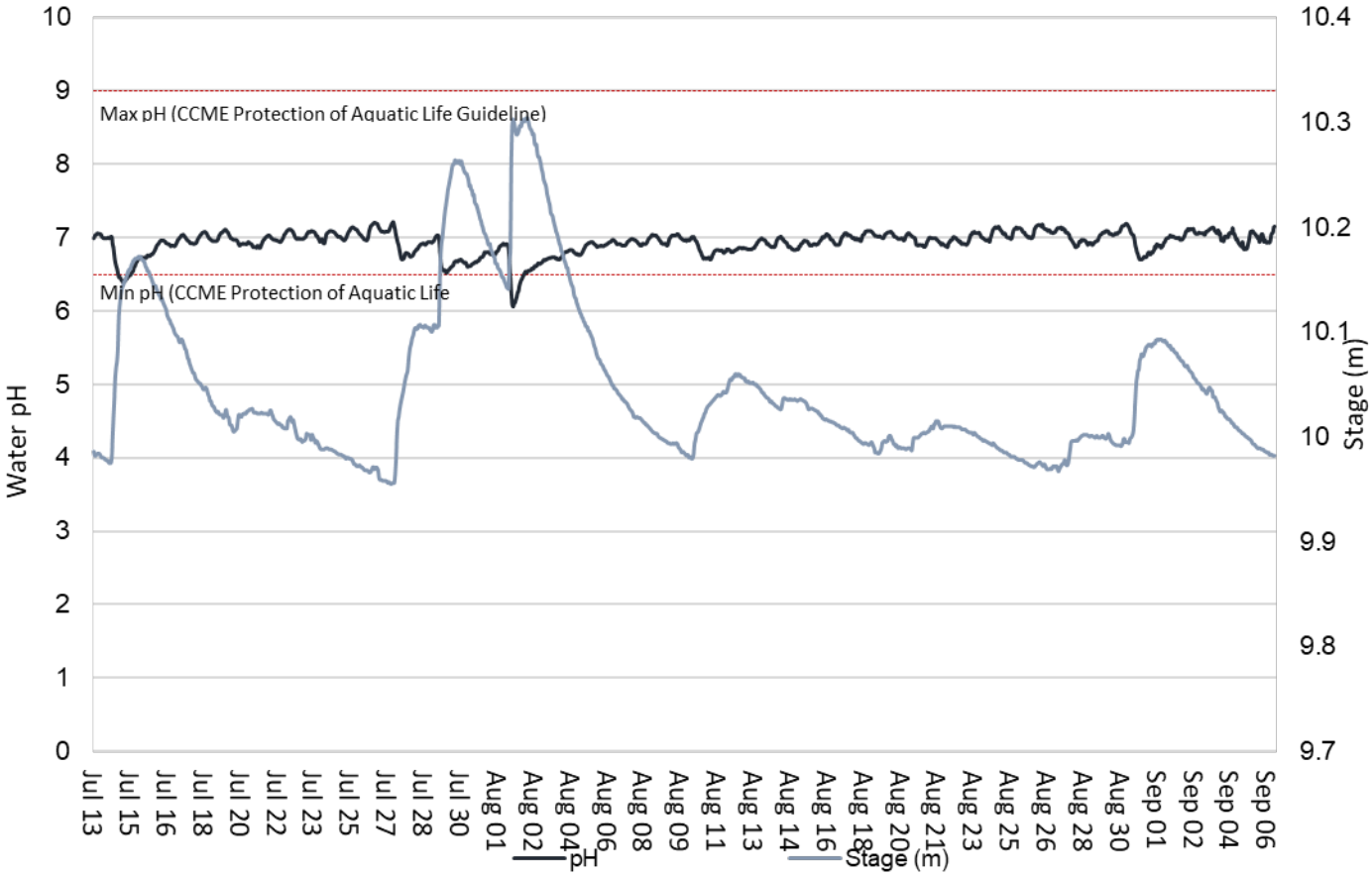



**Figure 15: Water pH and Stage**

- Specific conductivity ranged from 25.8 to 43.7 µs/cm (Figure 16) with a median of 33.6 µs/cm.
- Specific conductivity fluctuated but tended to increase over the course of this deployment period. During periods of high precipitation and corresponding stage increases, conductivity in Roebucks Brook decreased. A similar trend is seen at Valentine River but is different from Victoria River where conductivity generally increases for a short time when stage increases.
- This overall rise in conductivity as stage goes down indicates solutes in the river become concentrated without the addition of water from precipitation events.

