Real-Time Water Quality Deployment Report

Teck: Duck Pond Operations

October 1 to November 18, 2020

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment, Climate Change & Municipalities
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

General

This report will review the water quality data from October 1 to November 18, 2020 at two real-time water quality monitoring stations at TECK Duck Pond: Tributary to Gills Pond Brook and East Pond Brook below East Pond.

These stations are a part of the Newfoundland and Labrador Real-Time Water Quality Monitoring Network. The stations are maintained by the Department of Environment, Climate Change and Municipalities, 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 the WRMD website: www.gov.nl.ca/eccm/waterres/rti/stations/

For this report, air temperature and total precipitation data were obtained from the Environment and Climate Change Canada (ECCC) climate station located in Millertown.

Stage Level data is raw data, and the data has not been corrected. Corrected and finalized data may be retrieved from the Environment Climate Change Canada, Water Survey of Canada website.

The climate data was retrieved from:

https://climate.weather.gc.ca/climate_data/daily_data_e.html?hlyRange=2013-01-21%7C2020-05-28&dlyRange=2013-01-21%7C2020-05-28&mlyRange=%7C&StationID=50678&Prov=NL&urlExtension=_e.html&searchType=stnName&optLimit=yearRange&StartYear=2020&EndYear=2020&selRowPerPage=25&Line=0&searchMethod=contains&Month=8&Day=1&txtStationName=Millertown&timeframe=2&Year=2020

Maintenance and Calibration of Instrument

As part of the Quality Assurance and Quality Control protocol (QAQC), 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.

Upon deployment, a QA/QC Sonde is temporarily deployed *in situ*, adjacent to the Field Sonde. Depending on the degree of difference between each parameter from the Field and QAQC sondes, a qualitative rank is assigned (See Table 1). The possible ranks, from most to least desirable, are: Excellent, Good, Fair, Marginal, and Poor. A grab sample is also taken for additional confirmation of conditions at deployment and to allow for future modelling studies.

At the end of a deployment period, a freshly cleaned and calibrated QAQC Sonde is placed *in situ*, adjacent to the Field Sonde. Values are compared between all parameters and differences are ranked for placement in Table 1.

Table 1: Qualitative QAQC Rankings for October to November 2020 Deployment Period

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Tributary to Gill's Pond Brook	Oct 1	Deployment	Good	Good	Excellent	Excellent	Excellent
	Nov 18	Removal	Excellent	Fair	Good	Excellent	Good
East Pond Brook below East Pond	Oct 1	Deployment	Fair	Good	Excellent	Good	Excellent
	Nov 18	Removal	Excellent	Good	Excellent	Poor	Excellent

Data Interpretation

Water Temperature

Water Temperature is a major parameter used to describe the characteristics of a water body. It is directly influenced by ambient air temperature as well as factors such as water depth, amount of sunlight or shade and precipitation.

During this deployment period, East Pond Brook recorded water temperatures ranging from 0.03°C to 20.20°C with a median of 6.77°C. Tributary to Gills Pond Brook recorded a range of 0.70°C to 19.90°C with a median value of 6.75°C. Water temperatures at Tributary to Gills Pond Brook were generally cooler than East Pond Brook during this deployment period (Table 2).

Both sets of water temperature data display a natural diurnal pattern with higher temperatures in the day light hours and lower temperatures in the nighttime hours. The gradual decrease in temperature at both stations across the deployment is typical for the time of year and influencing ambient air temperatures as Winter approaches.

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Table 2: Summary Statistics for Water Temperature at Teck: Duck Pond Operations Stations (October – November 2020)

Station	Mean	Median	Min	Max
East Pond Brook	7.14	6.77	0.03	20.20
Tributary to Gills Pond Brook	6.97	6.75	0.70	19.90

