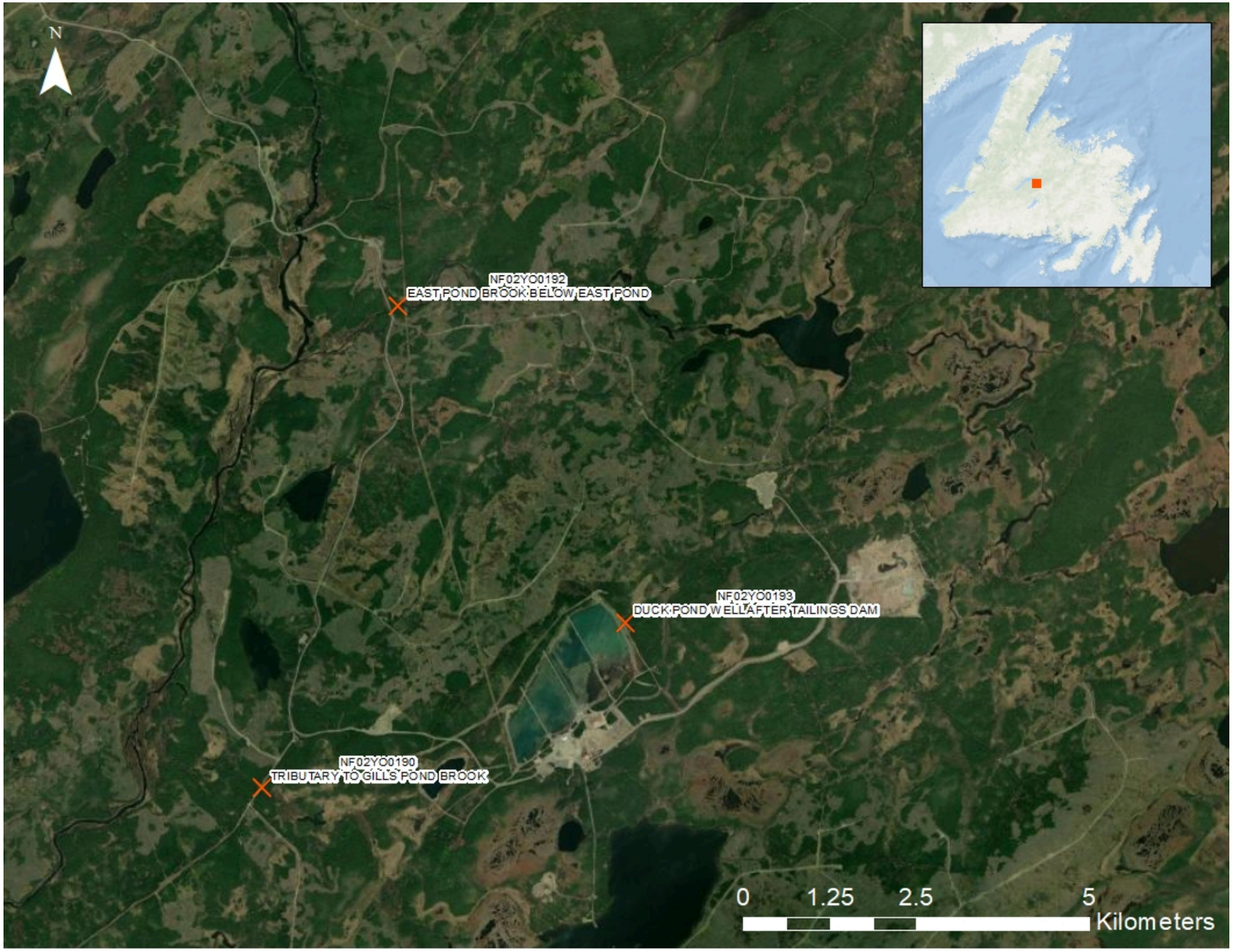
Real Time Water Quality Deployment Report
TECK: Duck Pond Operations
NF02YO0190 & NF02YO0192

2023-10-18 to 2024-05-22

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



TECK: Duck Pond Operations

This report will review the water quality data for the following two real-time water quality monitoring stations at TECK Duck Pond Operations: Tributary to Gills Pond Brook and East Pond Brook below East Pond, for the duration of 2023-10-18 through to 2024-05-22.

These stations are a part of the Real-Time Water Quality Network. The stations are maintained by the Department of Environment and Climate Change, Water Resources Management Division (WRMD). WRMD staff are responsible for the maintenance and calibration of the water quality instruments deployed at these sites. The data recorded by the real-time water quality stations is available on WRMD's website.

For the purposes of this report, air temperature and total precipitation data were used from the weather station located in Millertown. The data was retrieved from https://climate.weather.gc.ca/

Newfoundland Labrador

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. 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.