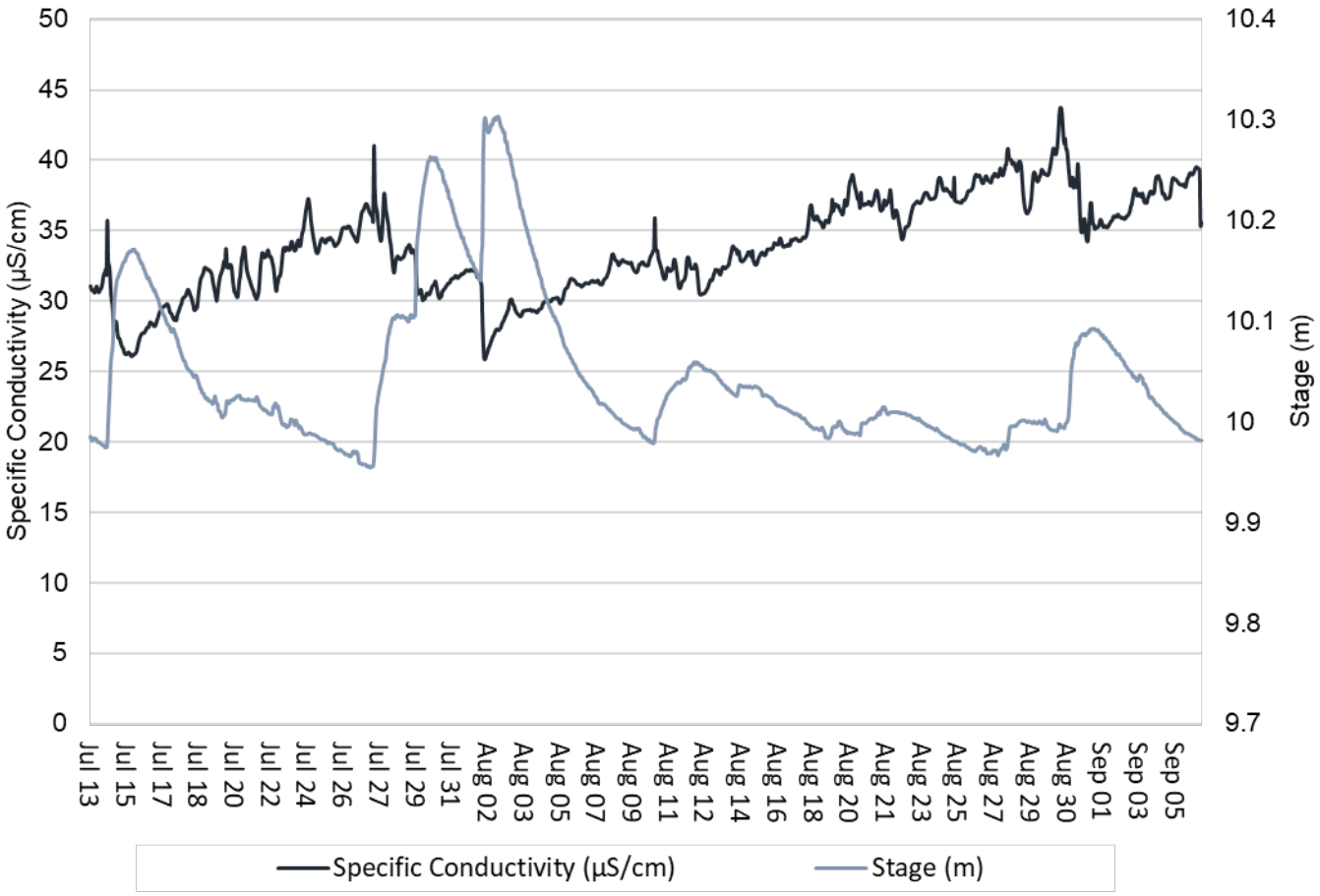



**Figure 16: Specific Conductivity of Water and Stage**

- The saturation of dissolved oxygen ranged from 91.7% to 108.0% and a range of 7.94 to 10.94 mg/l was found for the concentration of dissolved oxygen with a median value of 9.46 mg/l (Figure 17).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages while values hovered around the minimum CCME Guideline for the Protection of Early Life Stages. The guidelines are indicated in red on Figure 17.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen tended to increase overall, during the deployment period as water temperatures cooled into late summer.

