

# Real-Time Water Quality Deployment Report

Iron Ore Company of Canada  
Labrador West Network

June 12 to  
July 25, 2018



Government of Newfoundland & Labrador  
Department of Municipal Affairs and  
Environment  
Water Resources Management Division

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## General

- The Water Resources Management Division, in partnership with the Iron Ore Company of Canada (IOC) and Environment and Climate Change Canada (ECCC), maintain two real-time water quality (RTWQ) and water quantity stations at Wabush Lake.
- The official name of each station is *Wabush Lake at Dolomite Road* and *Wabush Lake at Lake Outlet*, hereafter referred to as the Dolomite Road station and the Julienne Narrows station.
- These stations are situated upstream (Dolomite Road) and downstream (Julienne Narrows) of the IOC tailings disposal area in Wabush Lake.
- On June 8<sup>th</sup>, 2016, an additional station was commissioned under this agreement. This station is located at *Dumbell Stream above Dumbell Lake*, hereafter referred to as Dumbell Stream.
- On June 12<sup>th</sup>, 2017 a new station was commissioned under this agreement. This station is located at *Pumphouse Stream above Drum Lake*, hereafter referred to as Pumphouse Stream.
- Water Resources Management Division staff monitor the real-time graphs regularly. They will inform IOC of any significant water quality events by email notification and by monthly deployment reports.
- Between June 12<sup>th</sup> and 13<sup>th</sup>, real-time water quality monitoring instruments were deployed at the four IOC stations. The instruments were deployed for a period of 40 days at Dolomite Road, 43 days at Dumbell Stream and 42 days at Pumphouse Stream. Due to a logistical issue, the instrument at Julienne Narrows was deployed for 65 days. For the purpose of this report only data up until July 23<sup>rd</sup> will be used for analysis for comparison purposes. The instruments were removed between July 23<sup>rd</sup> and 25<sup>th</sup>. This was the first deployment for 2018.



**Figure 1: RTWQ Monitoring Stations in Labrador West**

## 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 each 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 along side 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**

Parameter	Rank				
	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 IOC water quality stations deployed between June 12-13 and July 12-25, 2018 are summarized in Table 2.

Table 2: QA/QC comparison rankings for IOC stations between June 12 and July 25, 2018.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Dolomite Road	June 13, 2018	Deployment	Fair	Excellent	Excellent	Good	Excellent
	July 23, 2018	Removal	Good	Excellent	Excellent	Excellent	Poor
Julienne Narrows	June 13, 2018	Deployment	Good	Good	Excellent	Good	Excellent
	Aug 17, 2018	Removal	N/A	N/A	N/A	N/A	N/A
Dumbell Stream	June 12, 2018	Deployment	Good	Excellent	Excellent	Good	Excellent
	July 25, 2018	Removal	Excellent	Good	Good	Excellent	N/a
Pumphouse Stream	June 12, 2018	Deployment	Good	Good	Excellent	Excellent	Poor
	July 24, 2018	Removal	N/A	N/A	N/A	N/A	N/a

▪ **Dolomite Road**

At deployment, all parameters besides temperature ranked either ‘good’ or ‘excellent’. Temperature ranked ‘fair’. The field instrument read a value of 5.80°C, while the QA/QC instrument read a value of 6.34 °C.

At removal, all parameters besides turbidity ranked either ‘excellent’ or ‘good’. Turbidity ranked ‘poor’. The field instrument read a value of 0.4 NTU, while the QA/QC instrument read a value of 13.0 NTU.

▪ **Julienne Narrows**

At deployment, all parameters ranked either ‘good’ or ‘excellent’.

At removal, parameters could not be ranked due to a power issue at the station.

▪ **Dumbell Stream**

At deployment , all parameters ranked either ‘good’ or ‘excellent’.

At removal, all parameters besides turbidity ranked either ‘good’ or ‘excellent’. Turbidity could not be ranked due to a failure with the QA/QC sonde.

▪ **Pumphouse Stream**

At deployment, all parameters besides turbidity ranked either ‘good’ or ‘excellent’. Turbidity ranked ‘poor’. The field sonde read a value of 37.8 NTU, while the QA/QC sonde read a value of 24.1 NTU.

At removal, parameters could not be ranked due to the failure of the field sonde.

- 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 or more of the sensors.

## **Data Interpretation**

- The following graphs and discussion illustrate water quality-related events from June 12 to July 25, 2018 at the IOC RTWQ monitoring stations in Labrador West.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- There is a portion of data missing from the Julienne Narrows station; due to a power issue with the station. This issue was rectified on August 17<sup>th</sup>.

### Wabush Lake Network

- Water temperature ranged from 5.70 to 18.40°C at Dolomite Road and 4.80 to 16.80°C at Julienne Narrows during this deployment period (Figure 2). Water temperature at Dolomite Road is slightly higher than at Julienne Narrows.
- Water temperature increased during this deployment period, which corresponds with increasing ambient air temperature at this time (Figure 2).