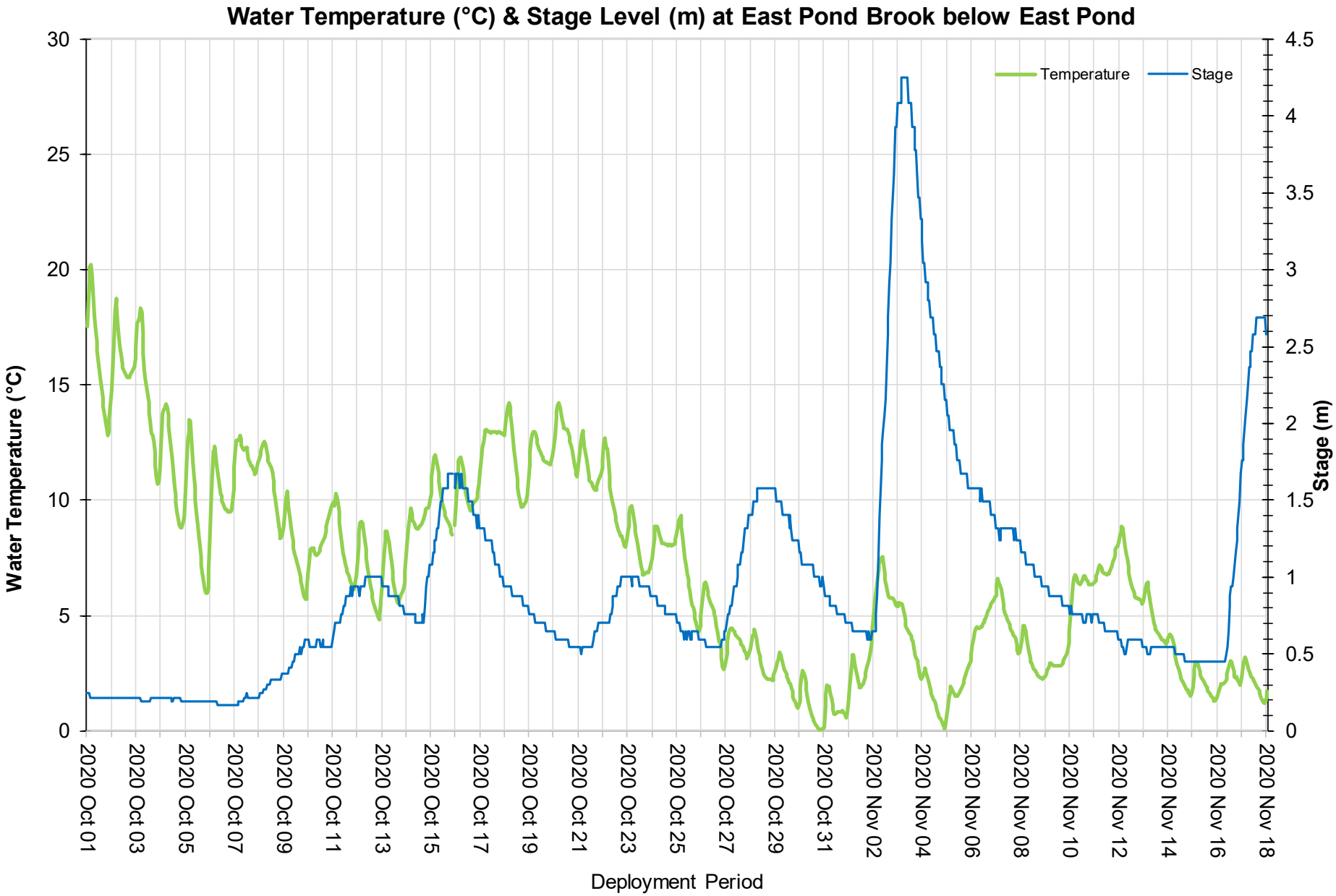

Figure 1: Water Temperature (°C) and Stage Level (m) at East Pond Brook

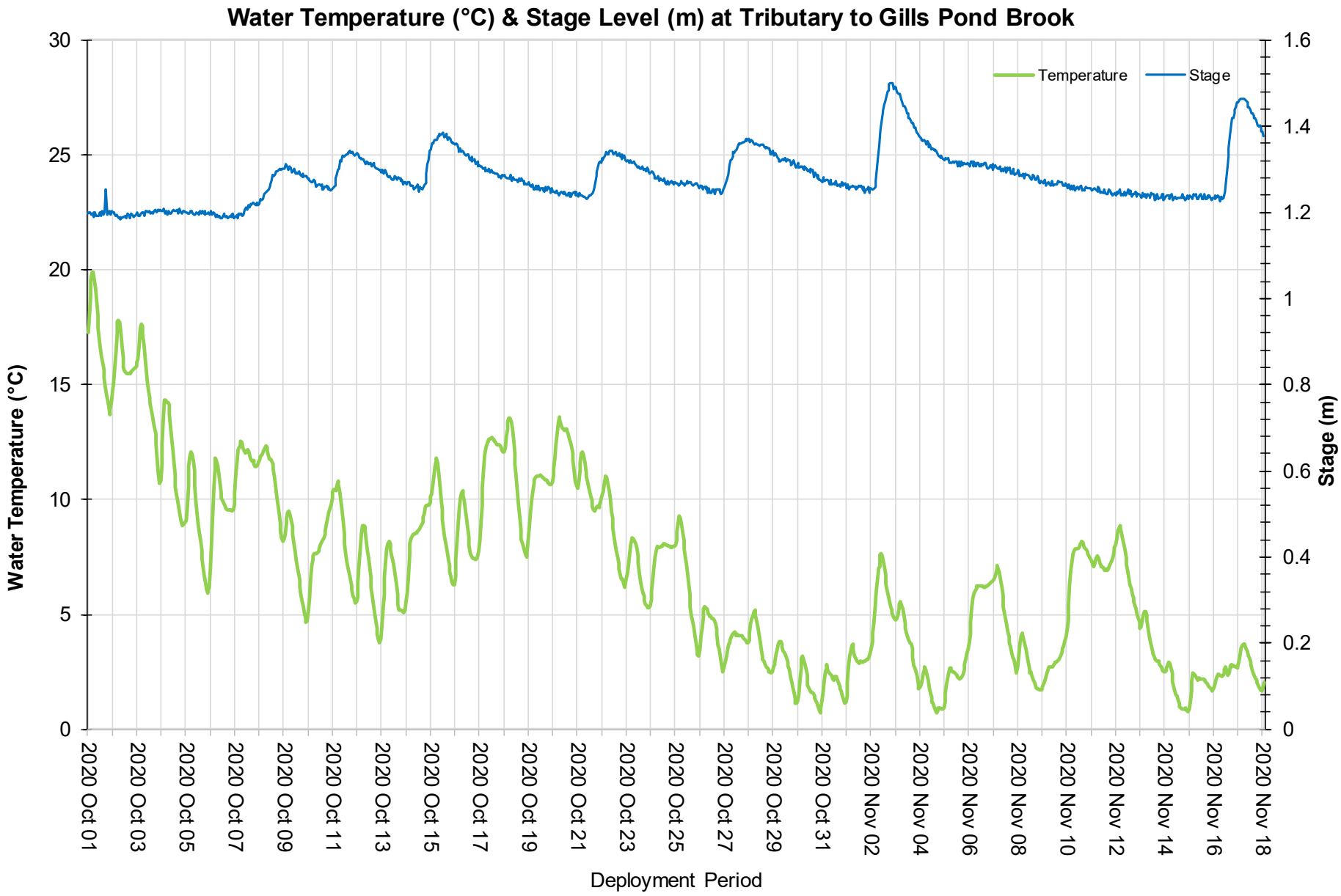

Figure 2: Water Temperature (°C) and Stage Level (m) at Tributary to Gills Pond Brook

pH

pH indicates the acidity or alkalinity of a solution. A value of 7.00 pH units denotes a neutral solution while lower values are acidic and higher values are basic.

The pH levels at East Pond Brook ranged from 5.87 to 7.16 with a median of 6.67 pH units, while ph levels at Tributary to Gills Pond Brook ranged from 6.05 to 7.35 with a median of 6.85 pH units (Table 3). pH values were generally lower at East Pond Brook than Tributary to Gills Pond Brook during this deployment period.

This deployment captures pH data during the fall months. There are notable drops in pH at Tributary to Gills Pond Brook throughout the deployment. The decreases correspond to increases in stage at this time. This is a natural effect on the water column as more acidic water is added to the system by precipitation. pH slowly returns to background levels after each drop. This effect is noticeable to a lesser extent at East Pond Brook. At both stations, pH shows an overall decreasing trend throughout the deployment period.

The CCME aquatic life guideline noted on the pH graph is a range by which to compare pH levels across Canada. It does not indicate the health of the brook. Due to the soil composition and natural geology of Newfoundland and Labrador, many of the brooks and waterways in the province have naturally lower pH ranges. During this deployment period, pH values at East Pond Brook were below the CCME minimum guideline for aquatic health for about half of the deployment, while values at Tributary to Gills Pond Brook only dropped below the minimum guideline on a few occasions when influenced by stage increases from precipitation events.

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Table 3: Summary Statistics for pH at Teck: Duck Pond Operations Stations (October - November 2020)

Station	Mean	Median	Min	Max
East Pond Brook	6.61	6.67	5.87	7.16
Tributary to Gills Pond Brook	6.82	6.85	6.05	7.35