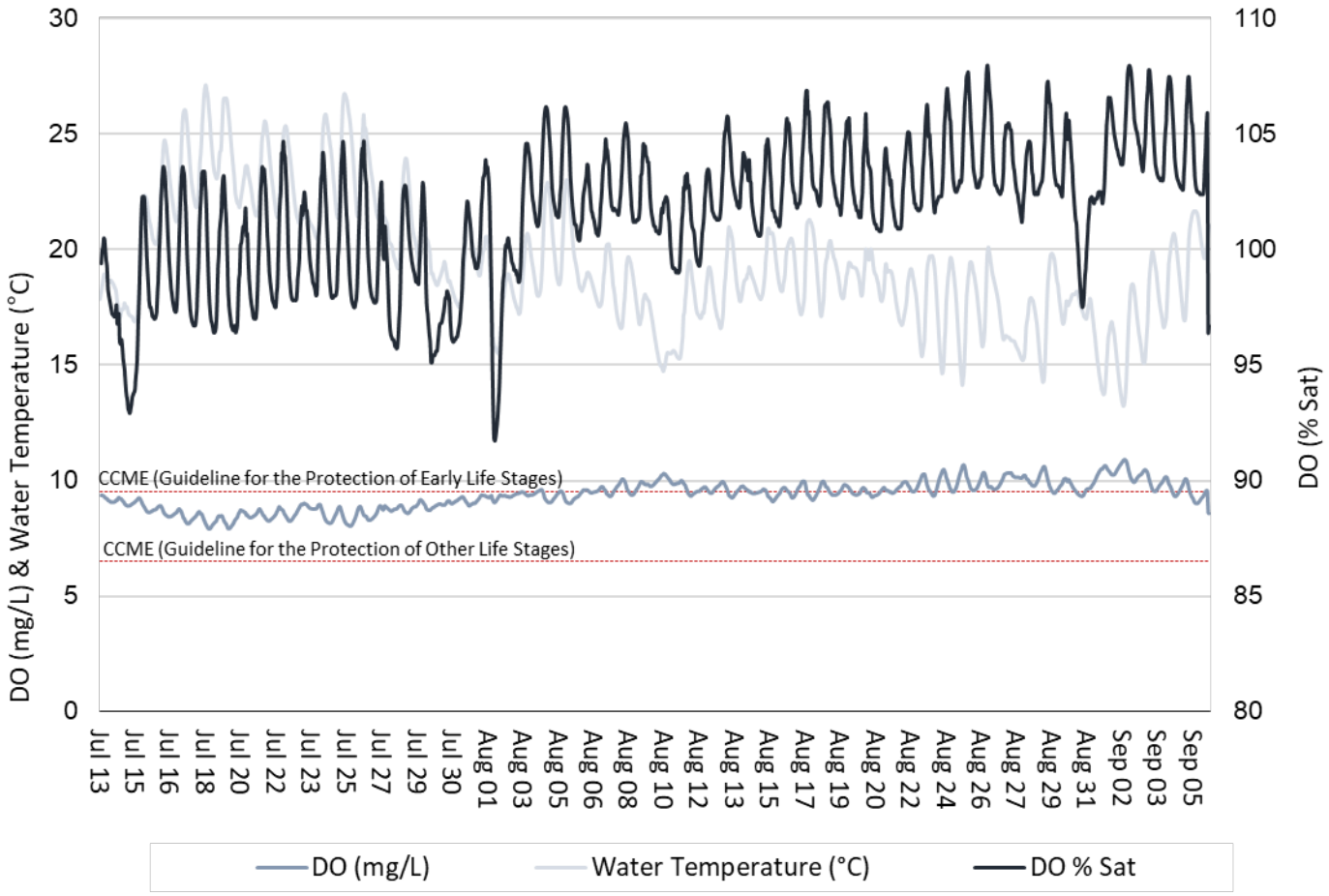



**Figure 17: Dissolved Oxygen and Water Temperature**

- Turbidity values range from 0.2 NTU to 362.3 NTU with a median of 1.4, indicating low background turbidity which was higher than Victoria or Valentine Rivers (Figure 18).
- Turbidity remained relatively stable throughout deployment with occasional spikes during stage events associated with precipitation (Figure 18). This indicates rainfall associated with stage increases may stir up sediments in the area for a brief period of time before returning to background levels.

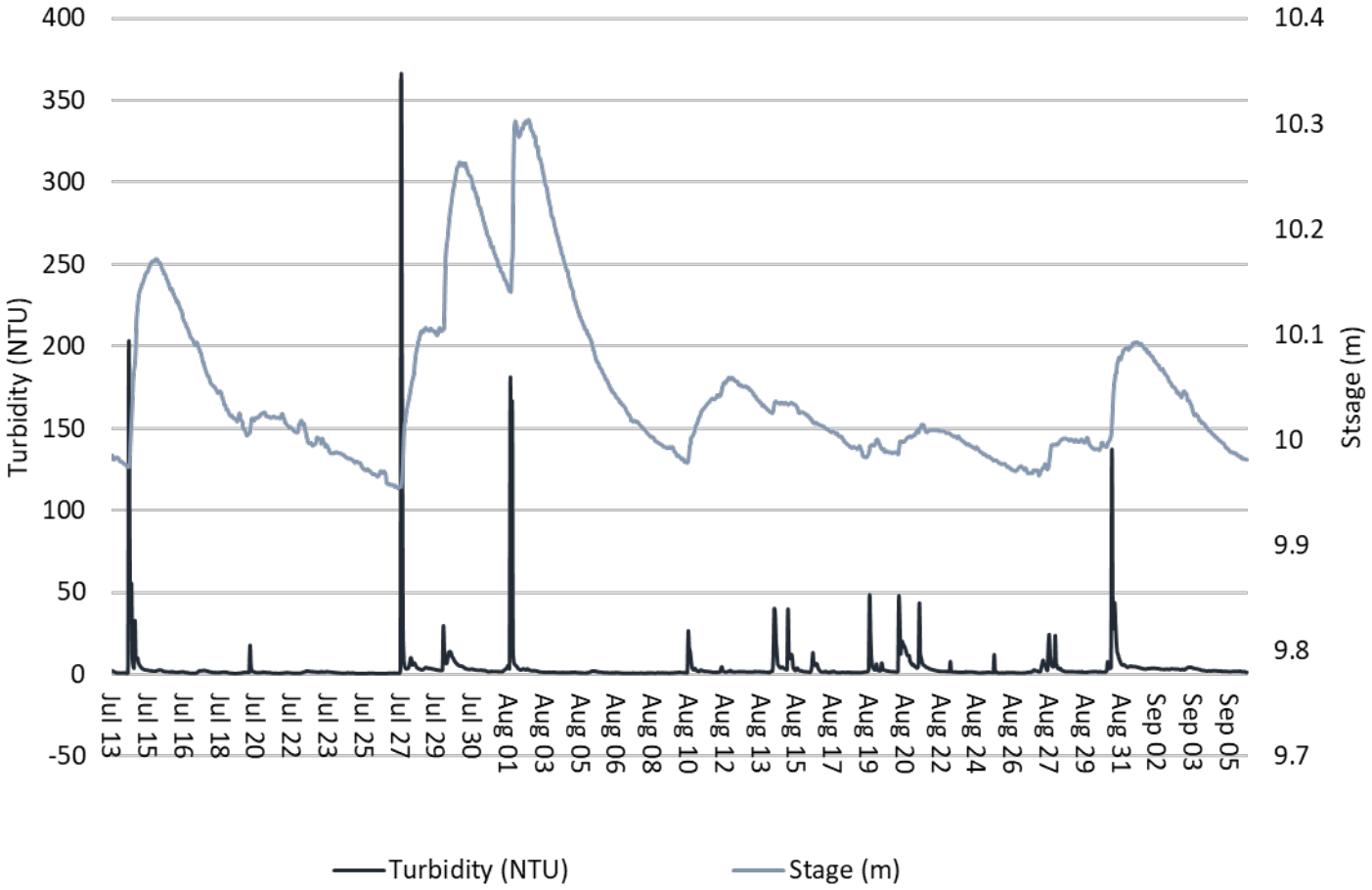



**Figure 18: Turbidity and Stage**

- Precipitation and stage during the deployment period are graphed below (Figure 19). Stage fluctuated throughout deployment, influenced by several major precipitation events.
- It is notable from the data that smaller precipitation events did not always lead to an increase in stage at this location.

