Real-Time Water Quality Deployment Report

Teck: Duck Pond Operations

November 17, 2016 to May 18, 2017

Government of Newfoundland & Labrador
Department of Municipal Affairs and Environment
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

Newfoundland Labrador

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General

- Department of Municipal Affairs and Environment staff monitors the real-time web pages consistently.
- The stations presented in this report are East Pond Brook below East Pond and Tributary to Gills Pond Brook abbreviated as EPB and TGPB, respectively.
- Throughout this report a magenta line illustrates the discharge volume of effluent from the Teck Duck Pond Operation's polishing pond. This water contains a relatively high level of dissolved solids compared to natural waters and influences the conditions of TGPB station considerably.
- Hydrometric data included in this report is provisional and used only for illustrative purposes. Corrected and finalized data may be retrieved from the Water Survey of Canada website (http://www.ec.gc.ca/rhc-wsc/)*.

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 Ranking

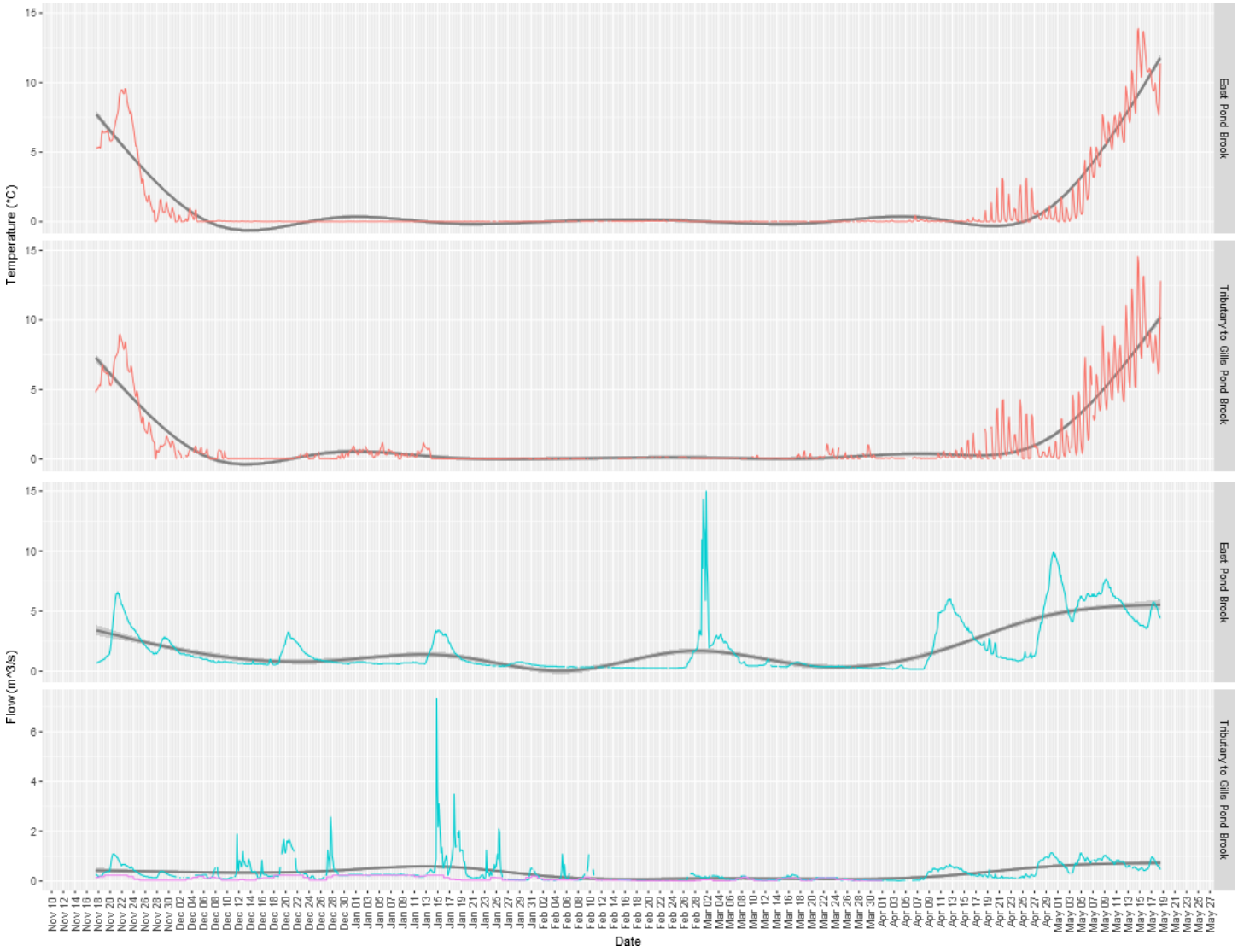
Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
East Pond Brook below East Pond	November 17, 2016	Deployment	Good	Fair	Excellent	Fair	Excellent
	May 18, 2017	Removal	Excellent	Poor	Excellent	Good	Excellent
Tributary to Gills Pond Brook	November 17, 2016	Deployment	Good	Excellent	Excellent	Excellent	Excellent
	May 18, 2017	Removal	Excellent	Good	Good	Fair	NA