Parameter	Excellent	Good	Fair	Marginal	Poor
Dissolved oxygen	≤ ± 0.3 mg/L	≤ ± 0.31 -0.5 mg/L	≤ ± 0.51 - 0.8 mg/L	≤ ± 0.81 - 1 mg/L	> ± 1 mg/L
pH	≤ ± 0.2 units	≤ ± 0.21 - 0.5 units	≤ ± 0.51 - 0.8 units	≤ ± 0.81 - 1 units	> ± 1 units
Specific Conductance	≤ ± 3 µS/cm or ≤ ± 3%, whichever is greater	≤ ± 3.1-10 µS/cm or ≤ ± 3.1-10%, whichever is greater	≤ ± 10 - 15 µS/cm or ≤ ± 10.1-15 %, whichever is greater	≤ ± 15.1 - 20 µS/cm or ≤ ± 15.1-20 %, whichever is greater	> ± 20 µS/cm or > ± 20 %, whichever is greater
Turbidity	≤ ± 2 turbidity units or ≤ ± 5%, whichever is greater	≤ ± 2.1-5 turbidity units or ≤ ± 5.1-10 %, whichever is greater	≤ ± 5.1-8 turbidity units or ≤ ± 10.1-15 %, whichever is greater	≤ ± 8.1-10 turbidity units or ≤ ± 15.1-20 %, whichever is greater	> ± 10 turbidity units or > ± 20 %, whichever is greater
Water Temperature	≤ ± 0.2°C	≤ ± 0.21 - 0.5°C	≤ ± 0.51 - 0.8°C	≤ ± 0.81 - 1°C	> ± 1°C

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.

There are a few circumstances which may cause QA/QC rankings below excellent, including 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.

The temperature sensor on any sonde is the most important. All other parameters can be divided into subgroups of: temperature dependent, temperature compensated, and temperature independent. Due to the temperature sensor's location on the sonde, the entire sonde must be at a constant temperature before the temperature 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.

QAQC Rankings

Station	Parameter	Deployment Rank	Grab Sample Rank	Removal Rank
East Pond Brook	Dissolved Oxygen (mg/l)	Excellent		Good
East Pond Brook	pH	Fair	Good	Fair
East Pond Brook	Specific Conductivity (µS/cm)	Excellent	Excellent	Excellent
East Pond Brook	Temperature (°C)	Excellent		Excellent
East Pond Brook	Turbidity (NTU)	Excellent	Excellent	Excellent
Tributary to Gill's	Dissolved Oxygen (mg/l)	Excellent		Excellent
Tributary to Gill's	pH	Good	Marginal	Good
Tributary to Gill's	Specific Conductivity (µS/cm)	Excellent	Good	Good
Tributary to Gill's	Temperature (°C)	Good		Good
Tributary to Gill's	Turbidity (NTU)	Excellent	Excellent	Excellent

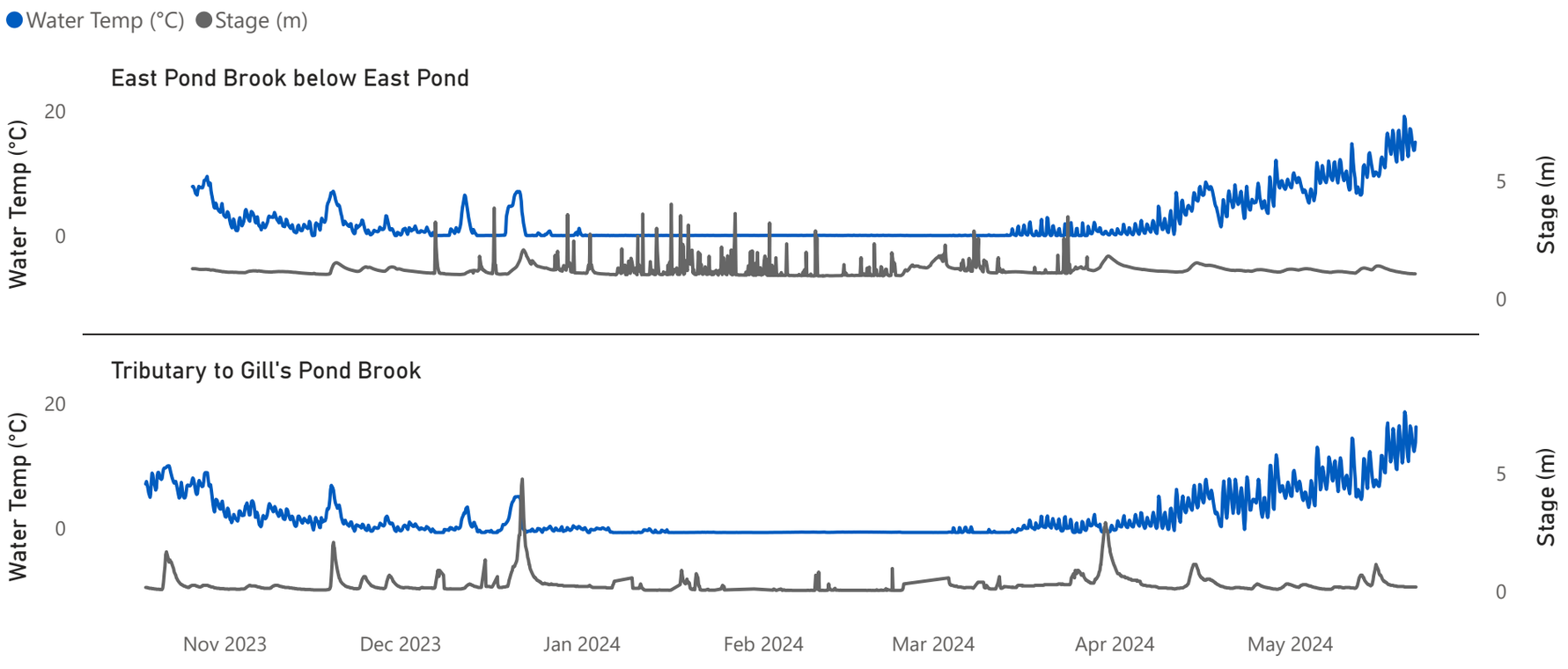
The parameters at East Pond Brook were rated as excellent and good, except for pH, which was rated as fair during both deployment and removal. This is likely due to insufficient time for the sonde to acclimate to the environment. Similarly, all parameters at Tributary to Gills were rated as good or excellent, with the exception of pH from the grab sample, which was rated marginal. This outcome may also be due to limited time for the sonde to equilibrate in the water, along with the time gap between the field measurement and the laboratory analysis of the grab sample.