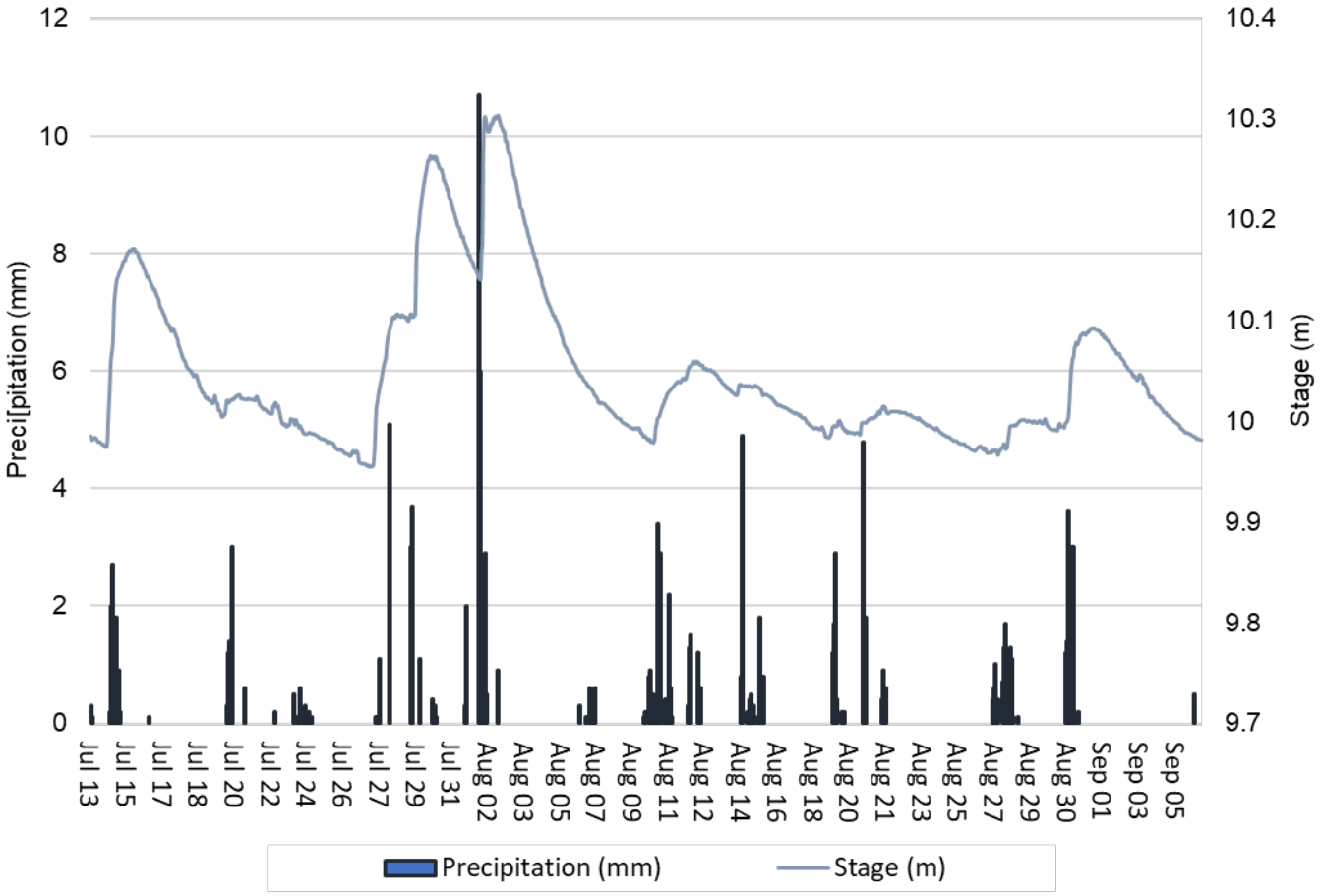



**Figure 19: Precipitation and Stage**

## Conclusions

- Instruments were deployed at three real time water quality/quantity monitoring stations which form the Marathon Gold Corp monitoring network on July 13th and removed on September 6th, 2023. This was the second deployment for the network in 2023.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations.
- Water temperature was found to be generally decreasing at all stations, as expected with seasonal air temperature progresses into late summer.
- All pH values were within the recommended CCME Guidelines for the Protection of Aquatic Life at Victoria and Valentine River. At Roebucks Brook, pH dropped below the minimum guideline briefly during periods of high precipitation.
- Specific conductivity remained relatively stable at Victoria over the course of this deployment period, with brief spikes during periods of high precipitation. Specific conductivity at Valentine is trending upward over the course of this deployment period while the stage appears to decrease suggesting increasing concentration of solutes in the river without added precipitation. Specific conductivity at Roebucks fluctuated but tended to increase over the course of this deployment period. During periods of high precipitation, conductivity in Roebucks Brook decreased, suggesting dilution instead of added solutes.
- Dissolved oxygen values were above the minimum CCME Guideline for the Protection of Other Life Stages of Cold Water Biota at all stations throughout the deployment. Dissolved Oxygen concentration values fluctuated above and below the Guidelines for the Protection of Early Life Stages at all stations when water temperatures were warmest.
- Low median turbidity values at Victoria and Valentine Rivers indicate low background turbidity at these locations. Roebucks Brook had a higher median value, indicating background turbidity may be higher at this location, at least during this deployment. Turbidity values at all locations were influenced by precipitation and associated stage increases for a short period of time before returning to background levels.
- Stage at all locations was influenced by large precipitation events which increased stage. Victoria River and Valentine River showed overall decreasing trend throughout the deployment, while Roebucks was stable overall.
- WRMD and Marathon Gold Crop staff will continue to work together in partnership to install, establish and maintain the real time monitoring network associated with the Valentine Lake gold project in central Newfoundland.

Prepared by:
Department of Environment & Climate Change
Water Resources Management Division

## Appendix A: Real Time Surface Water Quality/Quantity Network – November 2023

| Station Name | Station Number | Latitude | Longitude | Equipment Depth |
|---|---|---|---|---|
| Victoria River Outlet | NF02YN0047 | 48.407878 | -57.072439 | 0.9m |
| Valentine River Outlet | NF02YN0048 | -57.078128 | 48.424644 | 0.15m |
| Roebucks Brook | NF02YN0049 | -57.013102 | 48.544174 | 0.33m |

# Station Descriptions:

## Victoria River

*Station Location:* Victoria River 6.3km downstream of Victoria dam, below quarry pit. Station setup on western shoreline. Access via ATV trail below quarry pit.