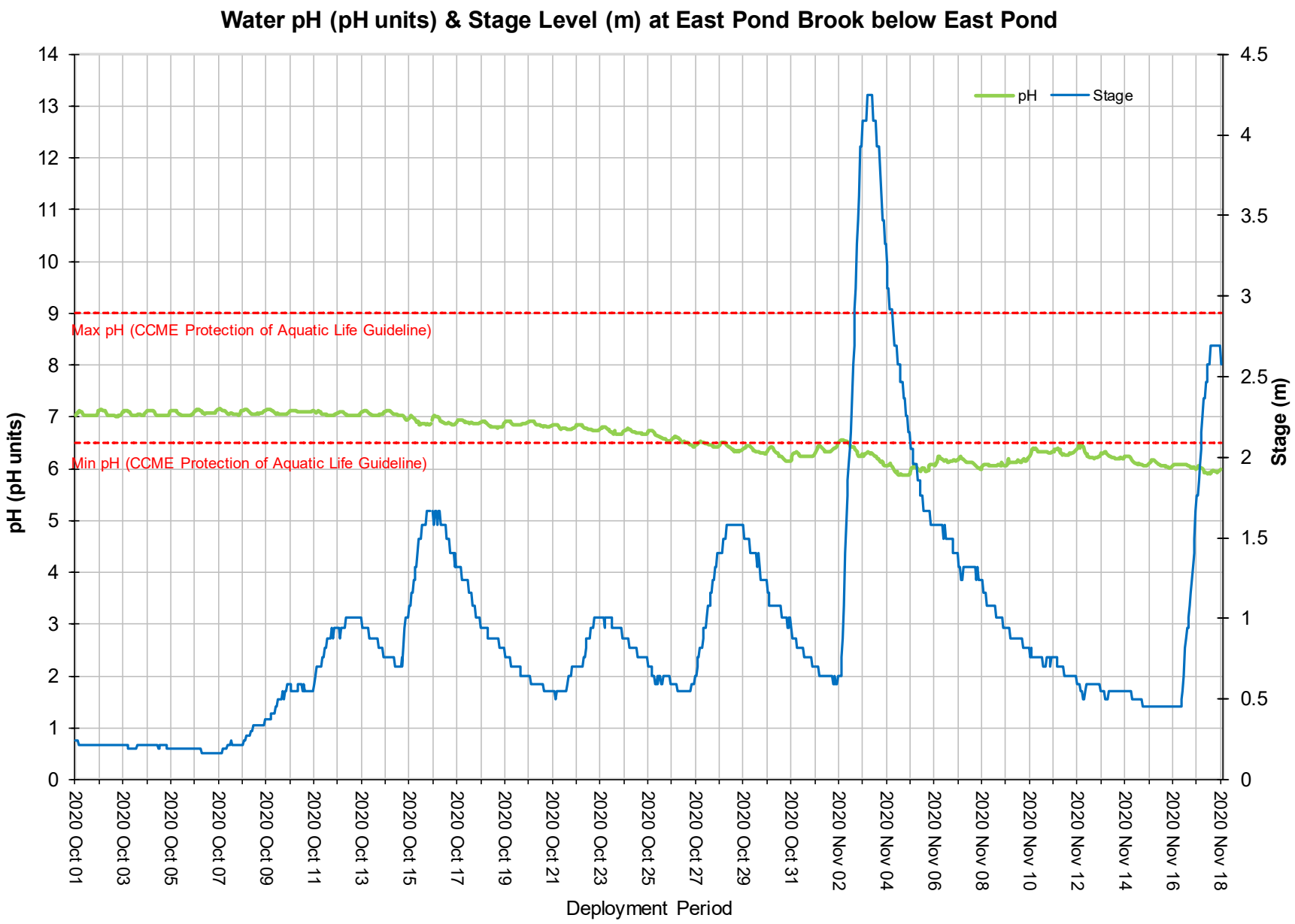

Figure 3: pH (pH units) and Stage Level (m) at East Pond Brook

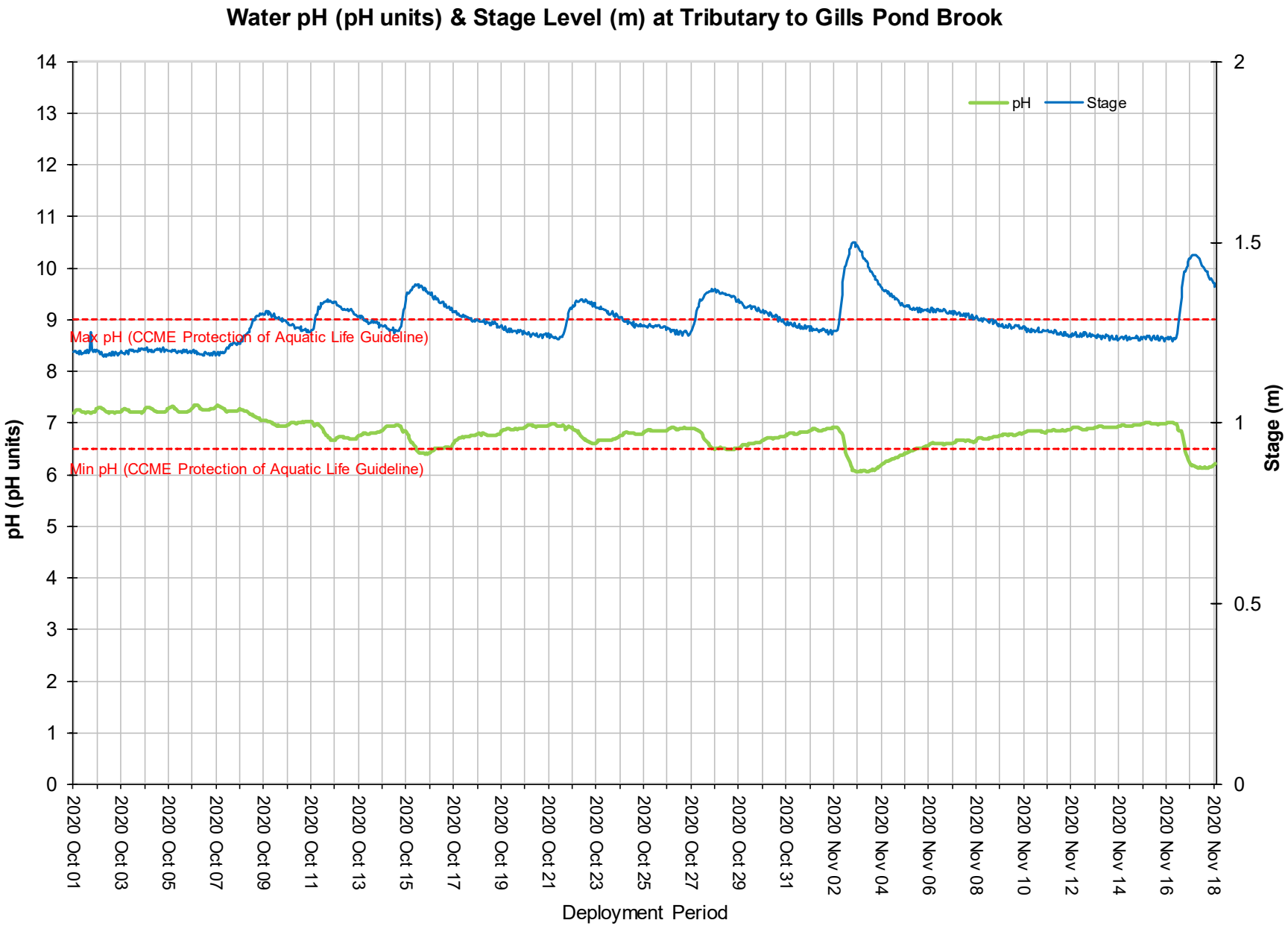

Figure 4: pH (pH units) and Stage Level (m) at Tributary to Gills Pond Brook

Specific Conductivity

Conductivity relates to the ability of an electric charge – or resistance – to pass through a solution. Conductivity is highly influenced by the concentration of dissolved ions in solution: distilled water has zero conductivity (infinite resistance) while salty solutions have high conductivity (low resistance). Specific Conductivity is corrected to 25^{o}C to allow comparison across variable temperatures.

At East Pond Brook, specific conductivity values did not alter greatly over the deployment period, ranging only from 24.4 to 39.2 µS/cm with a median of 31.6 µS/cm (Table 4). These values are almost identical to the previous deployment. In contrast, Tributary to Gills Pond Brook had a significantly greater range of 37.4 to 419 µS/cm with a median of 140 µS/cm. Values are also significantly higher than at East Pond Brook. This is normal for water quality at this location as it is influenced by discharge from the Duck Pond Tailings Management facility upstream.

When water is discharged from the facility, there is a visible increase in specific conductivity at the station. Figure 7 displays the effluent discharge (m^3/day) that occurred across deployment. Other factors that could influence conductivity are low precipitation and evaporation of water, both which are a direct result of the warmer temperatures occurring during summer.