- A "Poor" rank was achieved for pH during removal of the East Pond Brook sonde. This is likely the result of drift occurring over the long winter deployment.
- No ranking is available for Turbidity during deployment due to a sensor failure.

Data Interpretation

Temperature

Water Temperature is a major factor used to describe water quality. Temperature has major implications on both the ecology and chemistry of a water body, governing processes such as the metabolic rate of aquatic plants and animals and the degree of dissolved oxygen saturation.



Station	Mean	Median	Min	Max
East Pond Brook	0.97	0.02	-0.02	13.89
Tributary to Gills Pond Brook	1.10	0.09	0.00	14.56

- This deployment report captures the entirety of the winter season from the fall cool-down to spring thaw. During the winter, a flat water temperature near 0^{o}C predominates during ice-cover. At this time, biochemical processes are largely dormant and water quality events are dictated by weather patterns and groundwater inflow – especially at EPB station.

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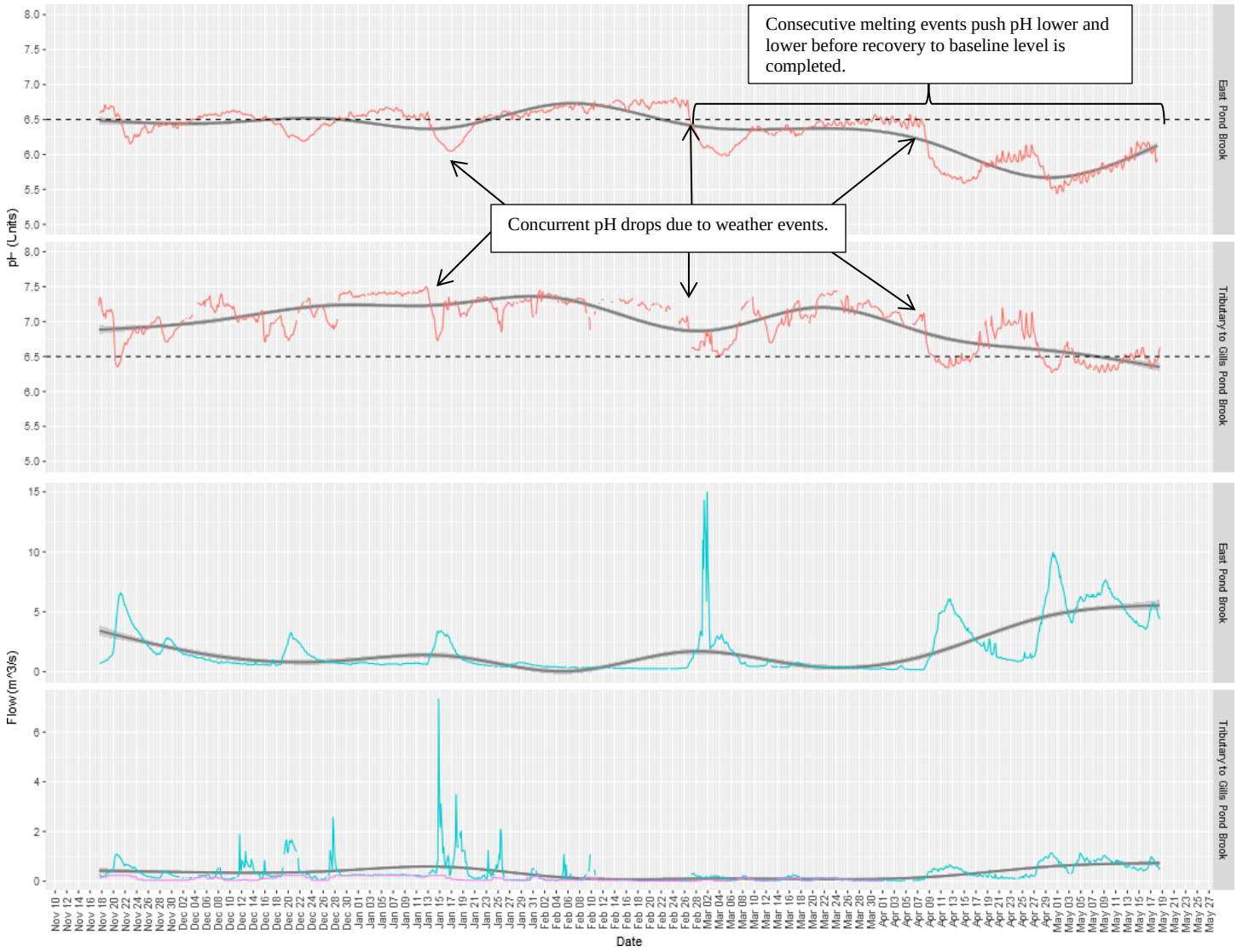
pH