## Valentine River

*Station Location:* Valentine River at access road, 1.9km downstream of Valentine Lake outlet. Station located 15m upstream of access road crossing bridge on southern shoreline.

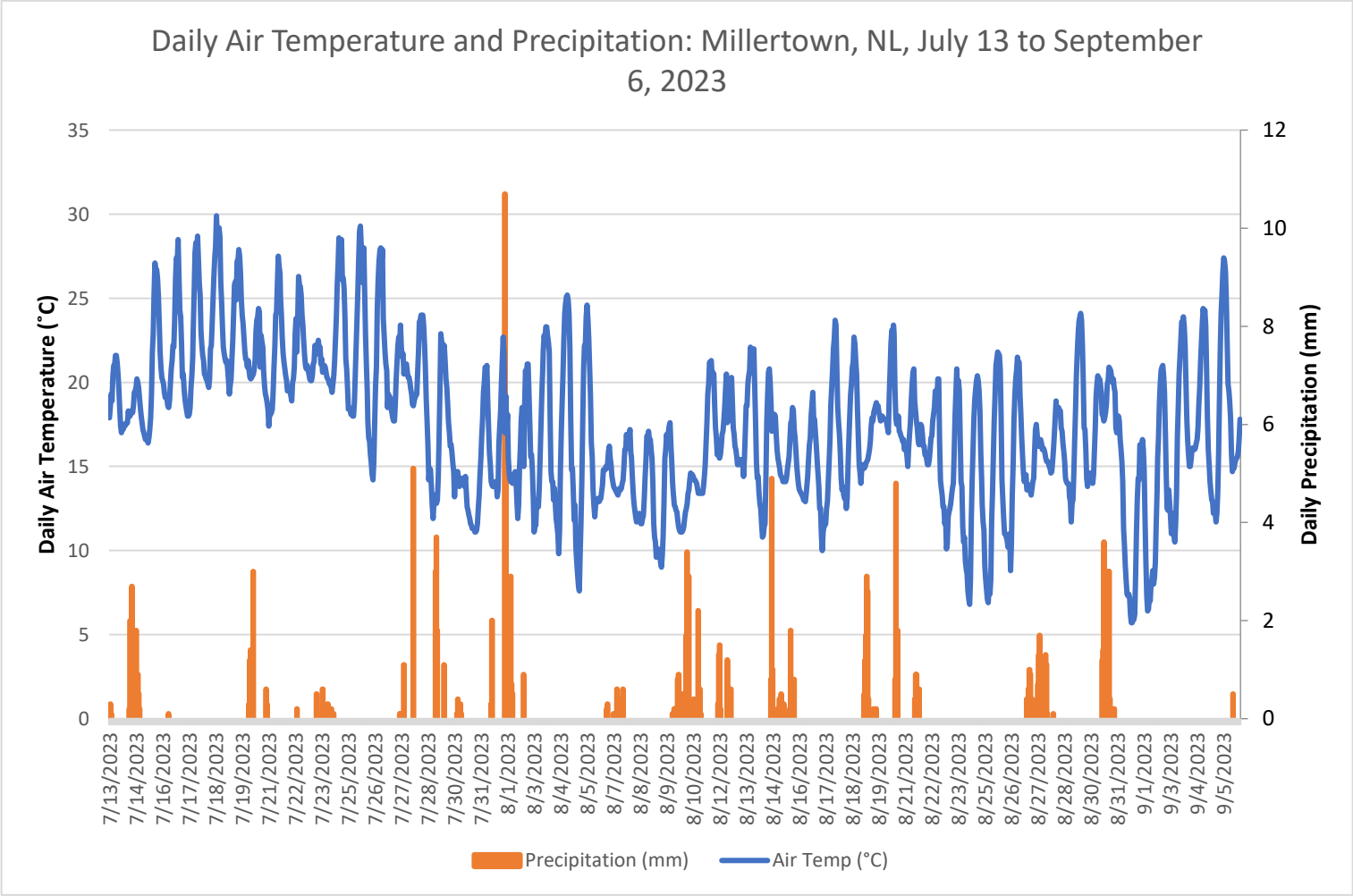


## Roebucks Brook

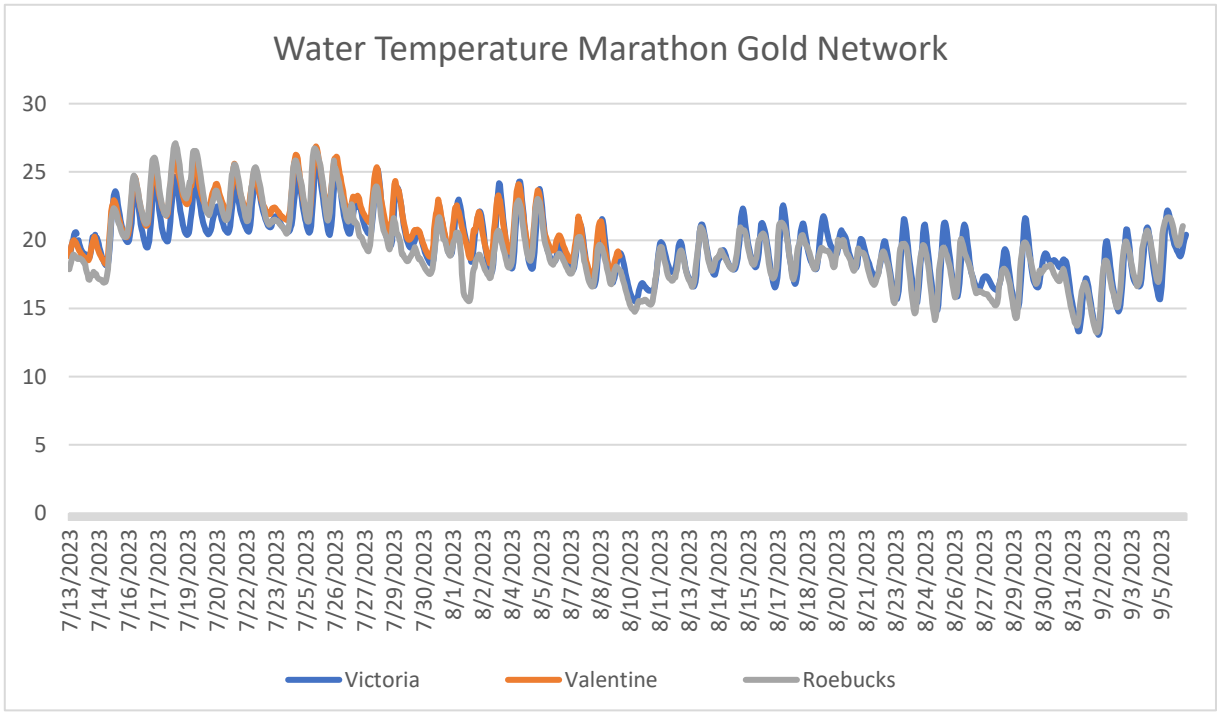
Station Location: Roebucks Brook 30m downstream of access road bridge crossing on western shoreline. Station is 1.6km downstream of Roebucks Lake outlet.