There were several increases in stage at Tributary to Gills Pond Brook, all with corresponding drops in specific conductivity (Figure 6). This is a natural relationship: as more water is added to the system, it is diluted, decreasing the concentration of dissolved ions. Overall, specific conductivity at Tributary to Gills Pond Brook showed a decreasing trend across the deployment (Figure 6).

East Pond Brook station also displays a drop in conductivity when stage levels rise on November 3rd, however the decline is not as noticeable as those at Tributary to Gills Pond Brook, likely because the natural range at East Pond Brook is so small in comparison to Tributary to Gills Pond Brook. After a large stage increase on November 3rd, specific conductivity also showed an uncharacteristic increase before returning to background levels. This indicates that sediments may have washed into the brook during the recent rainfall. Overall, East Pond Brook showed a decreasing trend across the deployment period (Figure 5).

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Table 4: Summary Statistics for Specific Conductance at Teck: Duck Pond Operations Stations (October - November 2020)

Station	Mean	Median	Min	Max
East Pond Brook	31.7	31.6	24.4	39.2
Tributary to Gills Pond Brook	164.4	140.0	37.4	419.0

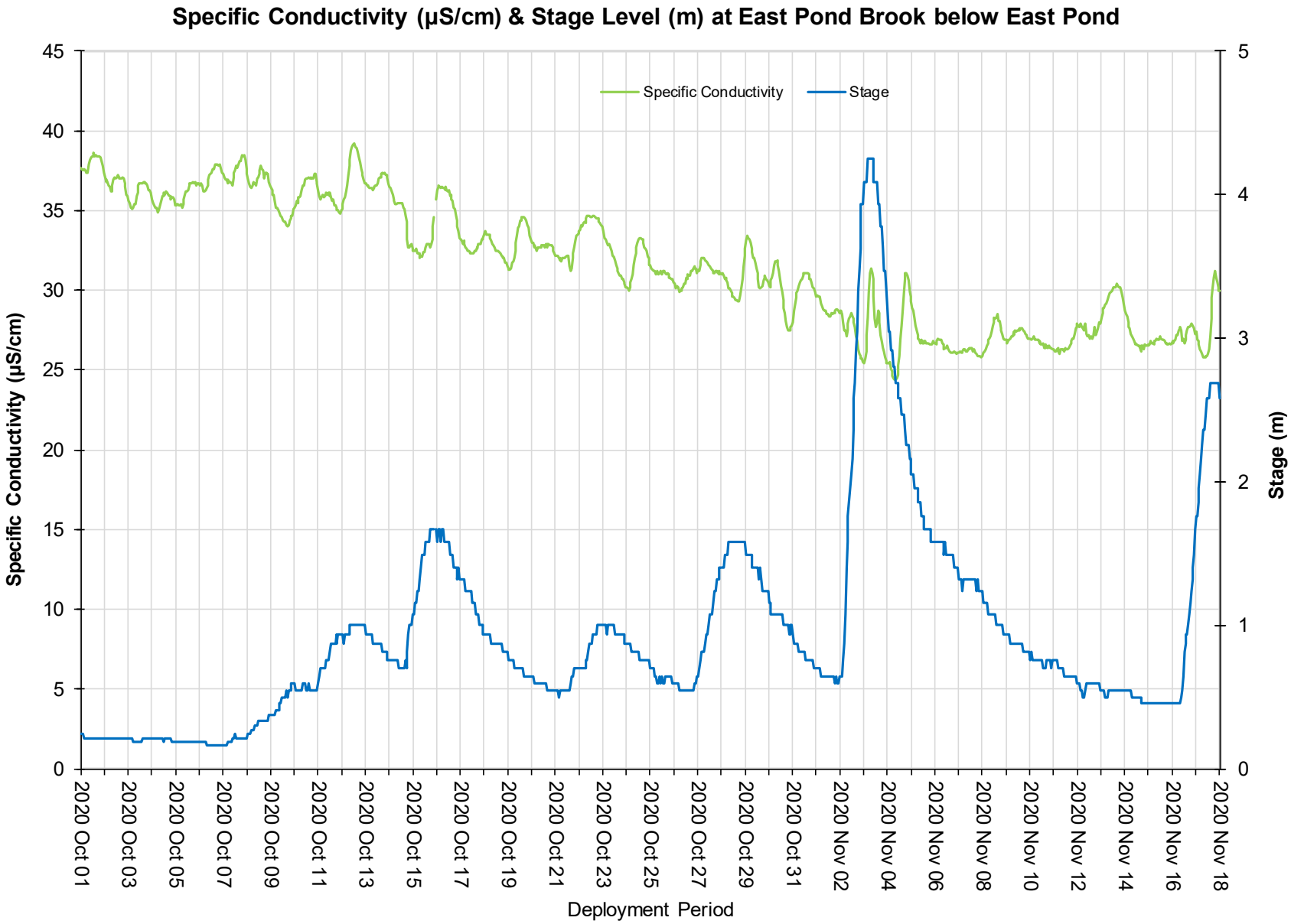


Figure 5: Specific Conductivity (µS/cm) and Stage Level (m) at East Pond Brook

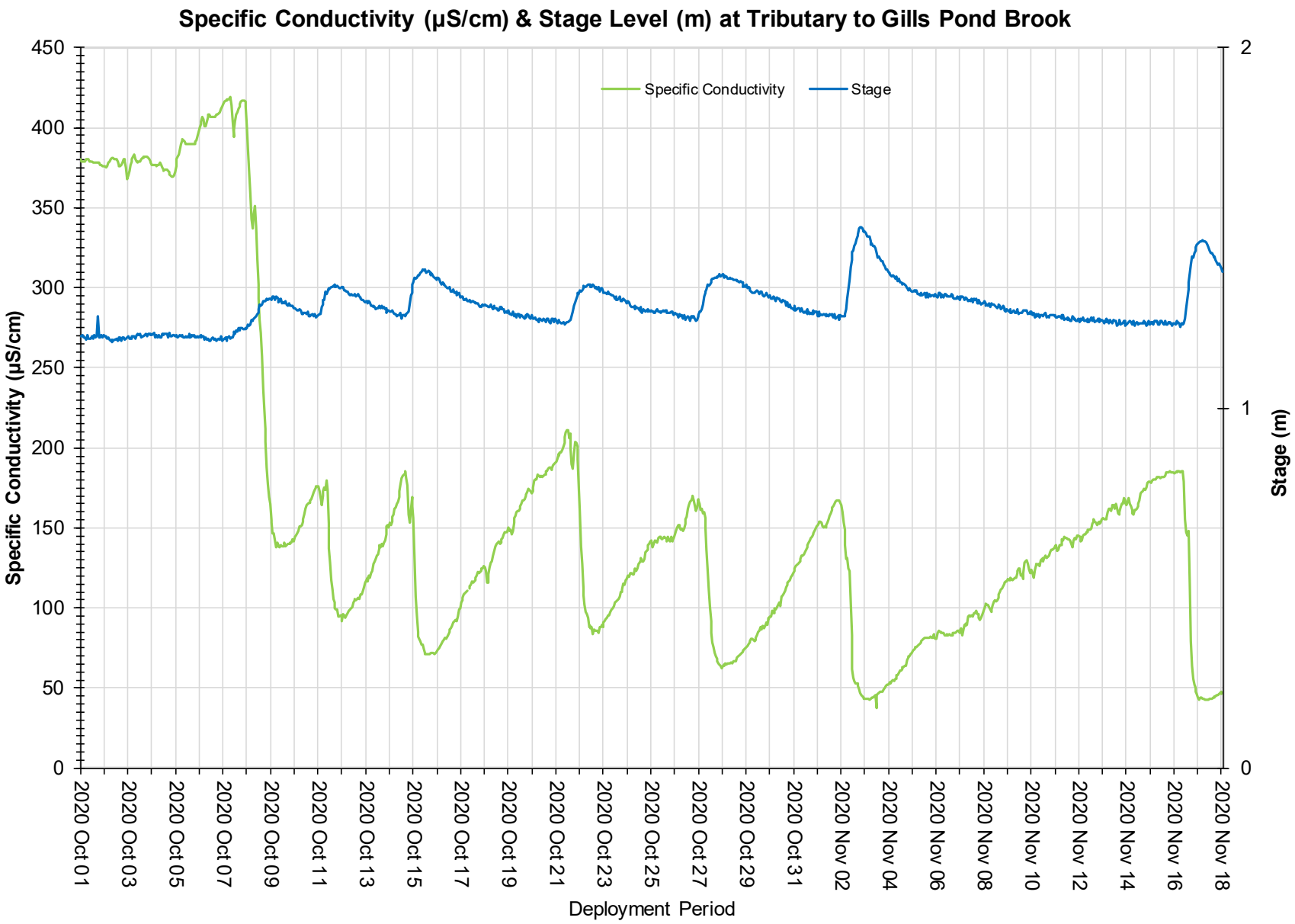


Figure 6: Specific Conductivity (µS/cm) and Stage Level (m) at Tributary to Gills Pond Brook