pH is used to give an indication of the acidity or basicity of a solution. A pH of 7 denotes a neutral solution while lower values are acidic and higher values are basic. Technically, the pH of a solution indicates the availability of protons to react with molecules dissolved in water. Such reactions can affect how molecules function chemically and metabolically.



Station	Mean	Median	Min	Max
East Pond Brook	6.33	6.43	5.44	6.81
Tributary to Gills Pond Brook	6.99	7.07	6.27	7.50

- The pattern of pH at EPB station is relatively simple and perturbations from the baseline level appears to fluctuate between 6.0 and 7.0. Melting events, which can be inferred by air temperatures above zero in the Appendix weather data and visualized through Flow on each graph, show that pH is depressed for a period of time after melting before recovering. pH values may be slightly higher than depicted due to sensor drift.
- pH at TGPB station is more complicated and is highly moderated by effluent from Teck's polishing pond. pH levels tend to be more neutral and resist the same long term changes seen at EPB station.

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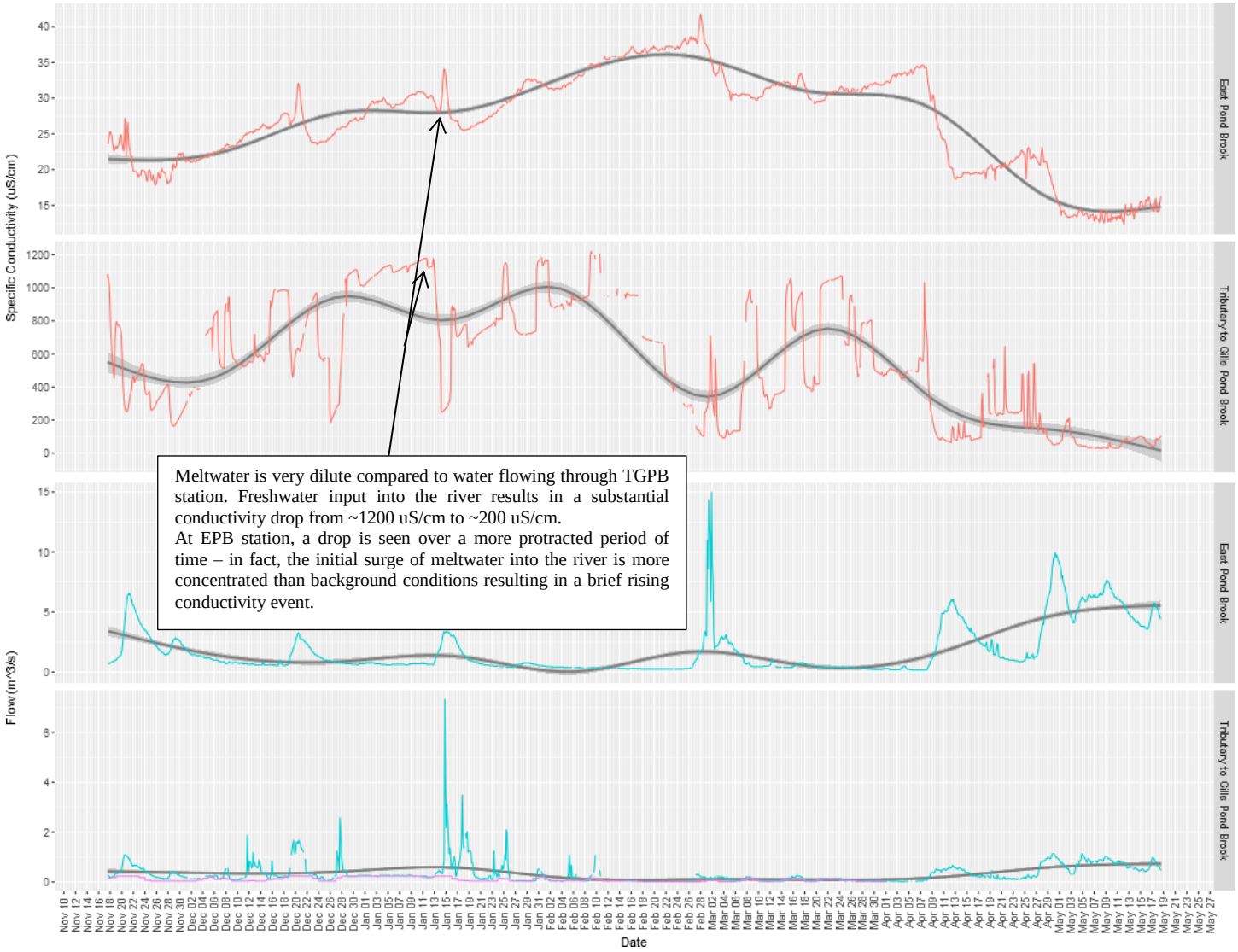
Specific Conductivity

Conductivity relates to the ease of passing an electric charge – or resistance – 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°C to allow comparison across variable temperatures.



Station	Mean	Median	Min	Max
East Pond Brook	26.8	27.9	12.4	41.8
Tributary to Gills Pond Brook	556.8	536.0	28.7	1220.0

- Specific conductivity and pH show similar tendencies at EPB station: both parameters are highly influenced by melting conditions. Specific conductivity reached its peak at EPB station in late February before a number of melting events pushed conductivity lower. While this effect is observed at TGPB station, the concentration of dissolved solids entering the river channel results in a much more 'flashy' characteristic with changes on a magnitude scale occurring regularly within 24 to 48 hours.