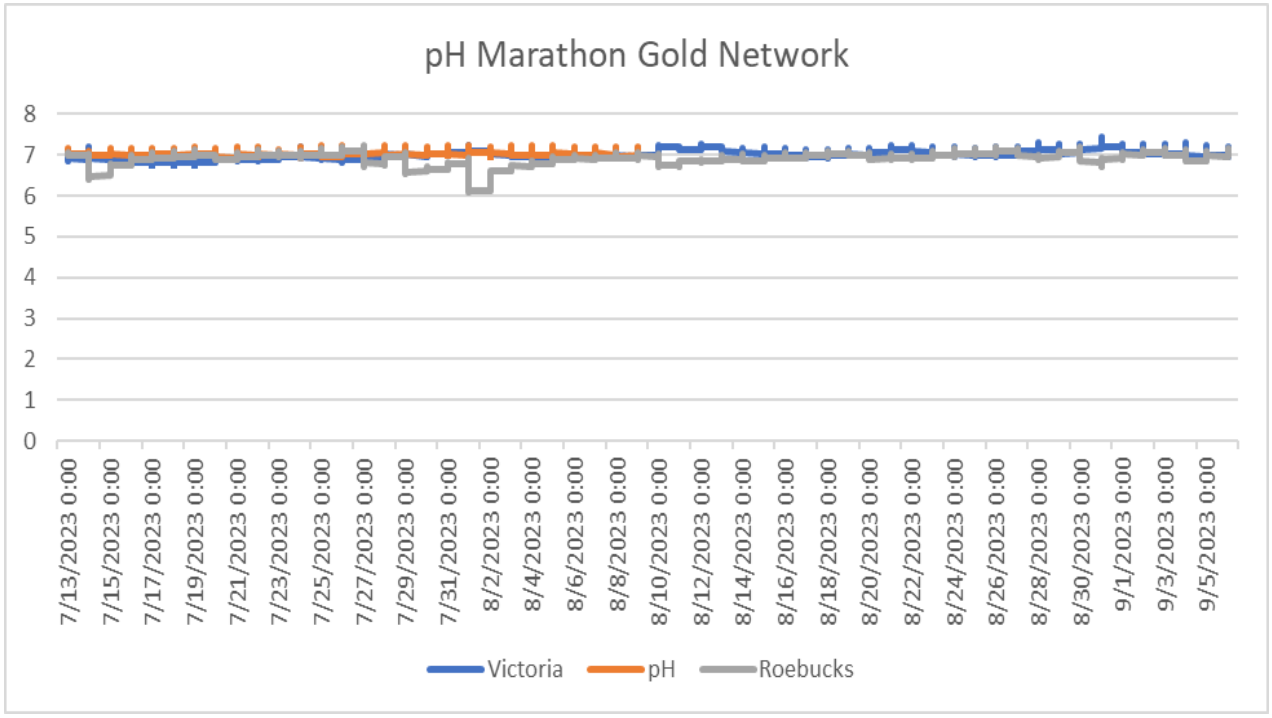


# Appendix B: Weather Data from Millertown RCS

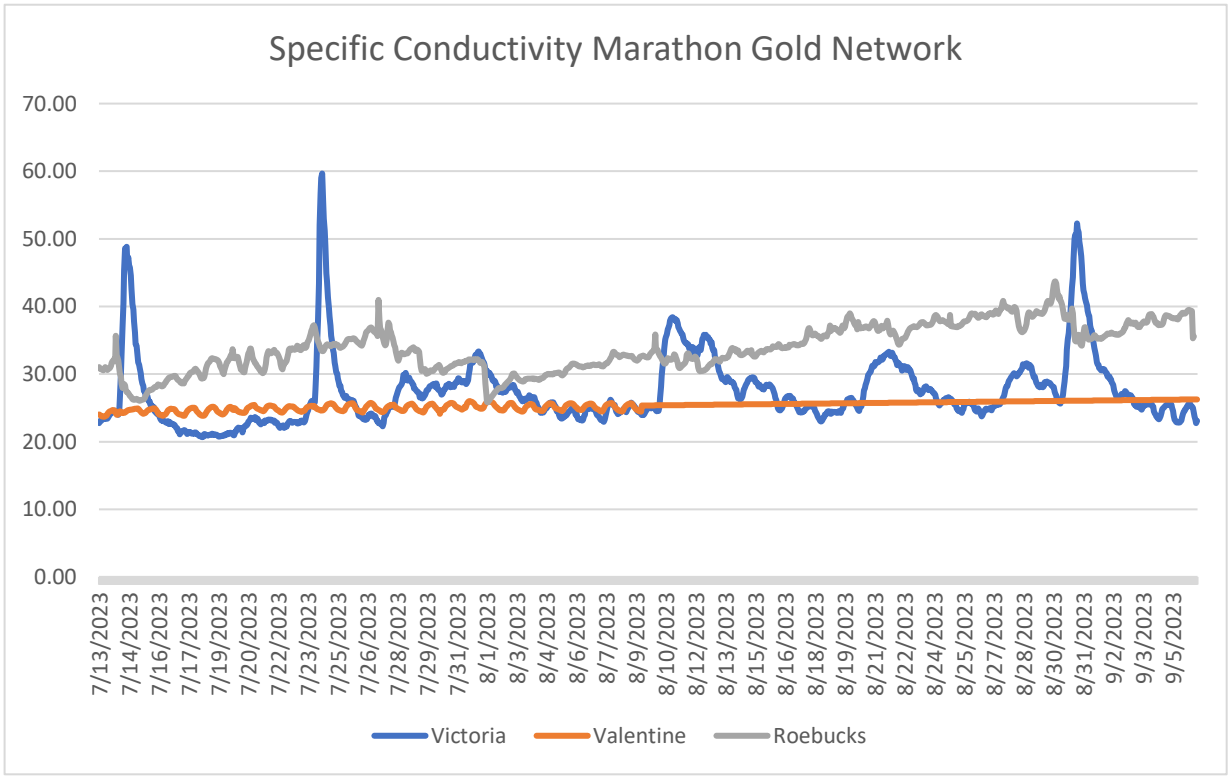