Water Temperature

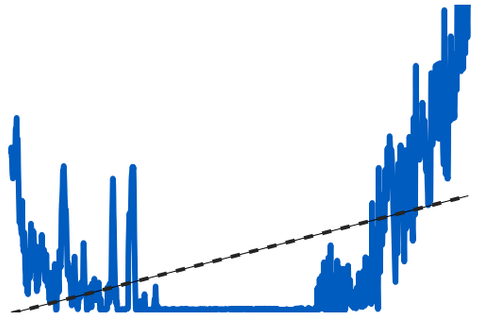
Water temperature is an important parameter for wildlife. Many organisms cannot regulate their own temperatures, and rely on surrounding air and water temperatures. Water temperature may be affected by inputs from industry or by modifying natural conditions like clearing trees and other vegetation, which eliminates the canopy protection they offer. Water temperature affects other parameters monitored including dissolved oxygen and specific conductivity.

The minimum water temperature at East Pond Brook, 0.03°C, occurred on 2024-03-26. and the maximum water temperature, 19.71°C, occurred on 2024-05-20. The minimum water temperature at Tributary to Gill's Pond Brook, -0.68°C, occurred on 2023-12-16. The maximum water temperature, 18.81°C, occurred on 2024-05-20. Water temperature usually falls overnight and rises during the day. East Pond Brook below East Pond is a fast-flowing water course with minimal canopy cover. Tributary to Gill's Pond Brook is a narrower waterbody and during the summer months is mostly covered by tree canopy. Water temperatures from November to May typically follow a seasonal cooling and warming trend. As temperatures drop in late fall, water gradually cools, reaching its coldest point in mid-winter, when the water temperature reaches freezing levels. From March onward, with increasing daylight and warmer air temperatures, water begins to warm again.

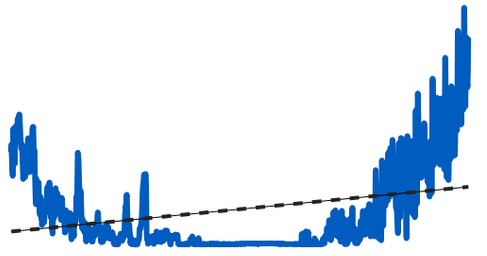
East Pond Brook Below East Pond		Tributary to Gill's Pond Brook	
2.43 Average	0.44 Median	1.93 Average	0.18 Median
0.03 Minimum	19.71 Maximum	-0.68 Minimum	18.81 Maximum



East Pond Brook Trendline



Tributary to Gill's Trendline



pH

pH relates to the free hydrogen ions in water and it is a measure of acidity in water. A pH of 7 indicates a neutral pH, below 7 is considered acidic, and above 7 is considered basic. The Canadian Council of Ministers of the Environment (CCME) Freshwater Aquatic Life guideline provides a basis by which to judge the overall health of the brook. Their freshwater guidelines recommend a minimum pH of 6.5 and a maximum pH of 9.0; however, many rivers in Newfoundland and Labrador are naturally more acidic due to the local geology. Water parameter maps can be found on the Water Resources Management website.