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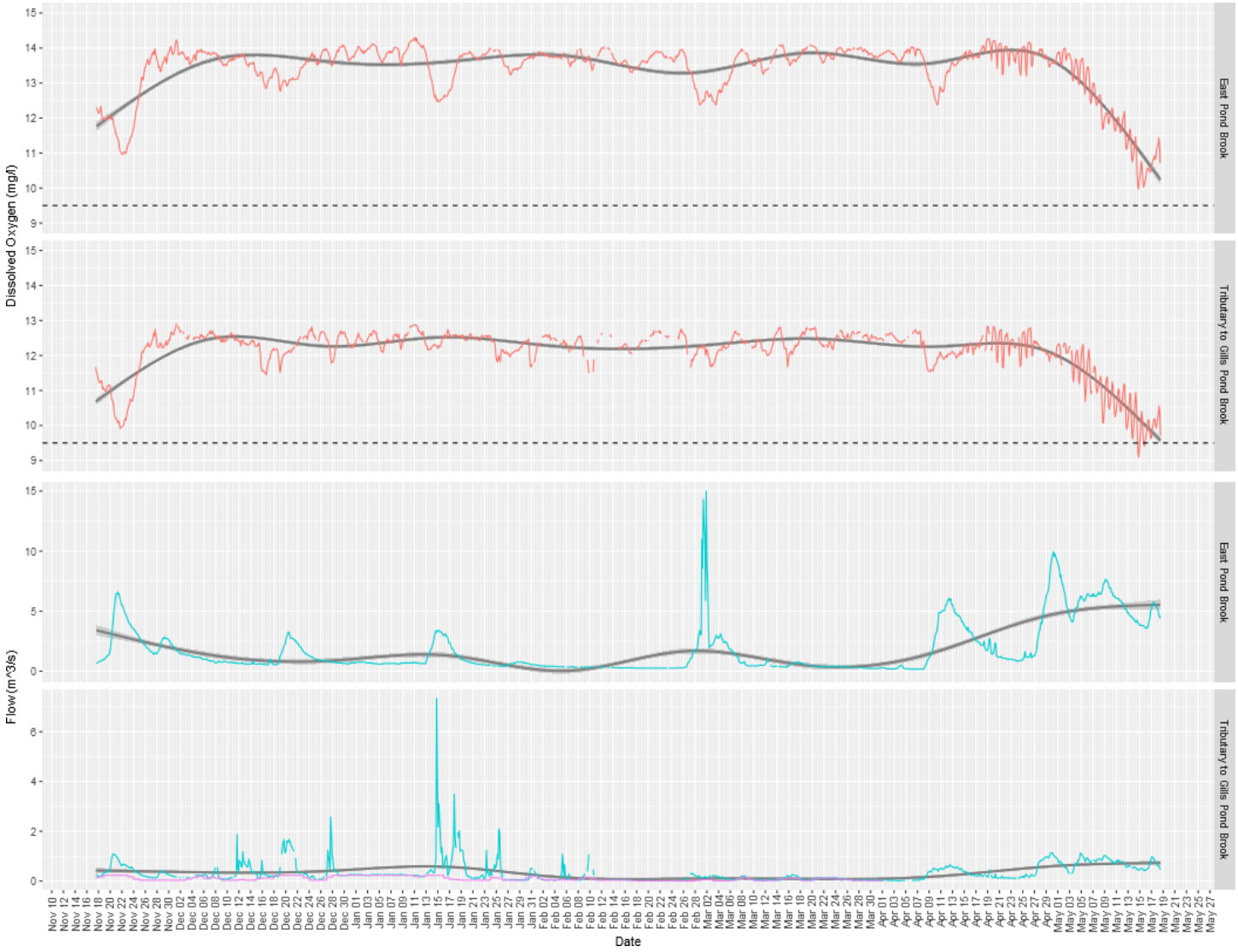
Dissolved Oxygen

Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, especially temperature – the saturation of oxygen in water is inversely proportional to water temperature. 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.



Station	Mean	Median	Min	Max
East Pond Brook	13.41	13.69	9.97	14.31
Tributary to Gills Pond Brook	12.14	12.33	9.09	12.92

- Dissolved oxygen values at TGPB station are routinely lower than observations at EPB station; however both stations show similar tendencies. Since many factors influence oxygen concentrations (such as flow characteristics and chemical constituents) the exact reason cannot be determined for the difference.