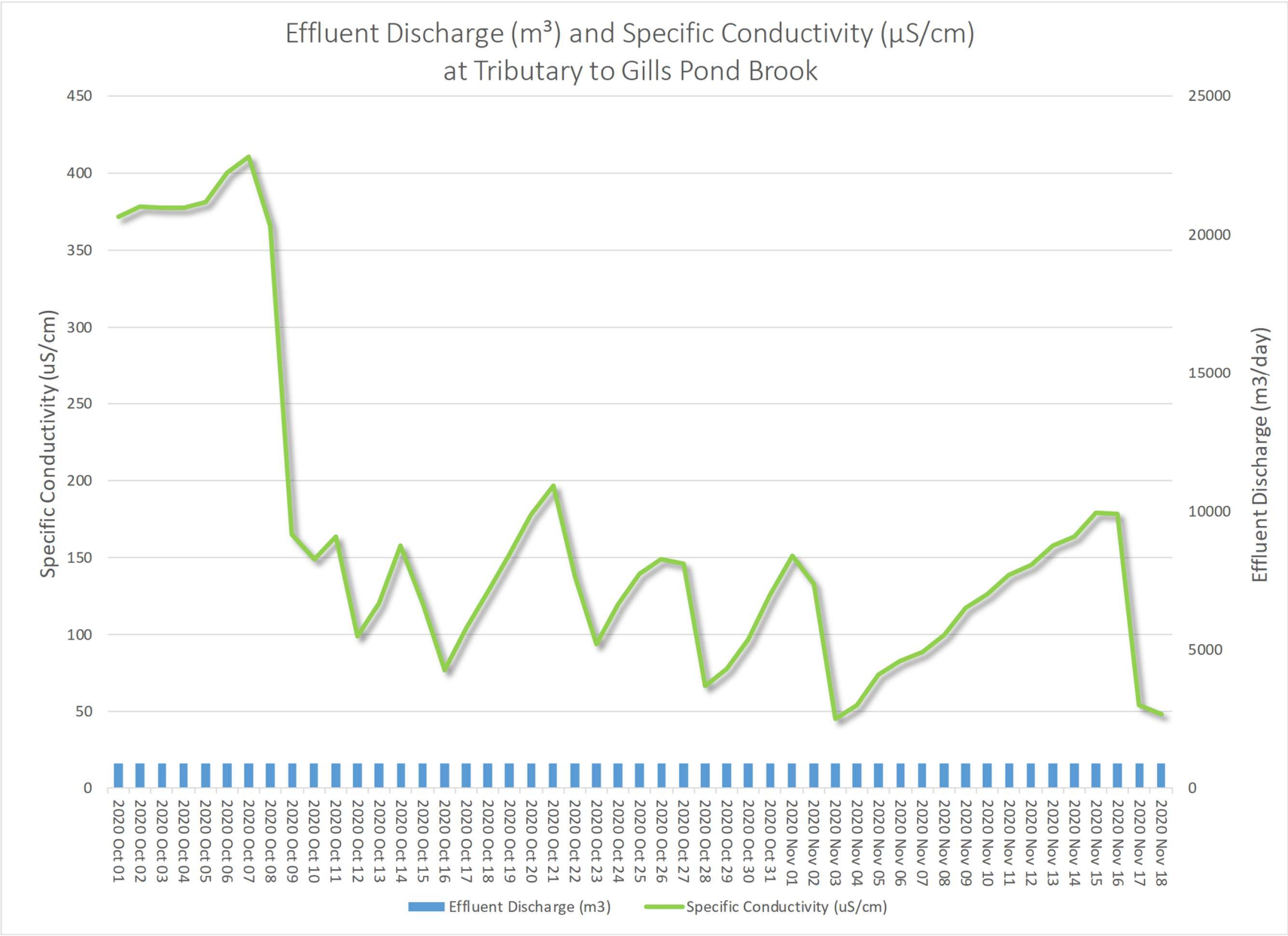


Figure 7: Effluent Discharge (m³/day) and Specific Conductivity (µS/cm) at Tributary at Gills Pond Brook

Dissolved Oxygen

Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on several factors, particularly temperature. The saturation of oxygen in water is inversely proportional to water temperature of the water body. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.

At East Pond Brook, dissolved oxygen levels ranged from 8.57mg/L to 13.21 mg/L with a median of 11.03 mg/L (Table 5). At Tributary to Gills Pond Brook, dissolved oxygen levels ranged from 8.30 mg/L to 13.33 mg/L with a median of 11.17 mg/L. Throughout the deployment, dissolved oxygen levels were generally lowest at East Pond Brook, which is in contrast to the previous deployment.

Both stations demonstrate increases in dissolved oxygen across the deployment period as air and water temperatures begin to decrease into Fall, influencing dissolved oxygen values naturally and inversely (Figure 8 & Figure 9). Major drops in dissolved oxygen on November 3rd, 6th and 10th are associated with rapid increases in water temperature as warmer weather systems pass through the area.

Dissolved oxygen concentrations (DO mg/L) at both stations were above the CCME aquatic life dissolved oxygen guideline for other life stages throughout the deployment period. Both stations recorded dissolved oxygen values below the minimum guideline for early life stages only for the first three days of the deployment period when water temperatures were warmest.