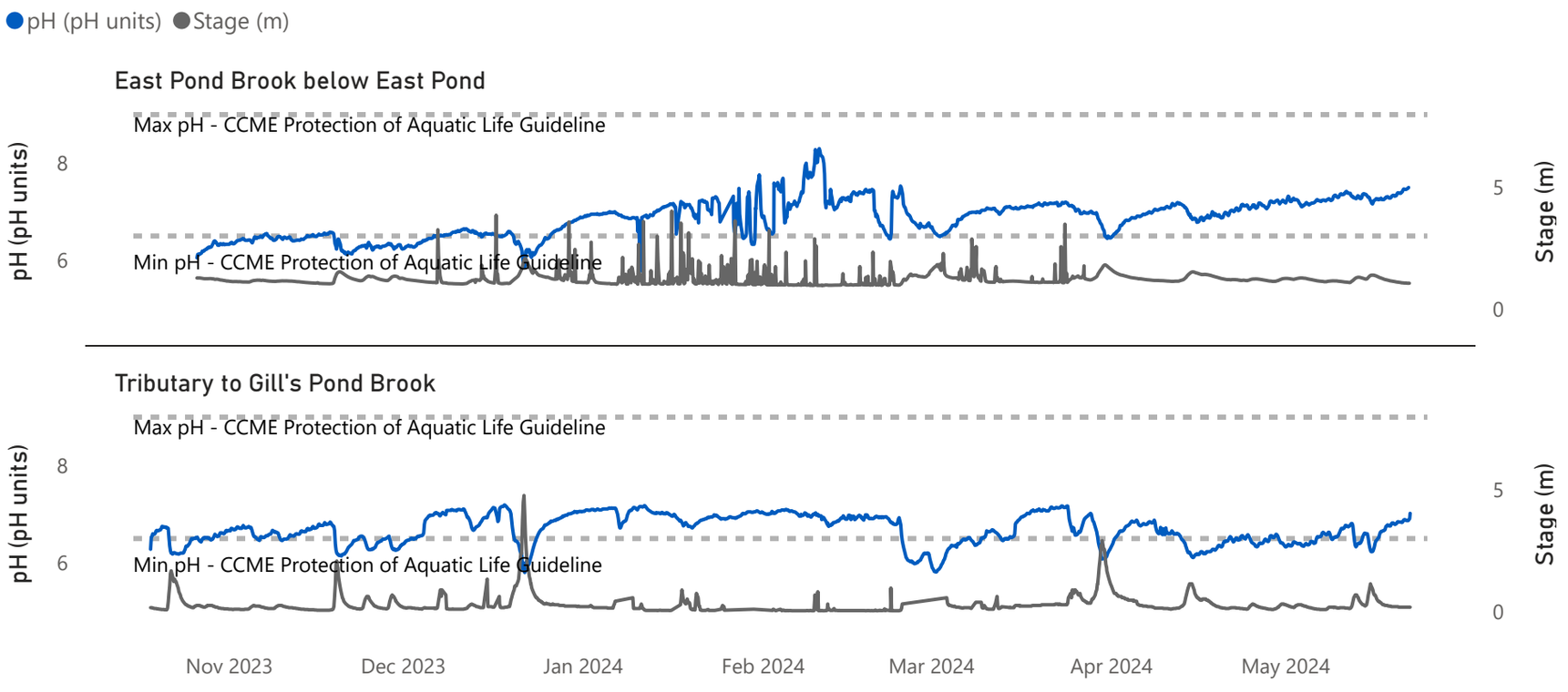
pH data for this deployment was collected from 2023-10-18 until 2024-05-22. The minimum pH at East Pond Brook was 6.10 pH units and the max pH was 8.35 pH units. The minimum pH at Tributary to Gill's Pond Brook was 5.80 pH units and the max pH was 7.19pH units. Daily fluctuations in pH are typical and can result from variations in temperature, the respiration of aquatic plants, as well as precipitation and snowmelt. Notably, significant increases in water stage often correspond with decreases in pH levels. The figure below indicates that the pH at East Pond Brook was near or below the lower guideline value during the first half of the deployment but remained within the guidelines in the latter half. The variation in pH observed at East Pond Brook during the winter months of January to March can be linked to the impact of freezing water temperatures on the sensor. Throughout the majority of the deployment period, the pH at Tributary to Gill's Pond Brook remained at or just above the lower guideline value. The decreases in pH observed can be associated with increases in water stage, as illustrated in the figure below.

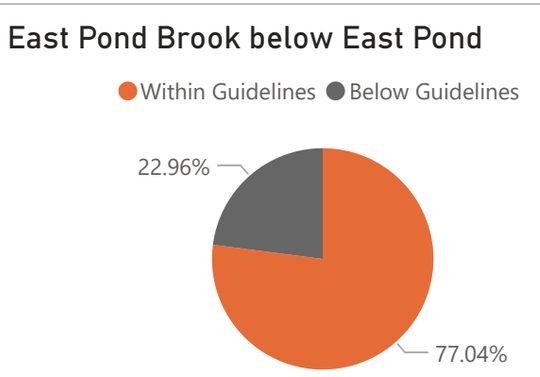
East Pond Brook Below East Pond

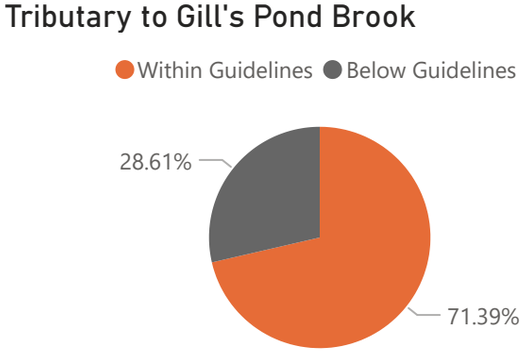
6.86 Average	6.92 Median
5.73 Minimum	8.35 Maximum