Water and Air Temperature : Wabush Lake Network  
June 13 to July 23, 2018

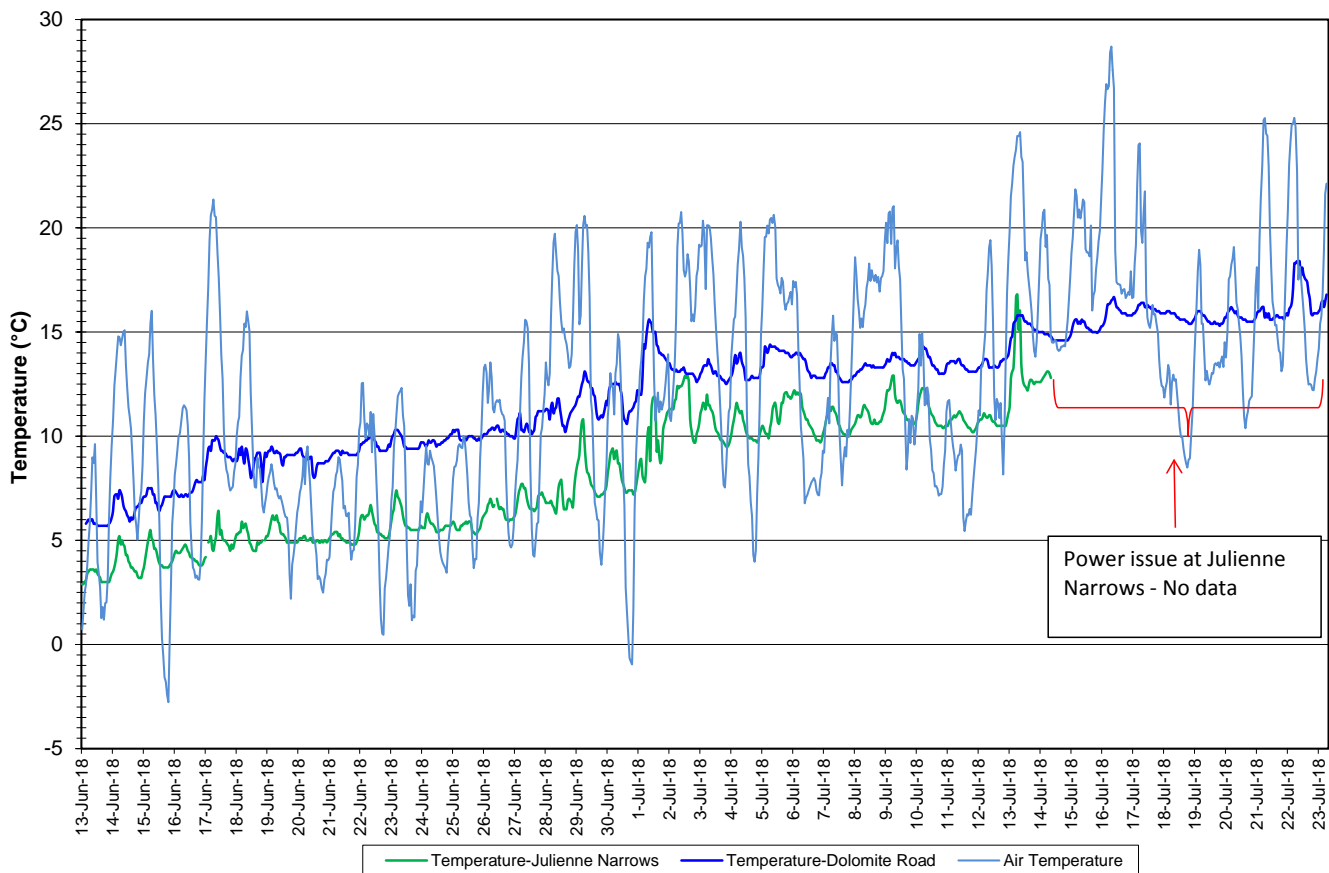


Figure 2: Water and Air Temperature - Wabush Lake network

(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)



- pH ranges from 6.34 to 7.49 pH units at Dolomite Road, and from 7.72 to 8.11 pH units at Julienne Narrows throughout the deployment period (Figure 3). The median pH is 7.31 and 7.90 units respectively.
- 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 throughout the day and night.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Water pH and Stage : Wabush Lake Network  
June 13 to July 23, 2018

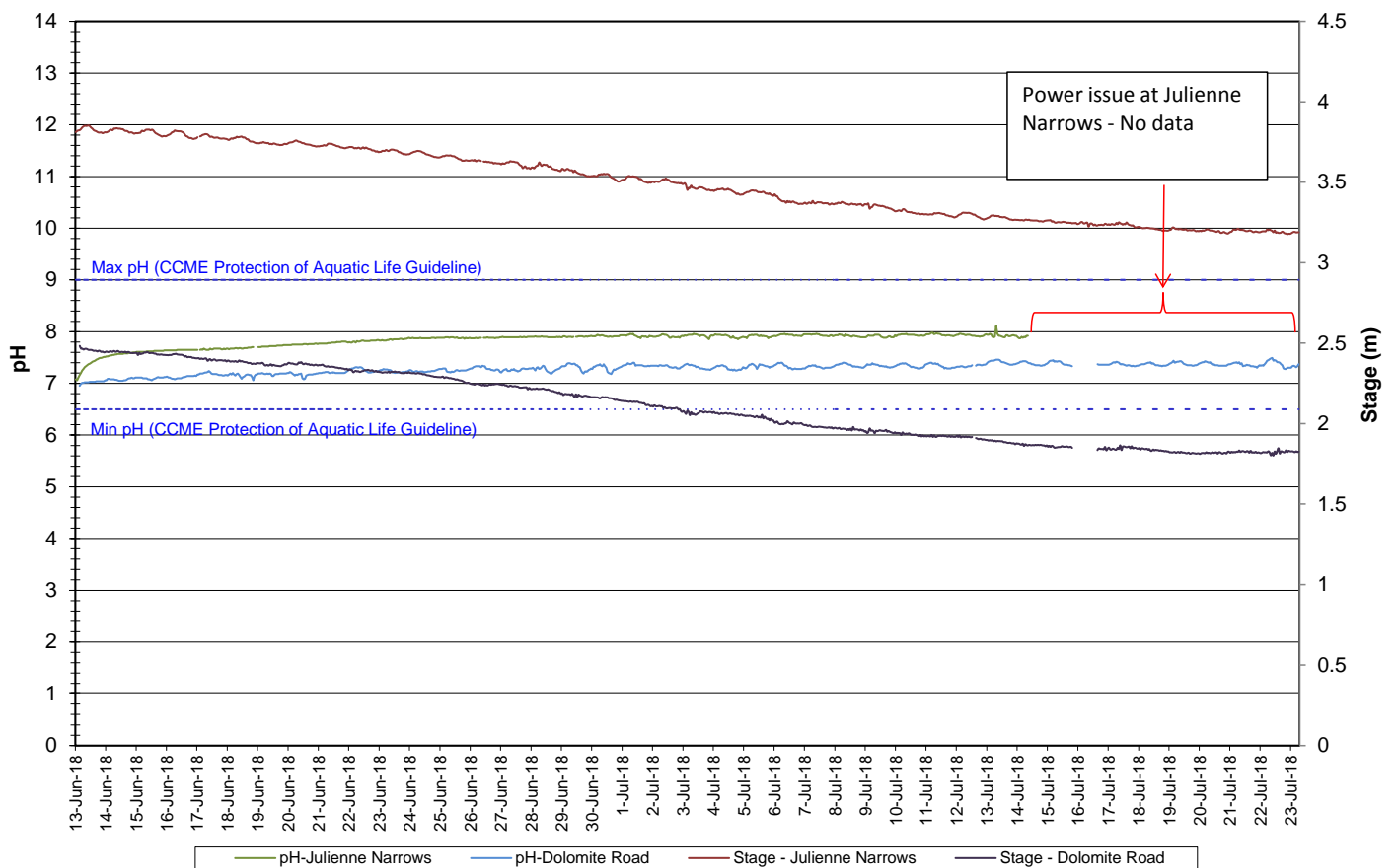


Figure 3: Water pH and stage– Wabush Lake network

- Specific conductivity ranged from 33.3 to 51.5  $\mu\text{S}/\text{cm}$  at Dolomite Road and from 76.9 to 102.0  $\mu\text{S}/\text{cm}$  at Julienne Narrows throughout the deployment period (Figure 4).
- Daily fluctuations are evident at the Julienne Narrows station. This can be attributed to varying contributions of iron ore tailings deposited into Wabush Lake upstream of Julienne Narrows and downstream of Dolomite Road. This can also explain the difference in specific conductivity levels between the two stations, as conductance values are generally higher at Julienne Narrows.
- Specific conductance gradually increases at Dolomite Road during this deployment period.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