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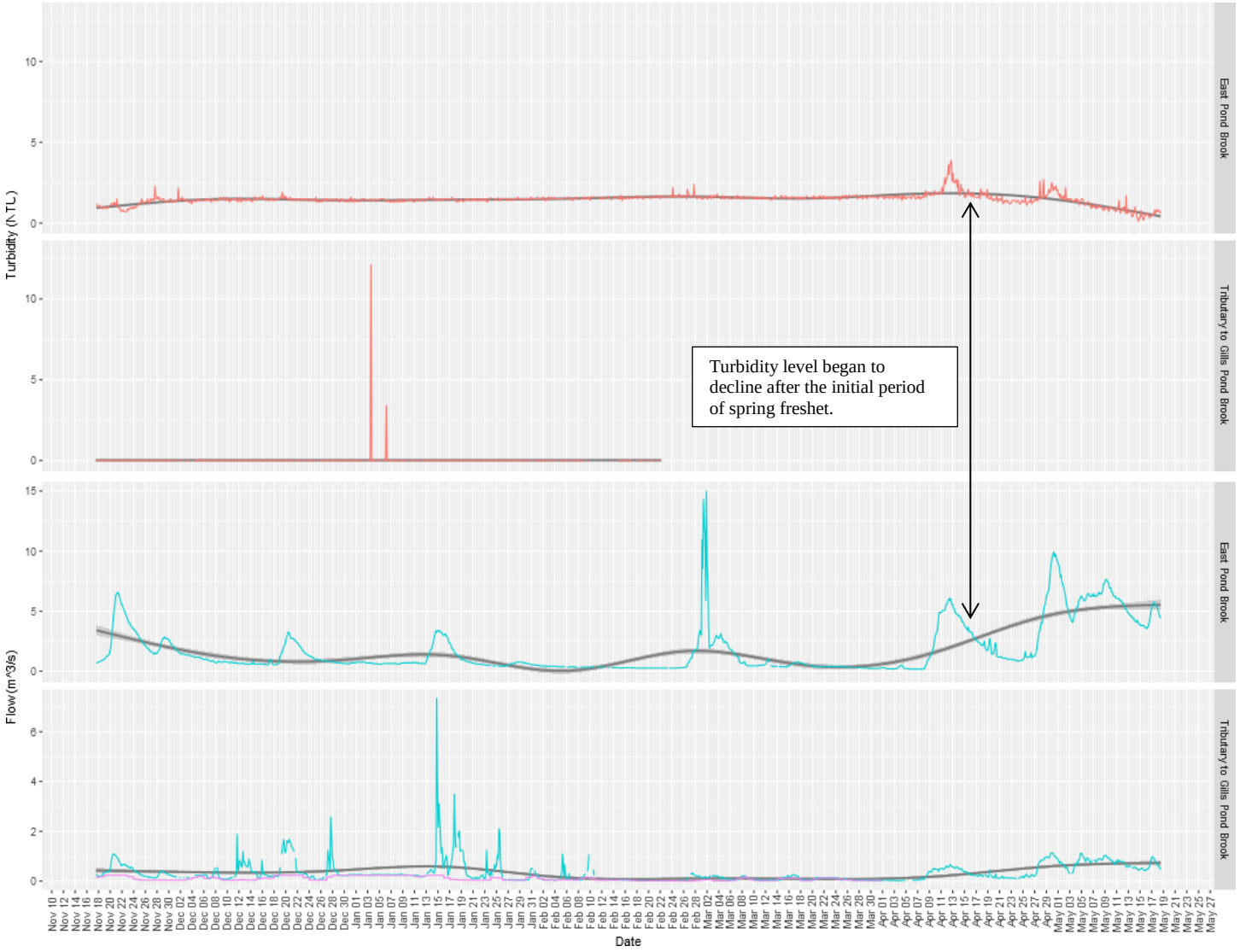
Turbidity

Turbidity 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.



Station	Mean	Median	Min	Max
East Pond Brook	1.5	1.5	0.1	3.9
Tributary to Gills Pond Brook	0.0	0.0	0.0	12.1

- A turbidity sensor failure at TGPB station in the latter half of the deployment resulted in a loss of data. For the first half of the deployment period, however, turbidity was observed to be slightly higher at EPB compared to TGPB.
- During the ice-cover period at EPB station, turbidity remained consistent near 1.5 NTU before declining once spring freshet began.