Tributary to Gill's Pond Brook

6.69 Average	6.71 Median
5.80 Minimum	7.19 Maximum





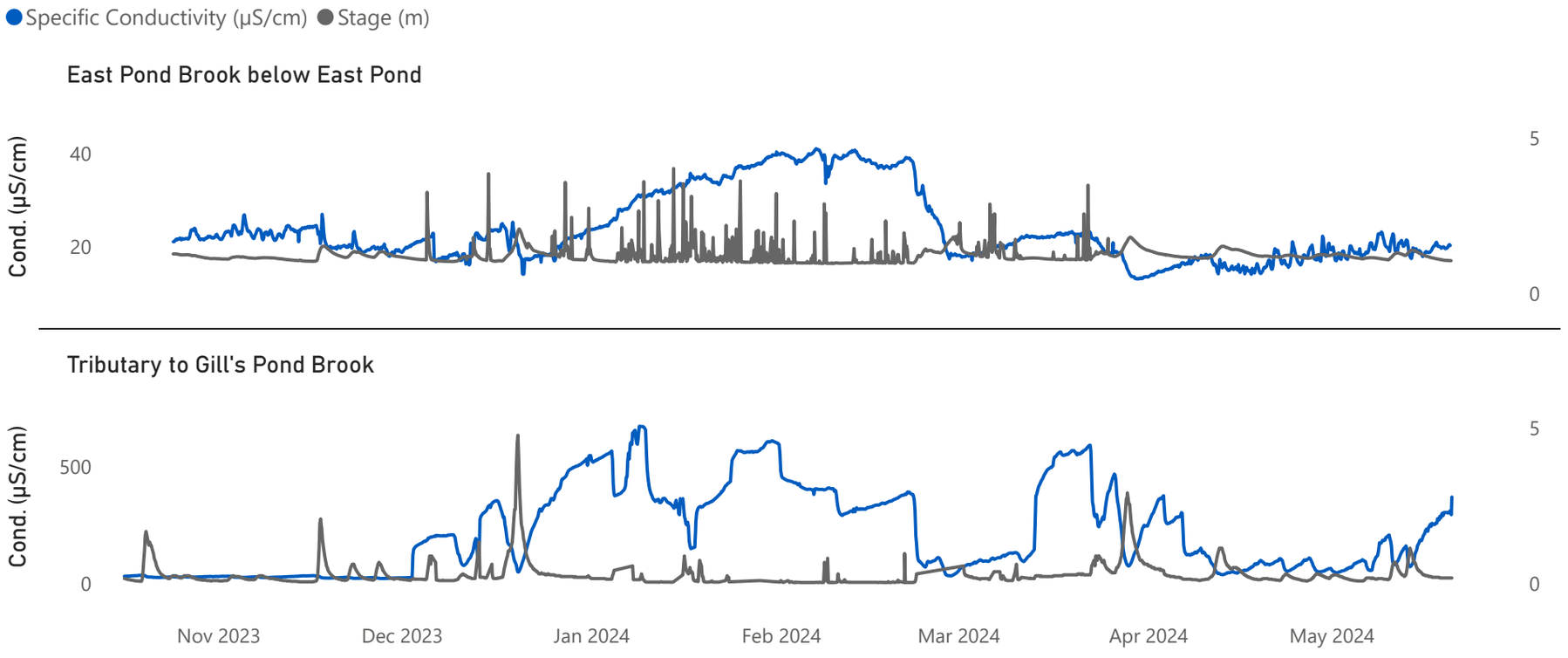


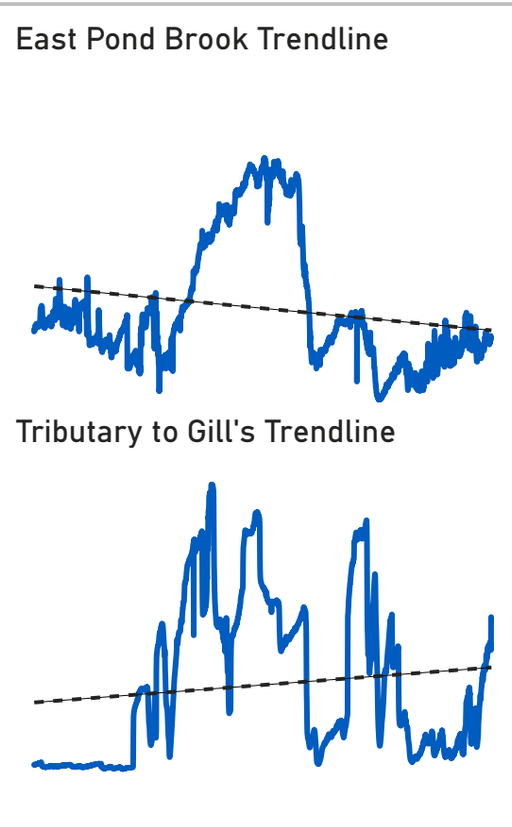
Specific Conductivity

Conductivity relates to the ability of an electric charge to pass through a solution. Pure water has low conductance and water with dissolved ions has higher conductance. Specific conductance is corrected to 25°C to allow comparison across variable temperatures. Water parameter maps can be found on the Water Resources Management website.

Specific conductance data for this deployment was collected from 2023-10-18 until 2024-05-22. The minimum specific conductance at East Pond Brook was 13.00 µS/cm, and the maximum specific conductance was 41.10 µS/cm. The minimum specific conductance at Tributary to Gill's Pond Brook was 21.00 µS/cm and the maximum specific conductance was 676.00 µS/cm. Precipitation and specific conductivity are strongly corelated. Rain water generally has a lower specific conductivity than surface water so during precipitation events, conductivity typically decreases. Specific conductivity at East Pond Brook remained consistently low and stable throughout the deployment period, showing no significant fluctuations. In contrast, specific conductivity at Tributary to Gill's Pond Brook displayed some variation but exhibited an overall increasing trend during the deployment period. This upward trend is likely due to lower water levels, reduced runoff, and decreased rainfall. Variations at Tributary to Gills may be attributed to the discharge of effluent into the brook increasing conductance, and precipitation events decreasing conductance.