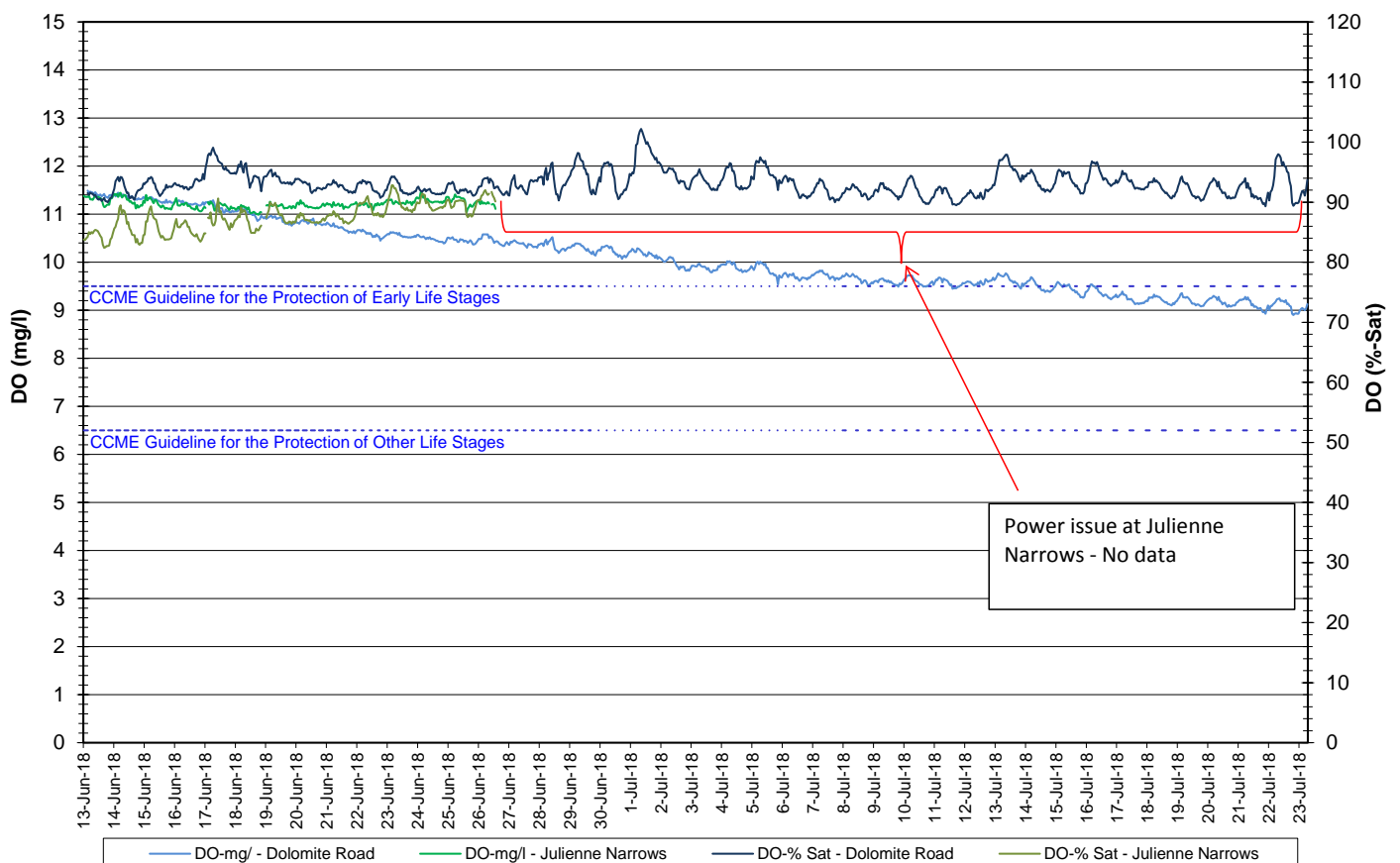
**Specific Conductivity and Stage: Wabush Lake Network  
June 13 to July 23, 2018**



**Figure 4: Specific conductivity and stage – Wabush Lake network**

- At the Dolomite Road station, the saturation of dissolved oxygen ranged from 89.3 to 102.2% while the dissolved oxygen content ranged from 8.90 to 11.49 mg/l with a median value of 9.95 mg/l (Figure 5).
- At the Julienne Narrows station, the saturation of dissolved oxygen ranged from 86.4 to 92.8% while the dissolved oxygen content ranged from 11.05 to 11.46 mg/l with a median value of 11.22 mg/l (Figure 5).
- All values recorded at Julienne Narrows and Dolomite Road were above the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota of Other Life Stages of 6.5 mg/l.
- All values recorded at Julienne Narrows were above the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota of Early Life Stages of 9.5 mg/l, while the majority of values recorded at Dolomite Road were above the guideline. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen decreased slightly at Dolomite Road towards the end of this deployment period, as water temperature increased. Dissolved oxygen fluctuated daily with decreases observed at night.

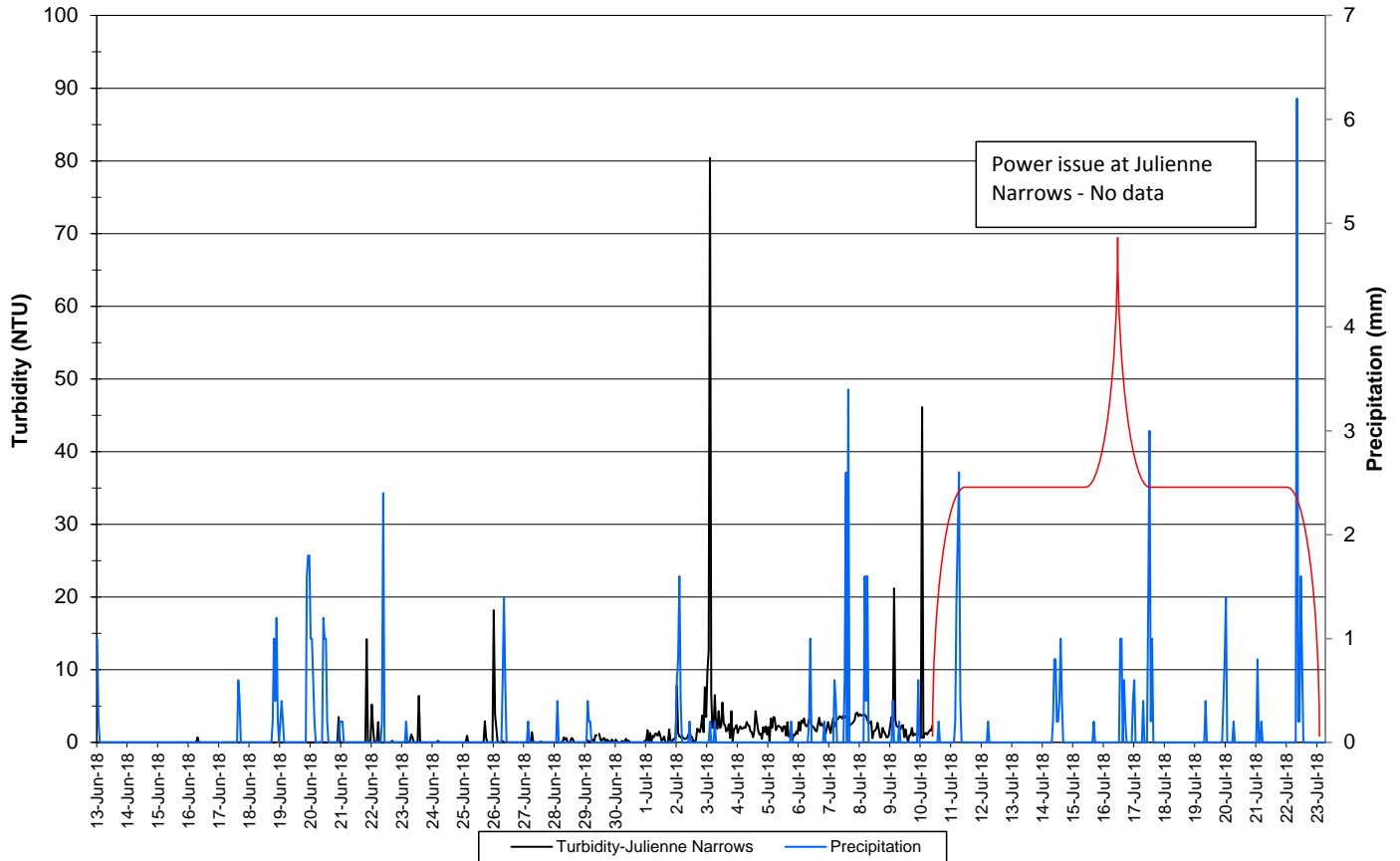
**Dissolved Oxygen : Wabush Lake Network  
June 13 to July 13, 2018**



**Figure 5: Dissolved oxygen and percent saturation – Wabush Lake Network**

- At the Julienne Narrows station, turbidity values range from 0.0 to 80.4 NTU throughout the deployment period (Figure 6). The median value was 0.2 NTU.
- In some instances, turbidity spikes can be attributed to precipitation events.