Table 5: Summary Statistics for Dissolved Oxygen at Teck: Duck Pond Operations Stations (October-November 2020)

Station	Mean	Median	Min	Max
Dissolved Oxygen (mg/L)				
East Pond Brook	11.04	11.03	8.57	13.21
Tributary to Gills Pond Brook	11.25	11.17	8.30	13.33
Dissolved Oxygen (%Sat)				
East Pond Brook	90.5	90.2	85.8	95.6
Tributary to Gills Pond Brook	91.9	92.1	83.5	95.5

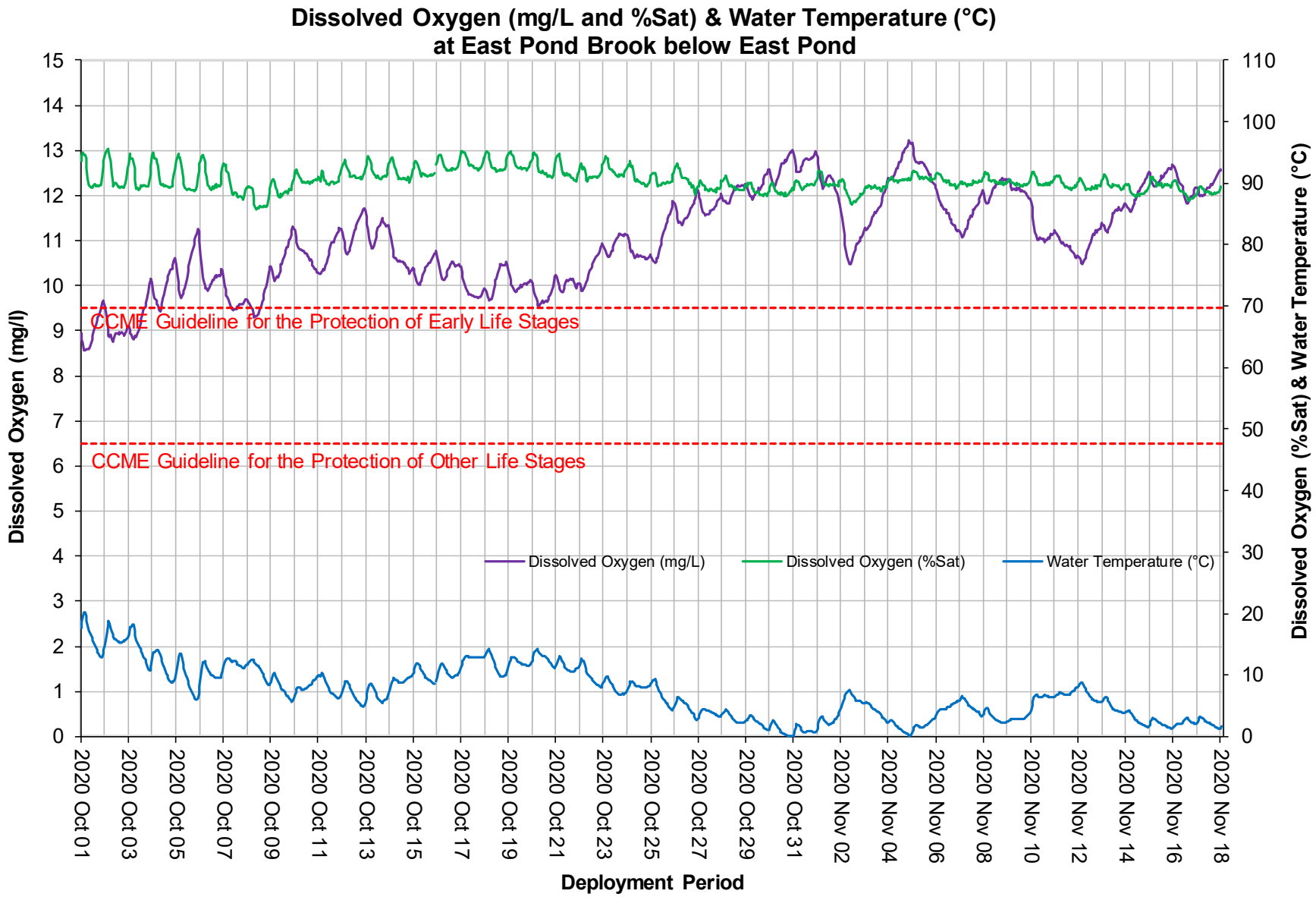


Figure 8: Dissolved Oxygen (mg/L & sat %) and Water Temperature (°C) at East Pond Brook

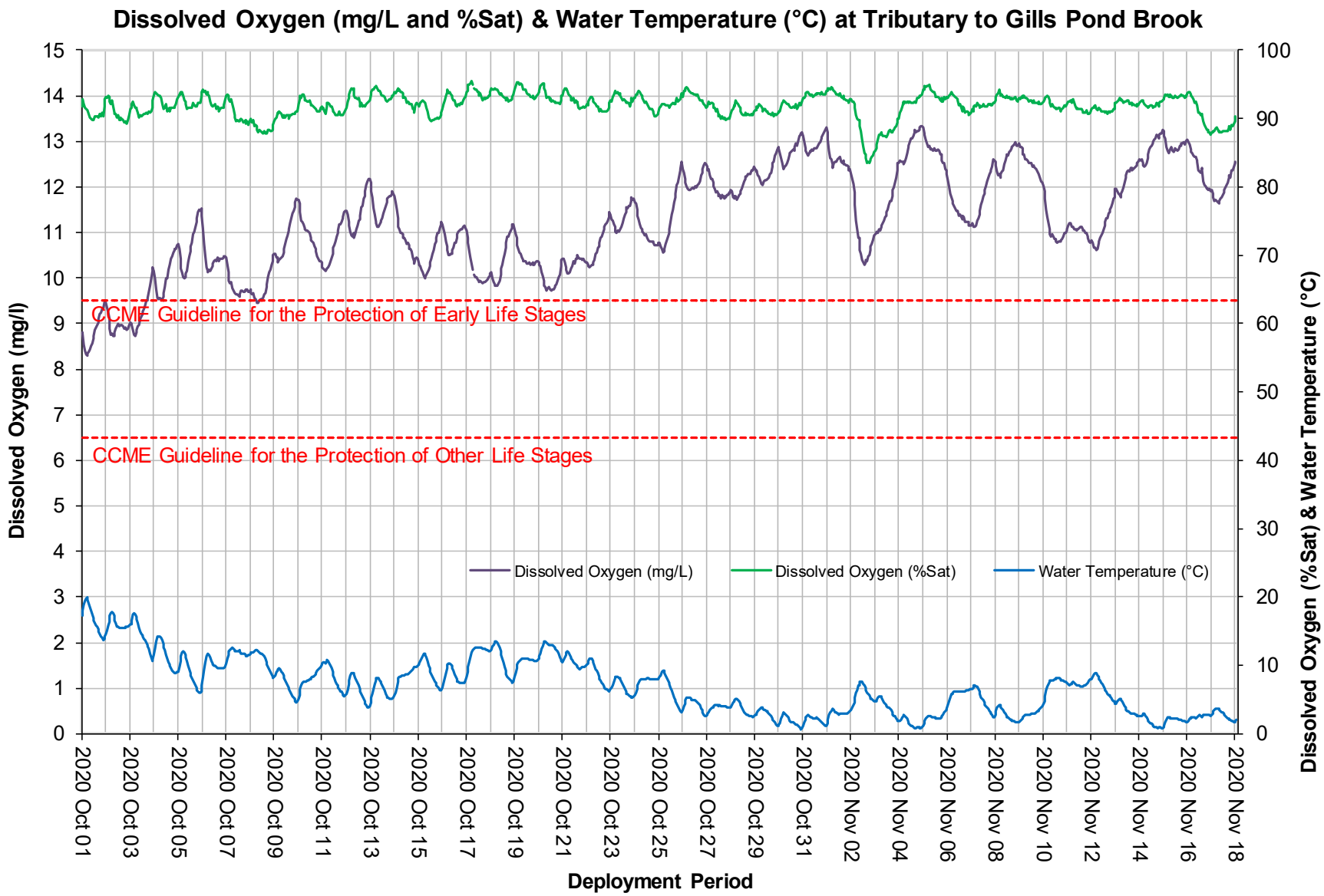


Figure 9: Dissolved Oxygen (mg/L & % Sat) and Water Temperature (°C) at Tributary to Gills Pond Brook

Turbidity

Turbid water is typically caused by fine suspended solids, such as silt, clay, or organic material. Consistently high levels of turbidity tend to block sunlight penetration into a waterbody, discouraging plant growth. High turbidity can also damage the delicate respiratory organs of aquatic animals and cover spawning areas.