East Pond Brook Below East Pond		Tributary to Gill's Pond Brook	
23.84 Average	21.60 Median	216.75 Average	141.85 Median
13.00 Minimum	41.10 Maximum	21.00 Minimum	676.00 Maximum





Dissolved Oxygen

Dissolved oxygen (DO) in water is crucial for aquatic life. The CCME (Canadian Council of Ministers of the Environment) Freshwater Aquatic Life guidelines provide a basis by which to judge the overall health of waterways. The minimum guideline for early life stages in cold water is 9.5 mg/L and the minimum guideline for other life stages is 6.5 mg/L. DO and water temperatures are correlated; colder waters can hold higher concentrations of DO than warm waters.

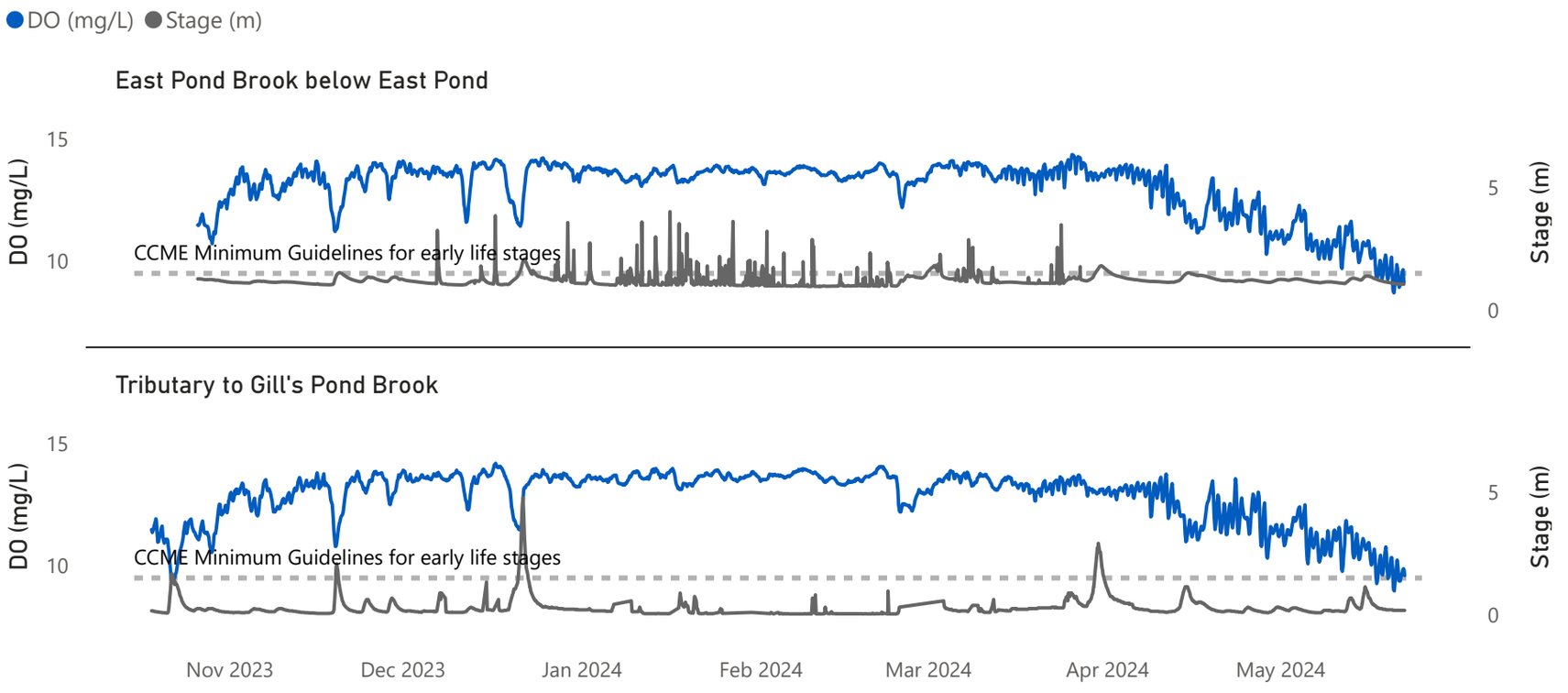
DO data for this deployment was collected from 2023-10-18 until 2024-05-22. The minimum DO reading at East Pond Brook was 8.60 mg/L and the maximum DO reading was 14.36 mg/L. Dissolved oxygen at Tributary to Gill's Pond Brook ranged form 8.95 mg/L to 14.19 mg/L. Daily fluctuations are common due to changes in temperature, respiration of aquatic plants and precipitation events. DO at both stations was above guideline levels for the majority of this deployment period, which would be expected given the cooler winter temperatures. DO concentrations started decreasing towards the end of the deployment period at both stations, which can be attributed to warming of the water in Spring months.