**Water Turbidity and Precipitation: Julienne Narrows  
June 13 to July 23, 2018**

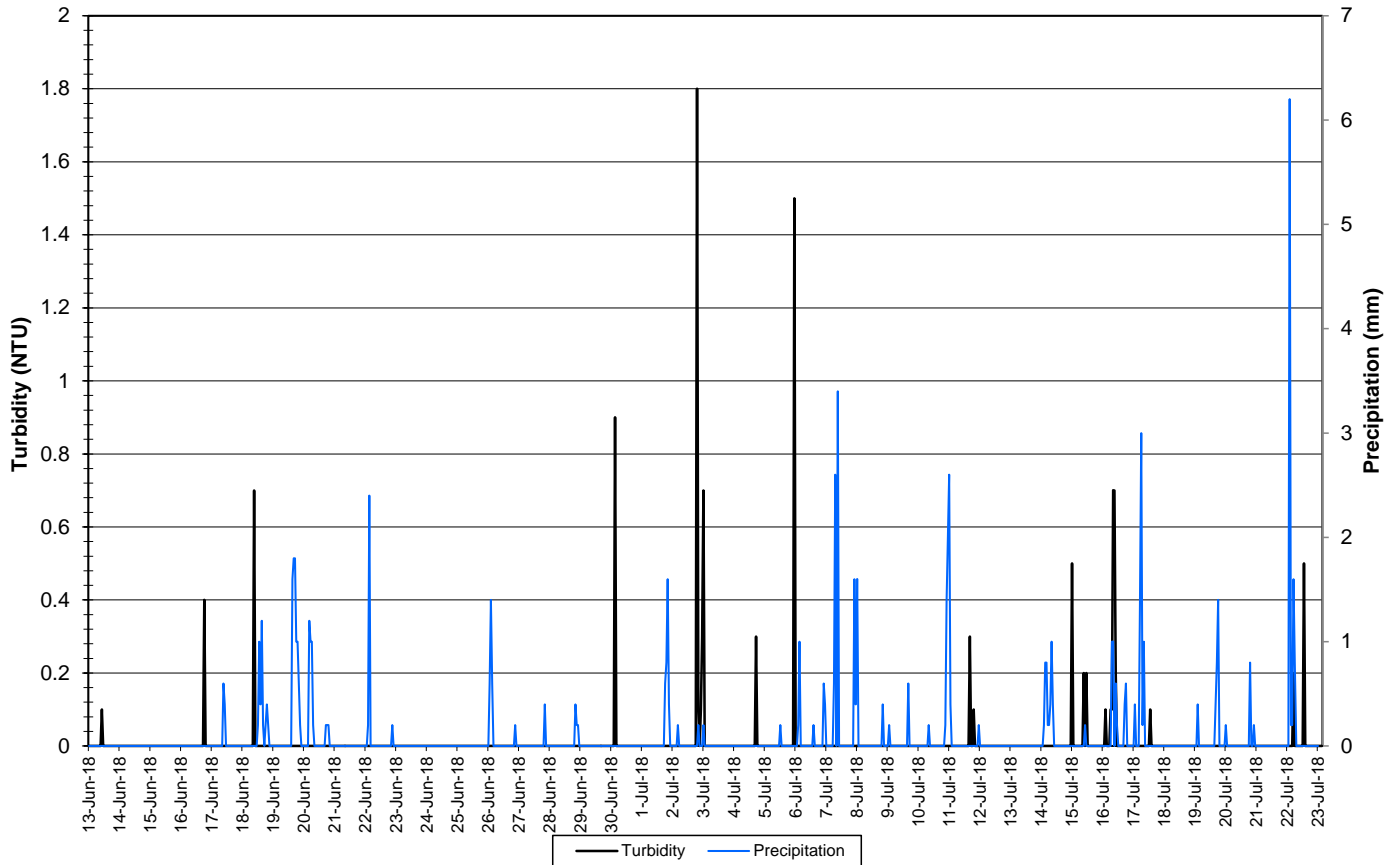


**Figure 6: Turbidity and precipitation – Julienne Narrows**

(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)

- At the Dolomite Road station, turbidity values ranged from 0.0 NTU to 1.8 NTU, throughout the deployment period (Figure 7). The median value was 0.0 NTU.
- In some instances, turbidity spikes can be attributed to precipitation events.

**Turbidity and Precipitation : Dolomite Road  
June 13 to July 23, 2018**



**Figure 7: Turbidity and precipitation – Dolomite Road**  
(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Dolomite Road and Julienne Narrows (Figure 8).
- Overall, stage decreases throughout the deployment period at both stations.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Stage and Precipitation: Wabush Lake Network  
June 13 to July 23, 2018