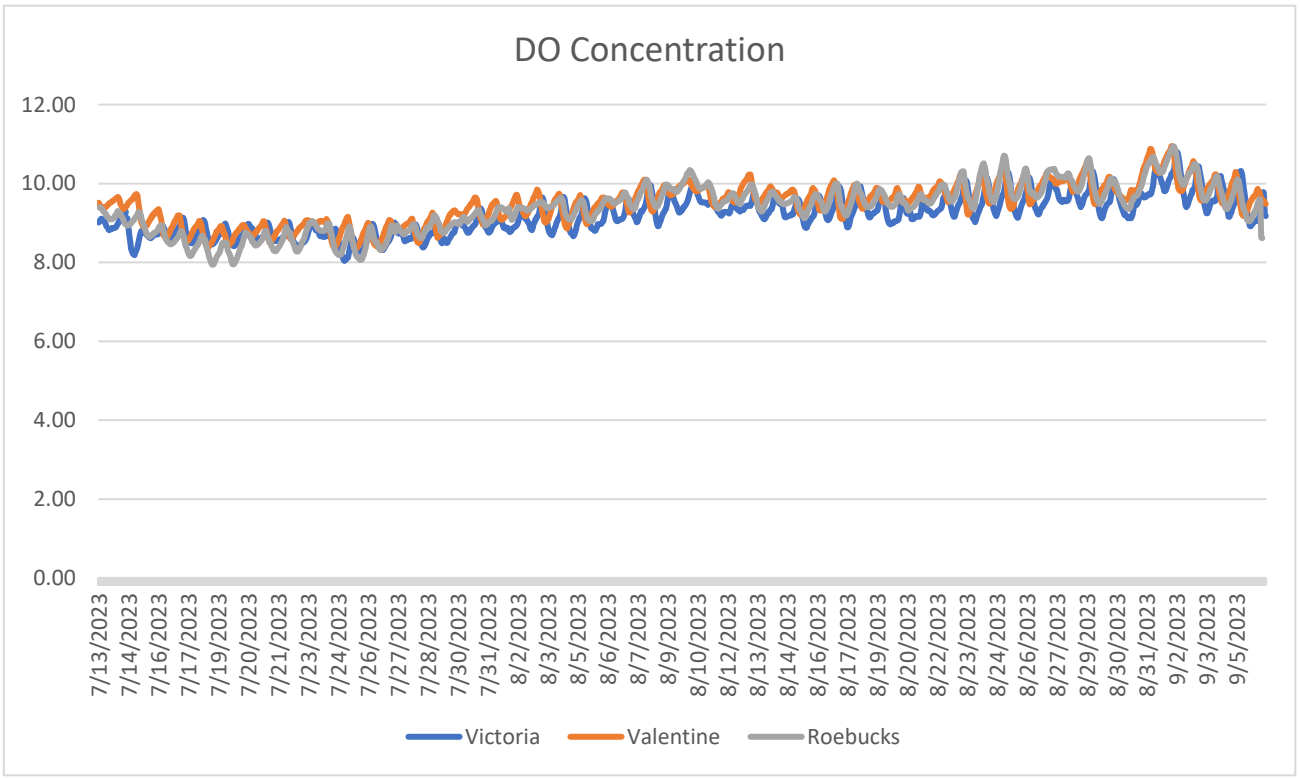
## Appendix C: Station Parameter Comparison Graphs (raw data)