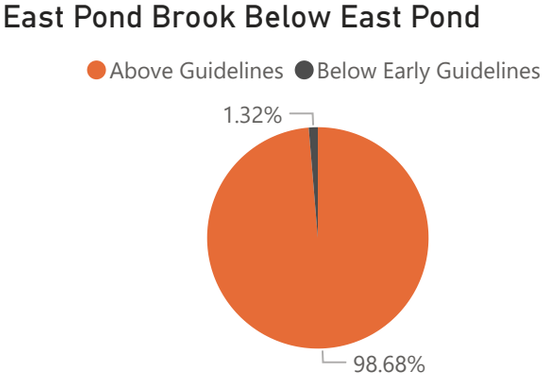
East Pond Brook Below East Pond

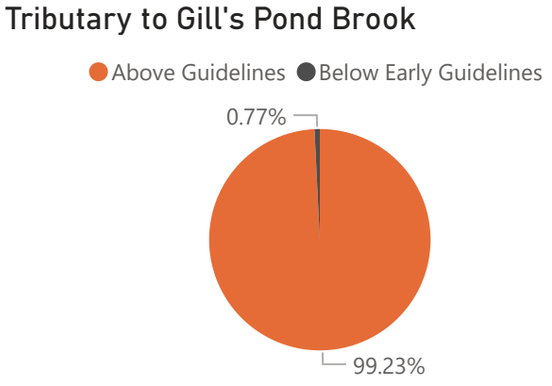
13.02 Average	13.51 Median
8.60 Minimum	14.36 Maximum

Tributary to Gill's Pond Brook

12.85 Average	13.31 Median
8.95 Minimum	14.19 Maximum







Turbidity

Increases in turbidity (cloudiness) are often caused by increased runoff during precipitation events. Runoff carries silt and other debris into the waterbody. Turbid conditions can prevent light from reaching plants, negatively impact benthic habitats, and clog or damage fish gills and equipment.

Turbidity data for this deployment was collected from 2023-10-18 until 2024-05-22. The minimum turbidity at East Pond Brook was 0.00 NTU and the maximum turbidity was 2428.00 NTU. The minimum turbidity at Tributary to Gill's Pond Brook was 0.00 NTU, and the maximum turbidity was 22.10 NTU.

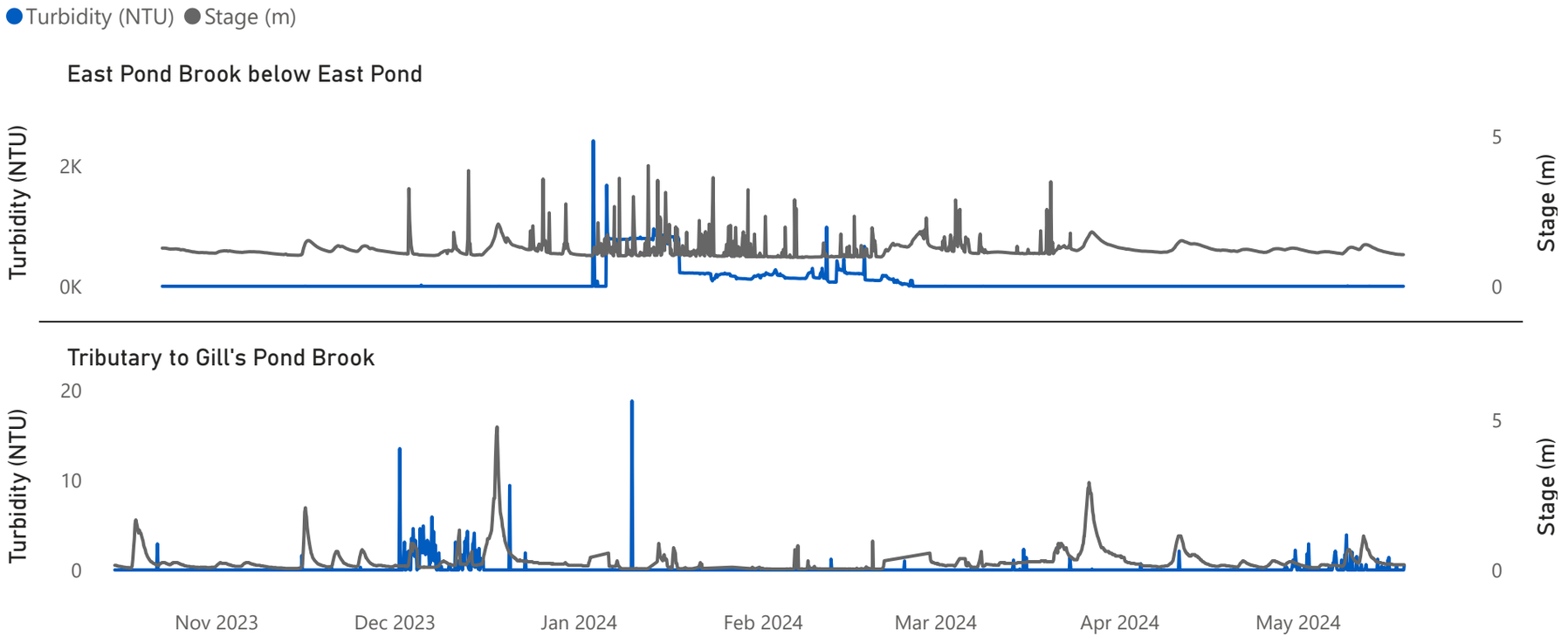
Turbidity levels at East Pond Brook were elevated from mid-January to March, likely due to the impact of ice formation on turbidity readings. Outside this period, turbidity levels remained relatively low and stable. At Tributary to Gill's Pond Brook, turbidity levels were consistently low and steady throughout the deployment period, with fluctuations corresponding to stage increases, potentially resulting from effluent discharge and precipitation events.