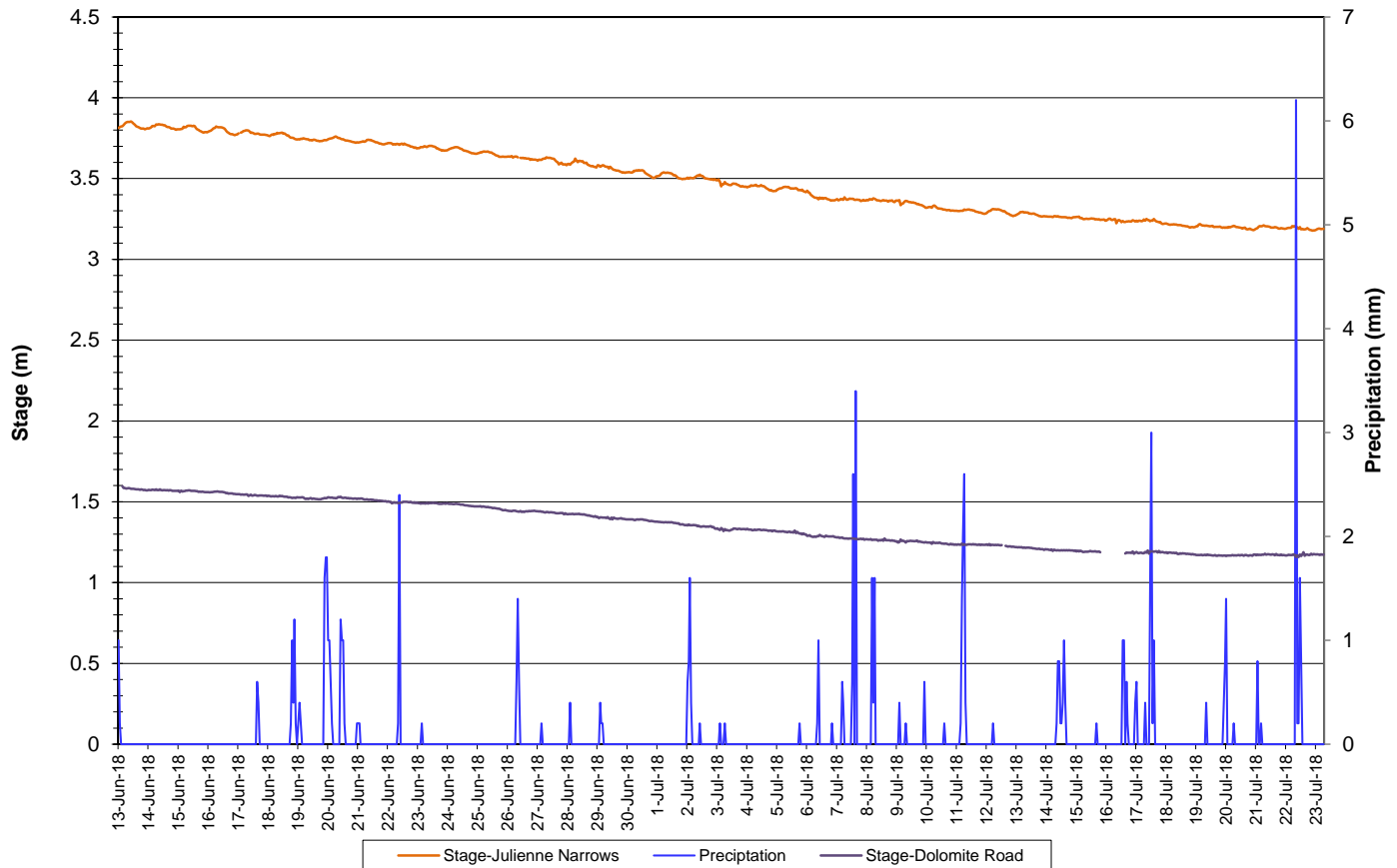
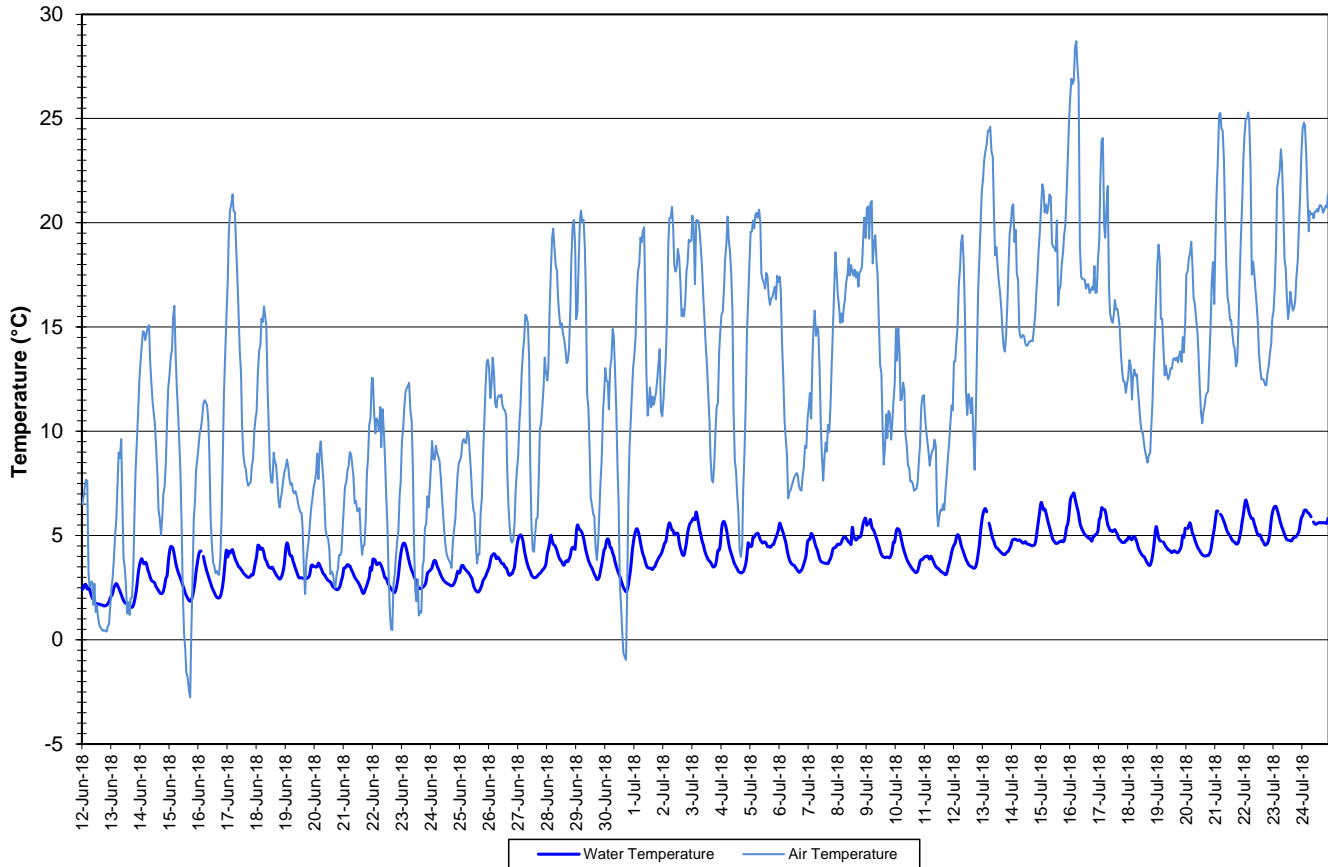


Figure 8: Stage and precipitation – Wabush Lake Network  
(Weather data collected at climate station located on TLH between Churchill Falls and Labrador City)

### Dumbell Stream

- Water temperature ranged from 1.56 to 7.04°C during this deployment period (Figure 9).
- Water temperature generally fluctuated within this range for the deployment period. This area is very shaded. Temperature increased slightly during the later portion of the deployment period due to increasing air temperature into the summer season (Figure 9).

**Water and Air Temperature : Dumbell Stream above Dumbell Lake  
June 12 to July 25, 2018**



**Figure 9: Water and air temperature – Dumbell Stream**

**(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)**

- pH ranged from 7.38 to 7.85 pH units (Figure 10). The median pH was 7.72.
- 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 throughout the day and night.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Water pH and Stage : Dumbell Stream above Dumbell Lake  
June 12 to July 25, 2018