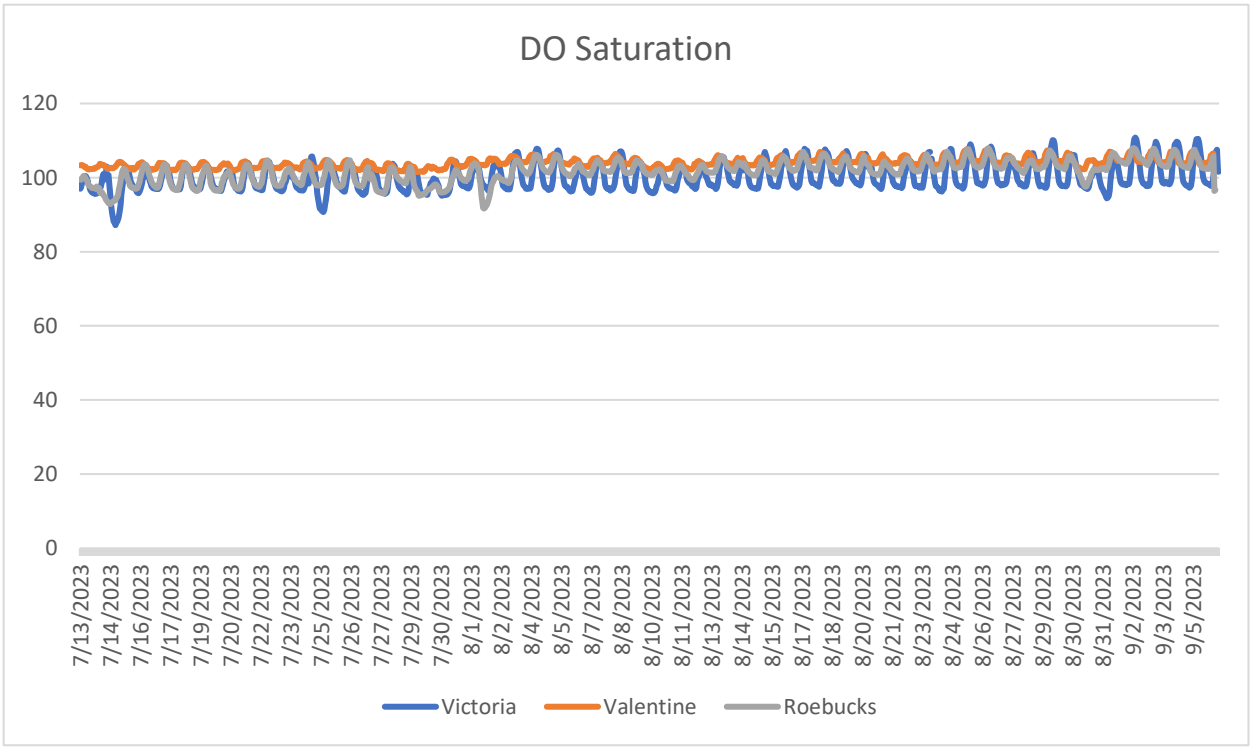


*Marathon Gold Corp, Newfoundland and Labrador*

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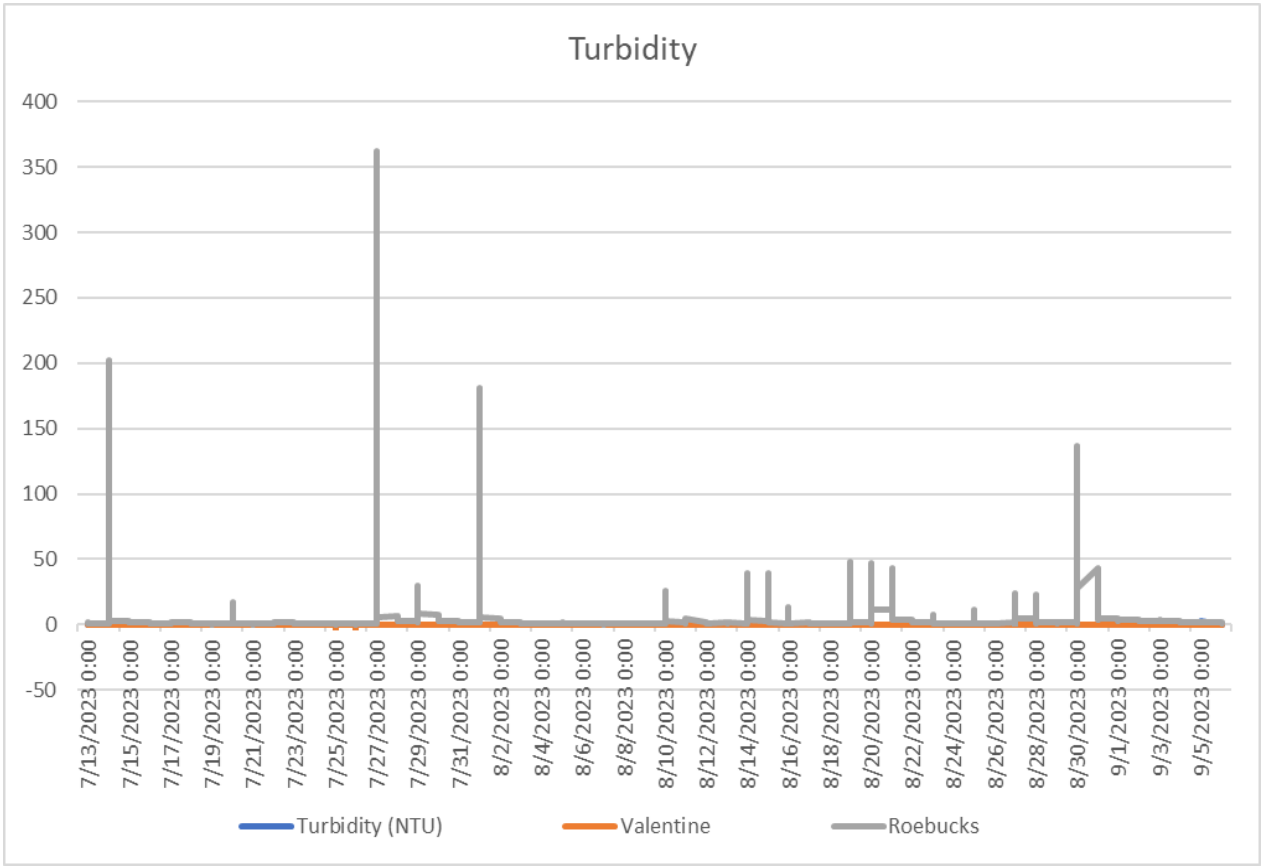
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9/5/2023 0:00
Turbidity (NTU)
Valentine
Roebucks

*Marathon Gold Corp, Newfoundland and Labrador*