Turbidity levels are generally low at East Pond Brook below East Pond (Figure 10). East Pond Brook has a natural tea-like color to the water, likely influenced by the surrounding marsh and bog lands. It is common for surface water to have a level of background turbidity as the surrounding ecosystems can influence the particulate matter present naturally. Persistent spikes and a prolonged increase in turbidity over a period would be of concern.

East Pond Brook below East Pond recorded turbidity data within 0.0 NTU to 13 NTU with a median of 0.9 NTU, indicating low background turbidity. The turbidity at Tributary to Gills Pond Brook ranged within 0.7 NTU to 10.7 NTU with a median of 1.9 NTU. The effluent discharged into Tributary to Gills Pond can increase turbidity for a short period of time, however, this was not evident during this deployment.

A large increases in stage at both stations around November 3rd had a prolonged effect on turbidity at both stations. As stage began to rise, turbidity also rose slowly for a period of time before returning to background levels around November 6th. This occurred at both stations (Figures 10 & 11).

Stage Level data is raw data. Corrected and finalized data may be retrieved from the Environment Climate Change Canada, Water Survey of Canada website https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html

Table 6: Summary Statistics for Turbidity at Teck: Duck Pond Operations Stations (October-November 2020)

Station	Mean	Median	Min	Max
East Pond Brook	1.1	0.9	0.0	13.0
Tributary to Gills Pond Brook	2.1	1.9	0.7	10.7