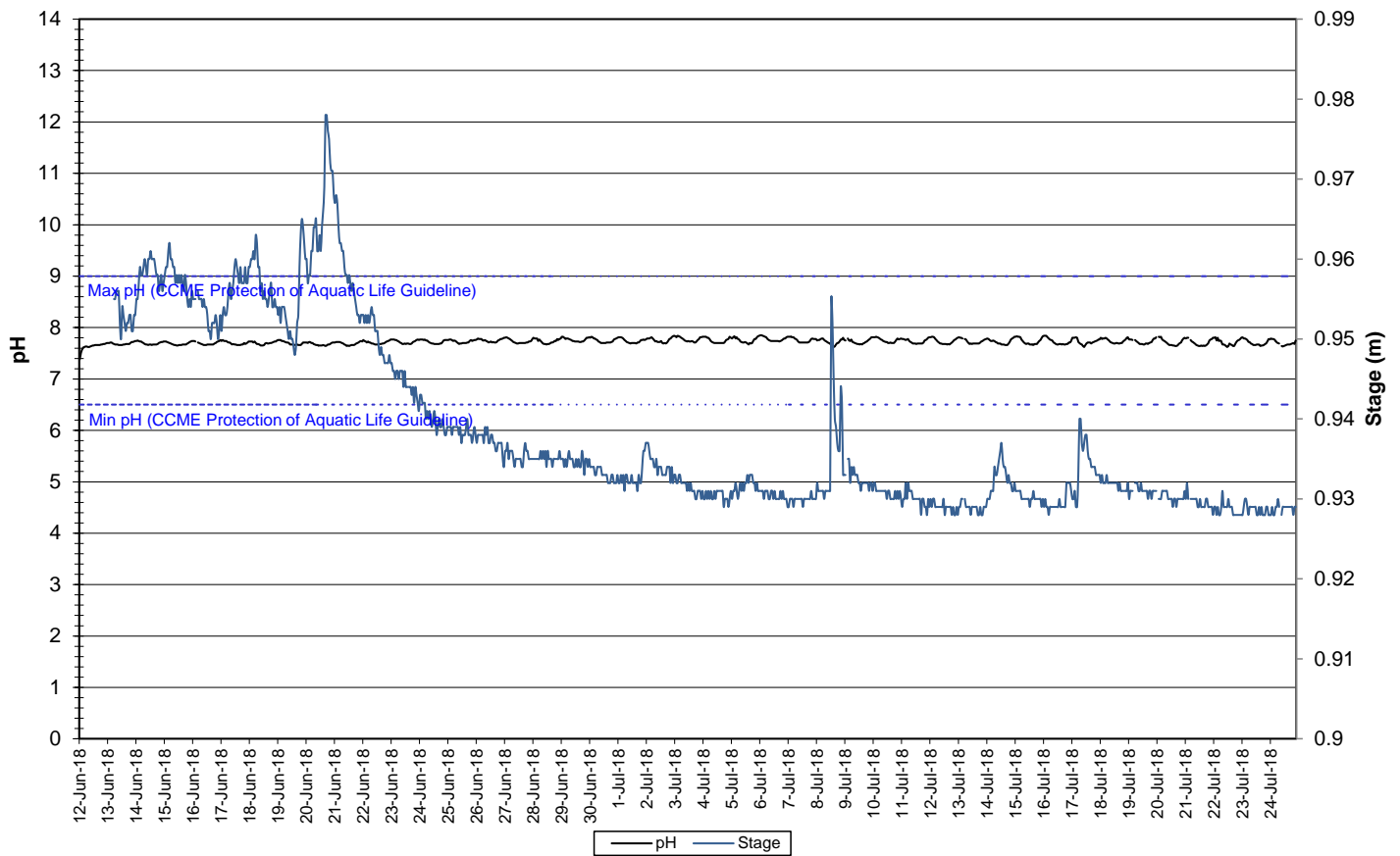


Figure 10: Water pH and stage – Dumbell Stream



- Specific conductivity ranged from 57.0 to 71.9  $\mu\text{S}/\text{cm}$  throughout the deployment period (Figure 11).
- Decreases in specific conductivity correspond to increases in stage. As more water is added to the system from precipitation, the solids in the water are diluted, decreasing conductivity. These decreases are indicated in red on Figure 11.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Specific Conductivity of Water and Stage Level : Dumbell Stream above Dumbell Lake  
June 12 to July 25, 2018

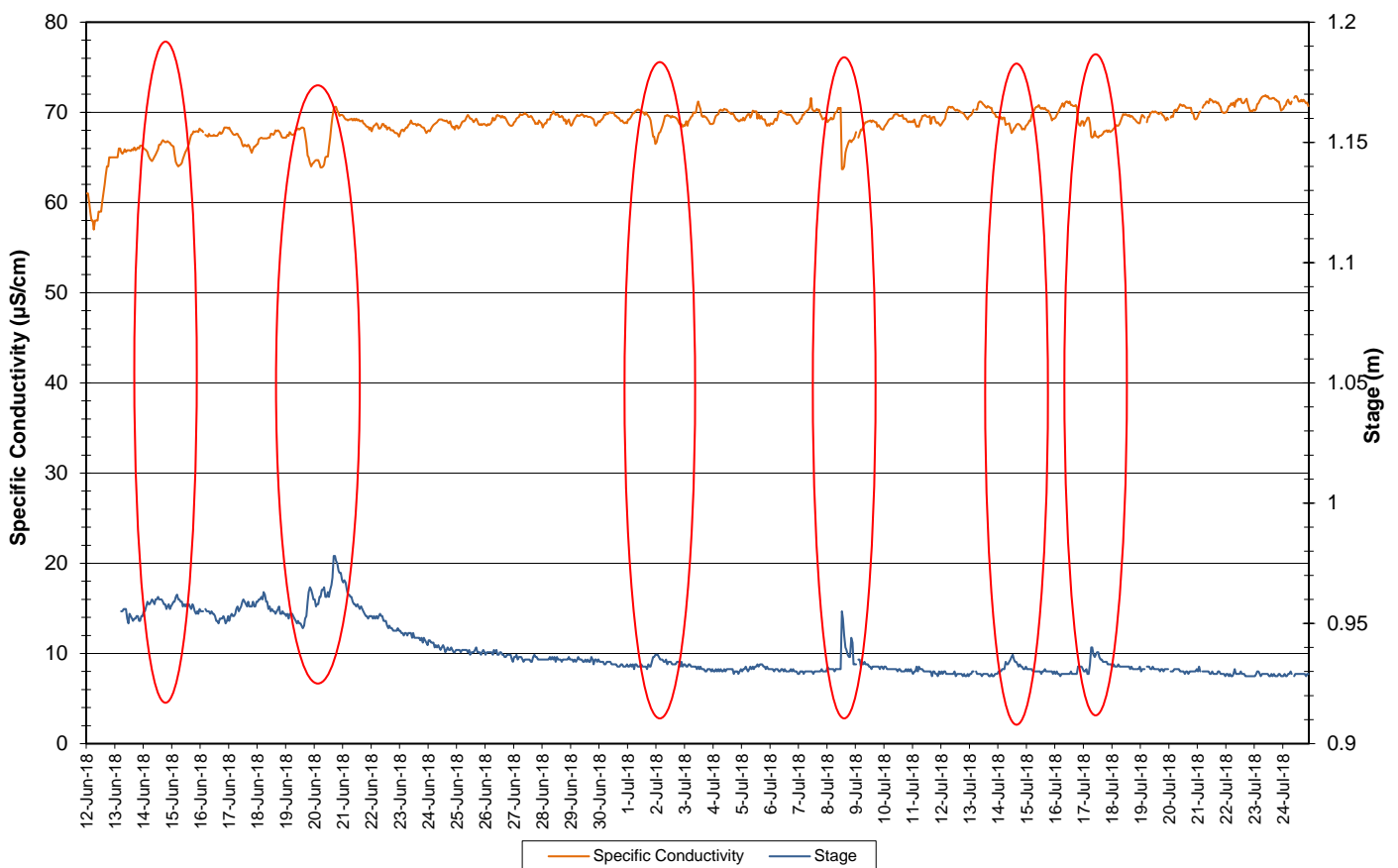


Figure 11: Specific conductivity and stage – Dumbell Stream

- The saturation of dissolved oxygen ranged from 88.0 to 91.6% while the dissolved oxygen content ranged from 10.92 to 12.67 mg/l with a median value of 11.80 mg/l (Figure 12).
- All values recorded at Dumbell Stream were above the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota of Other Life Stages of 6.5 mg/l and the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota of Early Life Stages of 9.5 mg/l. The guidelines are indicated in blue on Figure 12.
- Dissolved oxygen decreased slightly during this deployment period as water temperature increased.
- Dissolved oxygen fluctuated daily with decreases observed at night.

Dissolved Oxygen Concentration and Saturation : Dumbell Stream at Dumbell Lake  
June 13 to July 25, 2018