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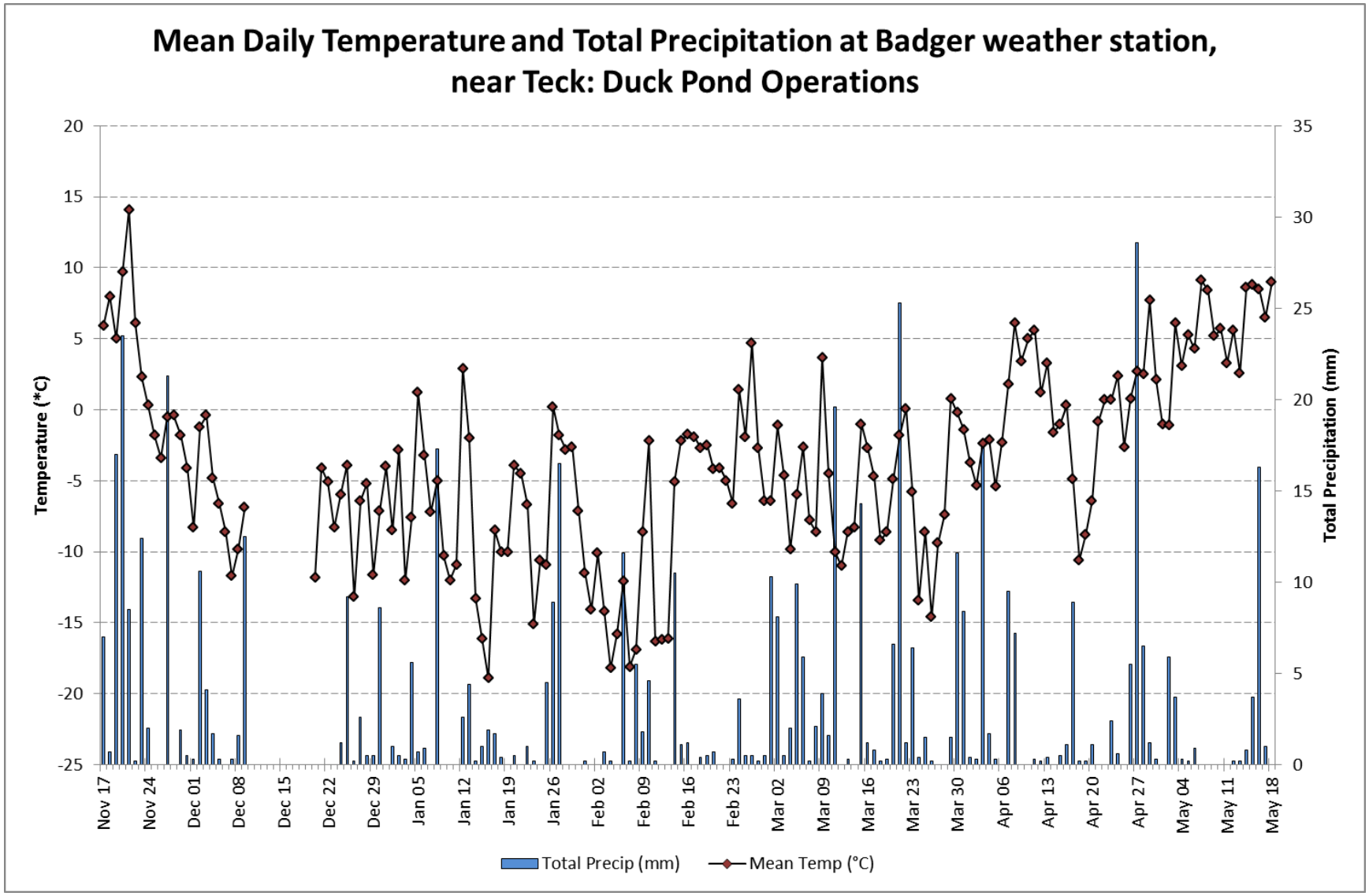
Appendix


Mean Daily Temperature and Total Precipitation at Badger weather station, near Teck: Duck Pond Operations
Temperature (*C)
Total Precipitation (mm)
20
15
10
5
0
-5
-10
-15
-20
-25
35
30
25
20
15
10
5
0
Nov 17
Nov 24
Dec 01
Dec 08
Dec 15
Dec 22
Dec 29
Jan 05
Jan 12
Jan 19
Jan 26
Feb 02
Feb 09
Feb 16
Feb 23
Mar 02
Mar 09
Mar 16
Mar 23
Mar 30
Apr 06
Apr 13
Apr 20
Apr 27
May 04
May 11
May 18
Total Precip (mm)
Mean Temp (°C)