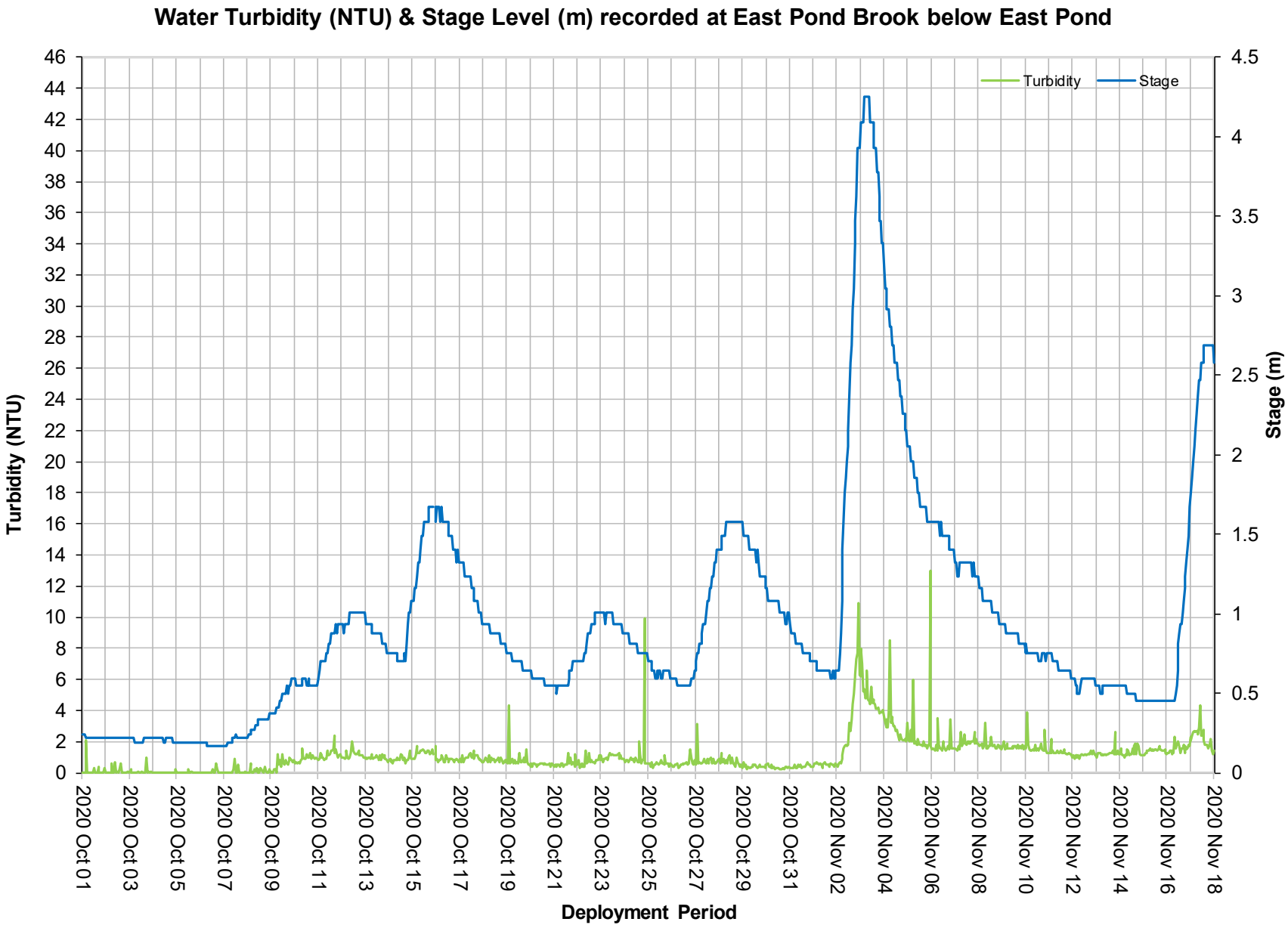


Figure 10: Turbidity (NTU) and Stage Level (m) at East Pond Brook

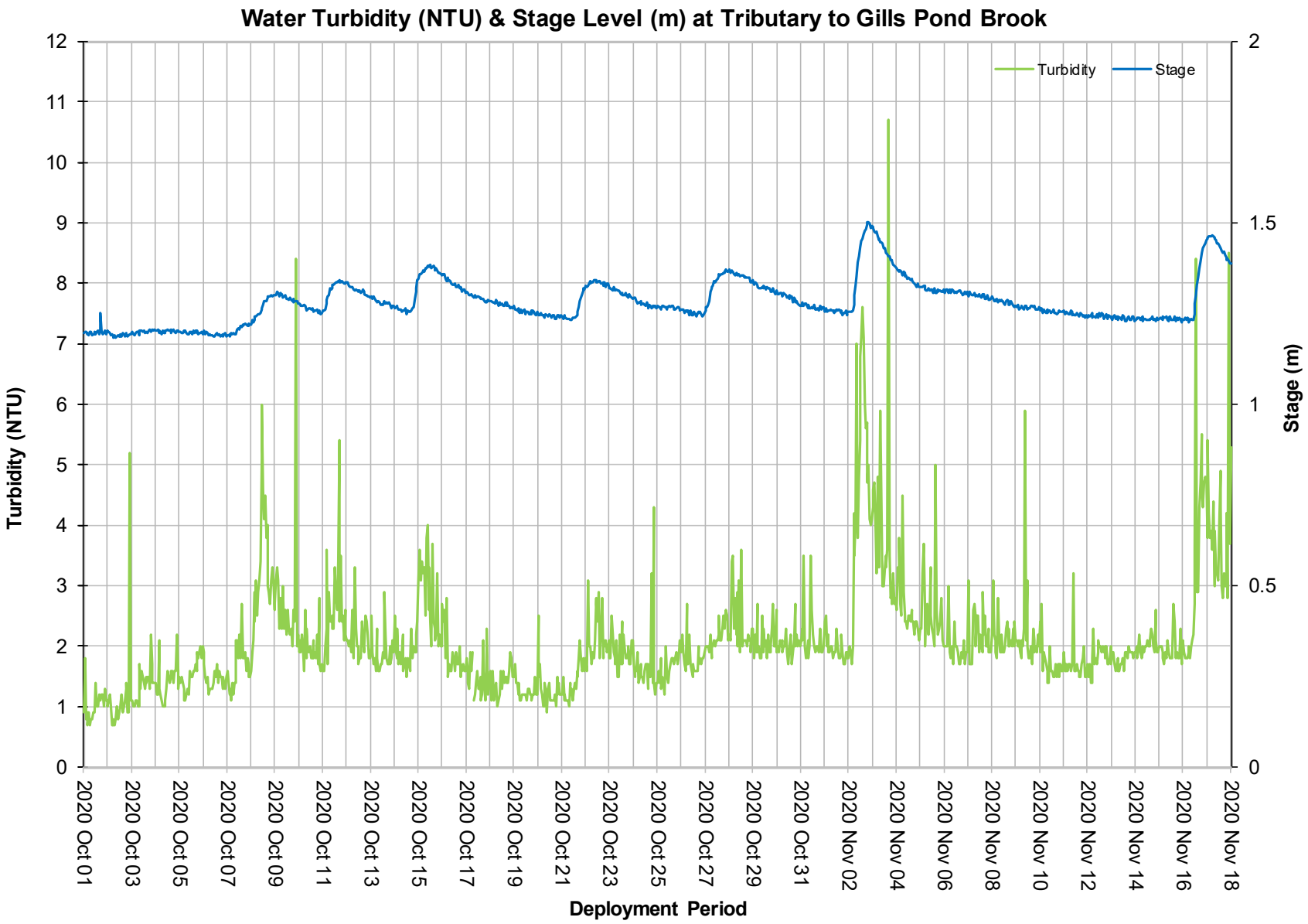
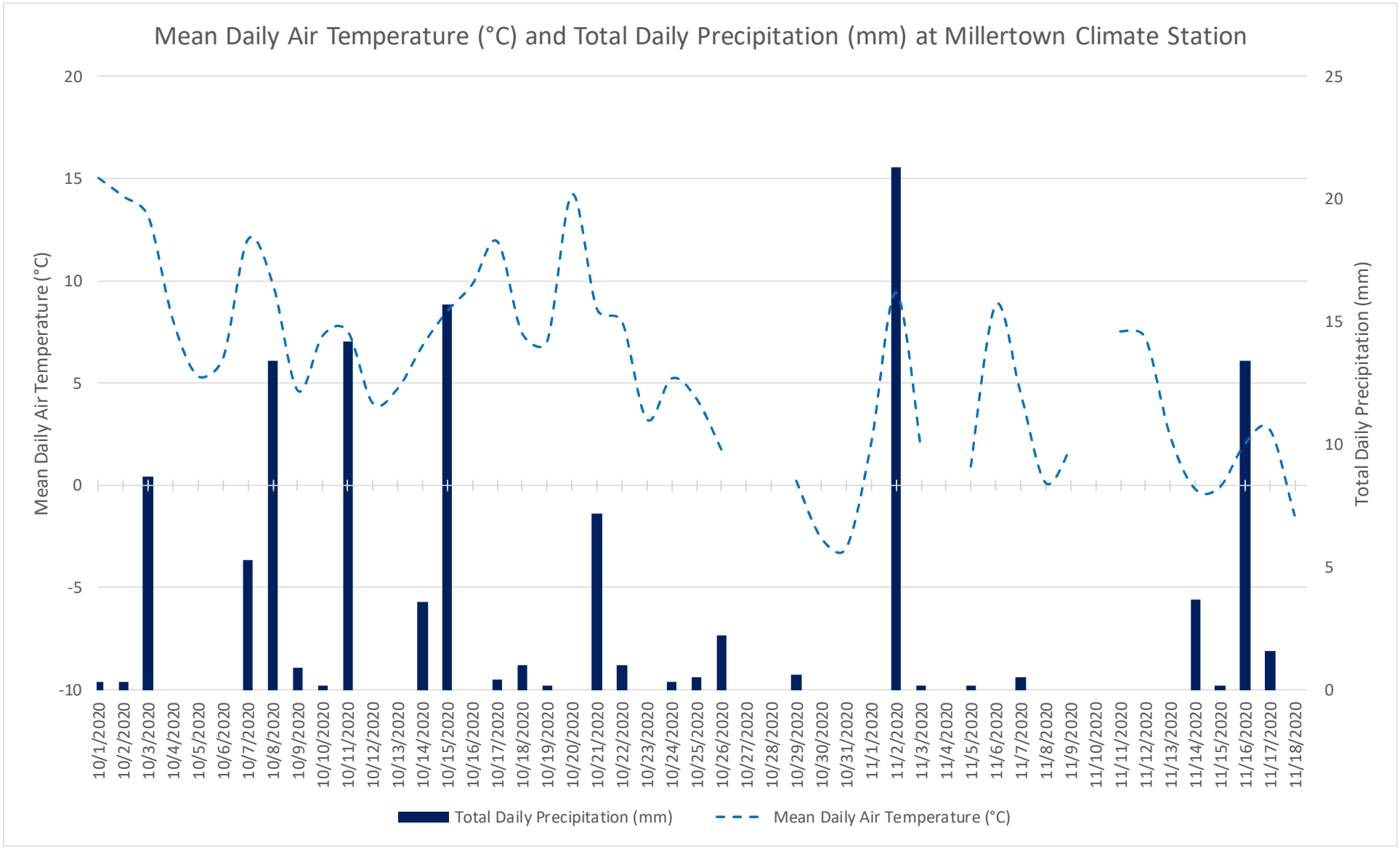


Figure 11: Turbidity (NTU) and Stage Level (m) at Tributary to Gills Pond Brook

APPENDIX I


Mean Daily Air Temperature (°C) and Total Daily Precipitation (mm) at Millertown Climate Station
Mean Daily Air Temperature (°C)
Total Daily Precipitation (mm)
20
15
10
5
0
-5
-10
25
20
15
10
5
0
10/1/2020
10/2/2020
10/3/2020
10/4/2020
10/5/2020
10/6/2020
10/7/2020
10/8/2020
10/9/2020
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11/11/2020
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11/13/2020
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11/18/2020
Total Daily Precipitation (mm)
Mean Daily Air Temperature (°C)