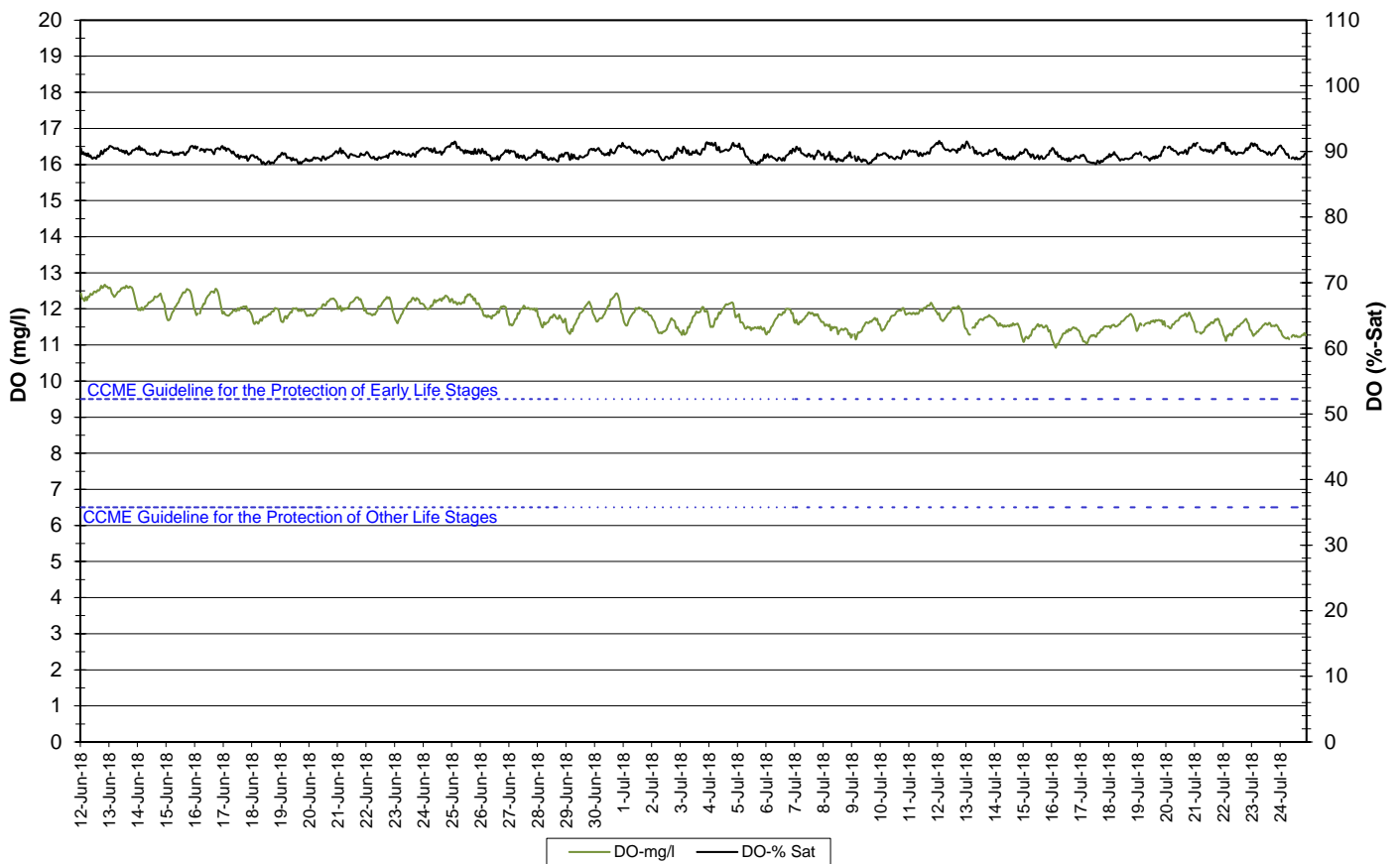
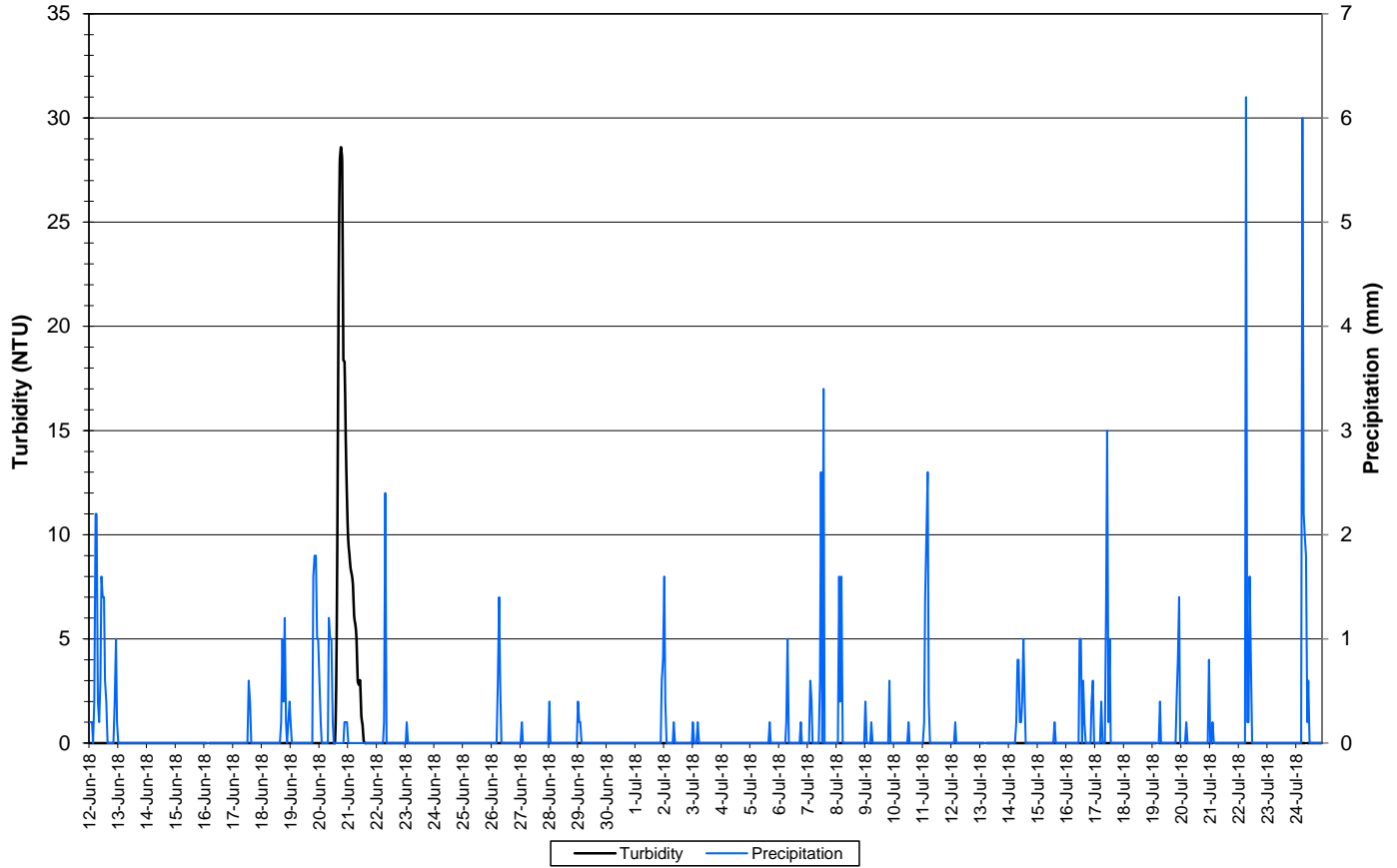


Figure 12: Dissolved oxygen – Dumbell Stream

- Turbidity values range from 0.0 to 28.6 NTU throughout the deployment period (Figure 13). The median value was 0.0 NTU.