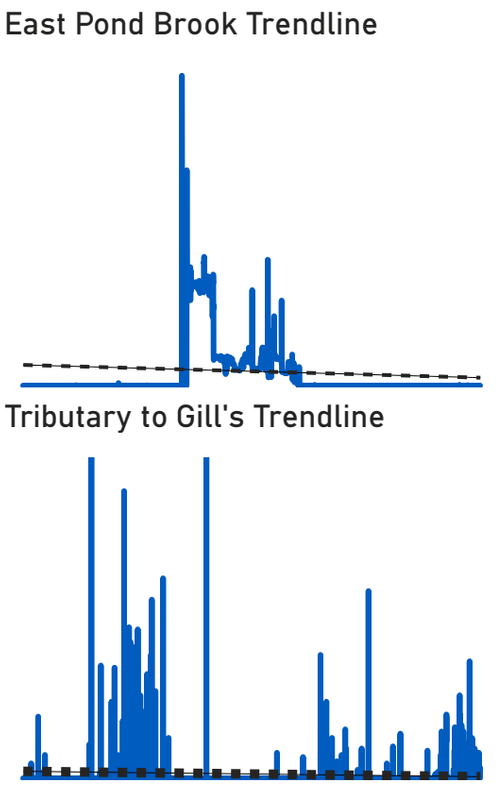
East Pond Brook Below East Pond

80.66 Average	0.00 Median
0.00 Minimum	2,428.00 Maximum

Tributary to Gill's Pond Brook

0.13 Average	0.00 Median
0.00 Minimum	22.10 Maximum

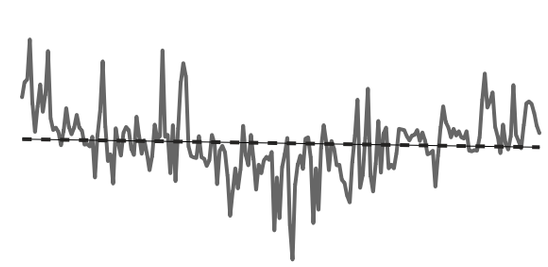




Meteorological and Hydrometric Data

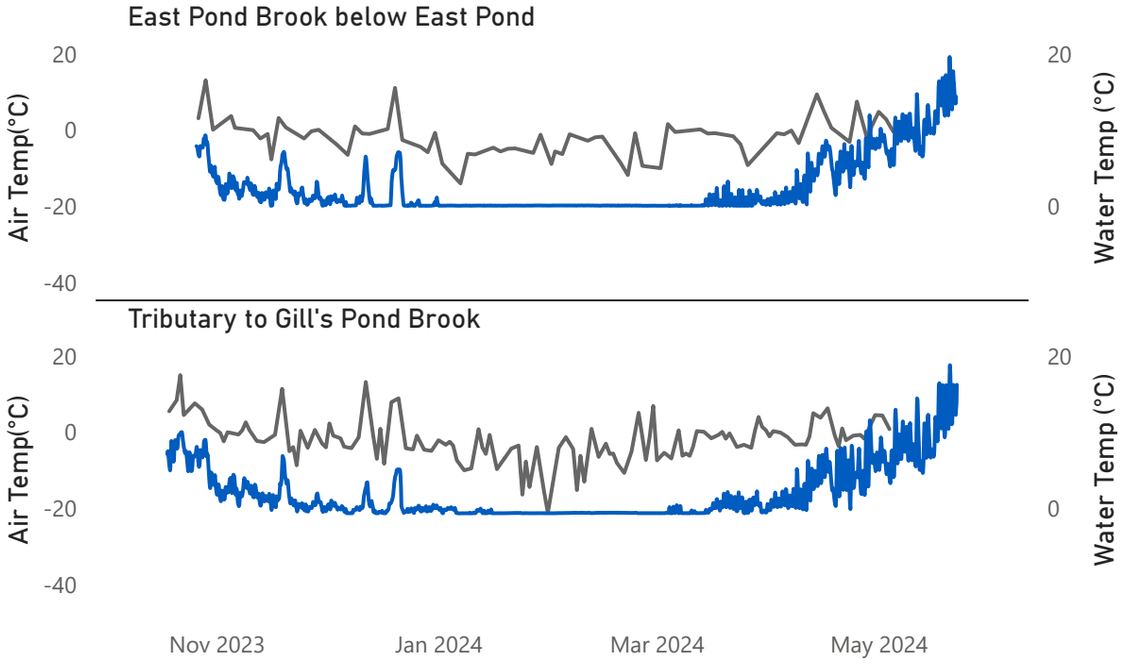
Newfoundland Labrador

Air Temperature Trendline

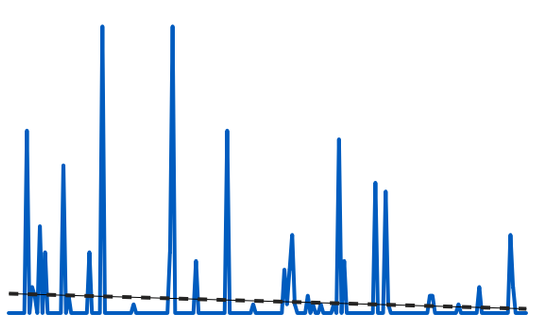


-2.07	-1.70
Average (°C)	Median (°C)
-21.20	15.00
Minimum (°C)	Maximum (°C)

Air Temperature (°C) Water Temperature (°C)



Precipitation Trendline



0.13	0.00
Average (mm/hr)	Median (mm/hr)
0.00	3.30
Minimum (mm/hr)	Maximum (mm/hr)

Precipitation (mm) Stage (m)