**Water Turbidity and Precipitation : Dumbell Stream above Dumbell Lake  
June 12 to July 25, 2018**



**Figure 13: Turbidity and precipitation – Dumbell Stream**

**(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)**

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Dumbell Stream (Figure 14).
- Stage decreases throughout the deployment period, with precipitation events causing periodic increases in stage.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Stage and Precipitation: Dumbell Stream  
June 12 to July 25, 2018

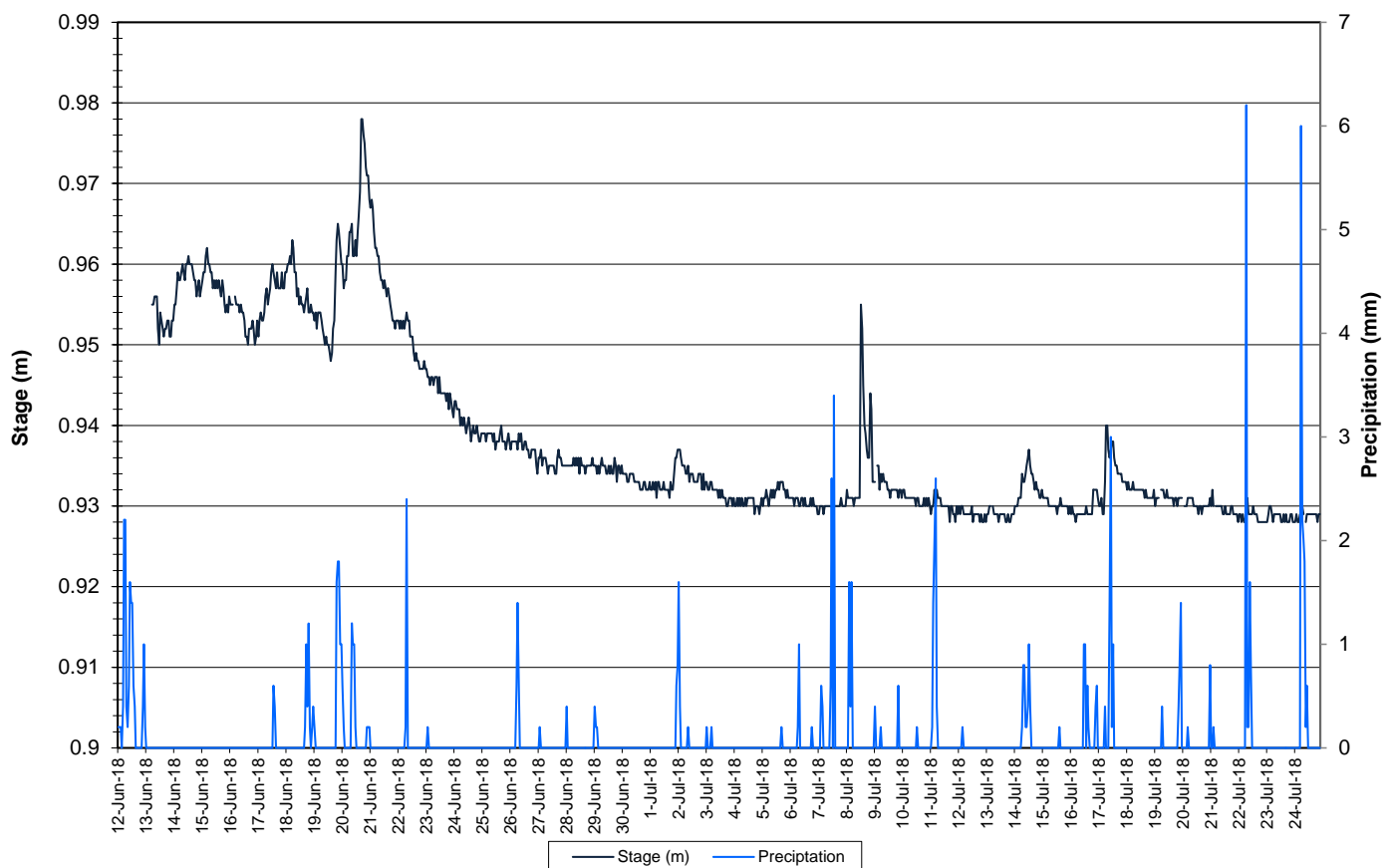
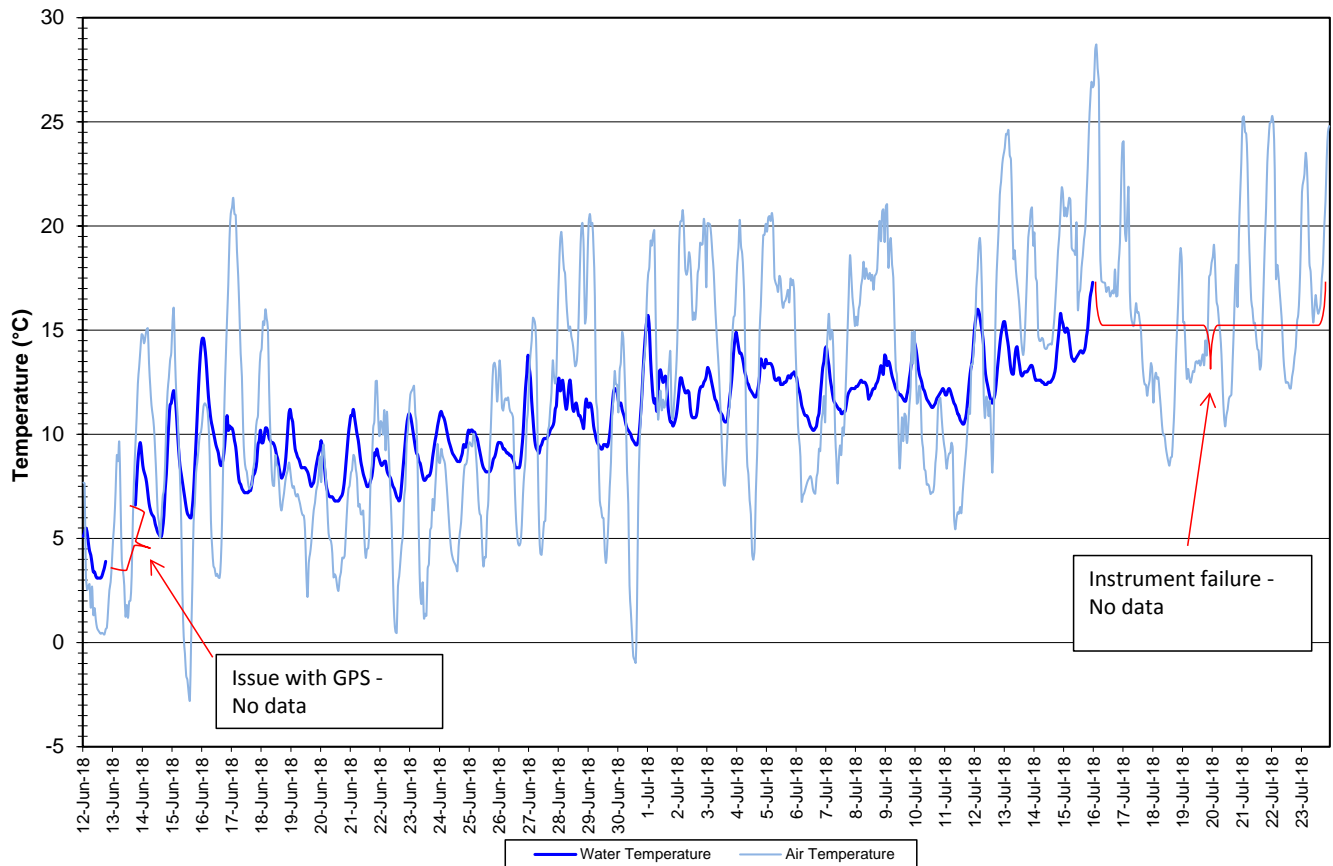


Figure 14: Stage and precipitation – Dumbell Stream  
(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)

### Pumphouse Stream

- Water temperature ranged from 3.10 to 16.00°C during this deployment period (Figure 15).
- Water temperature increased over the course of this deployment period, corresponding to increasing ambient air temperatures into summer (Figure 15).

**Water and Air Temperature : Pumphouse Stream above Drum Lake  
June 12 to July 24, 2018**



**Figure 15: Water and air temperature – Pumphouse Stream**

**(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)**

- pH ranged from 6.72 to 7.47 pH units (Figure 16). The median pH was 7.12.
- 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 throughout the day and night.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Water pH and Stage : Pumphouse Stream above Drum Lake  
June 12 to July 24, 2018

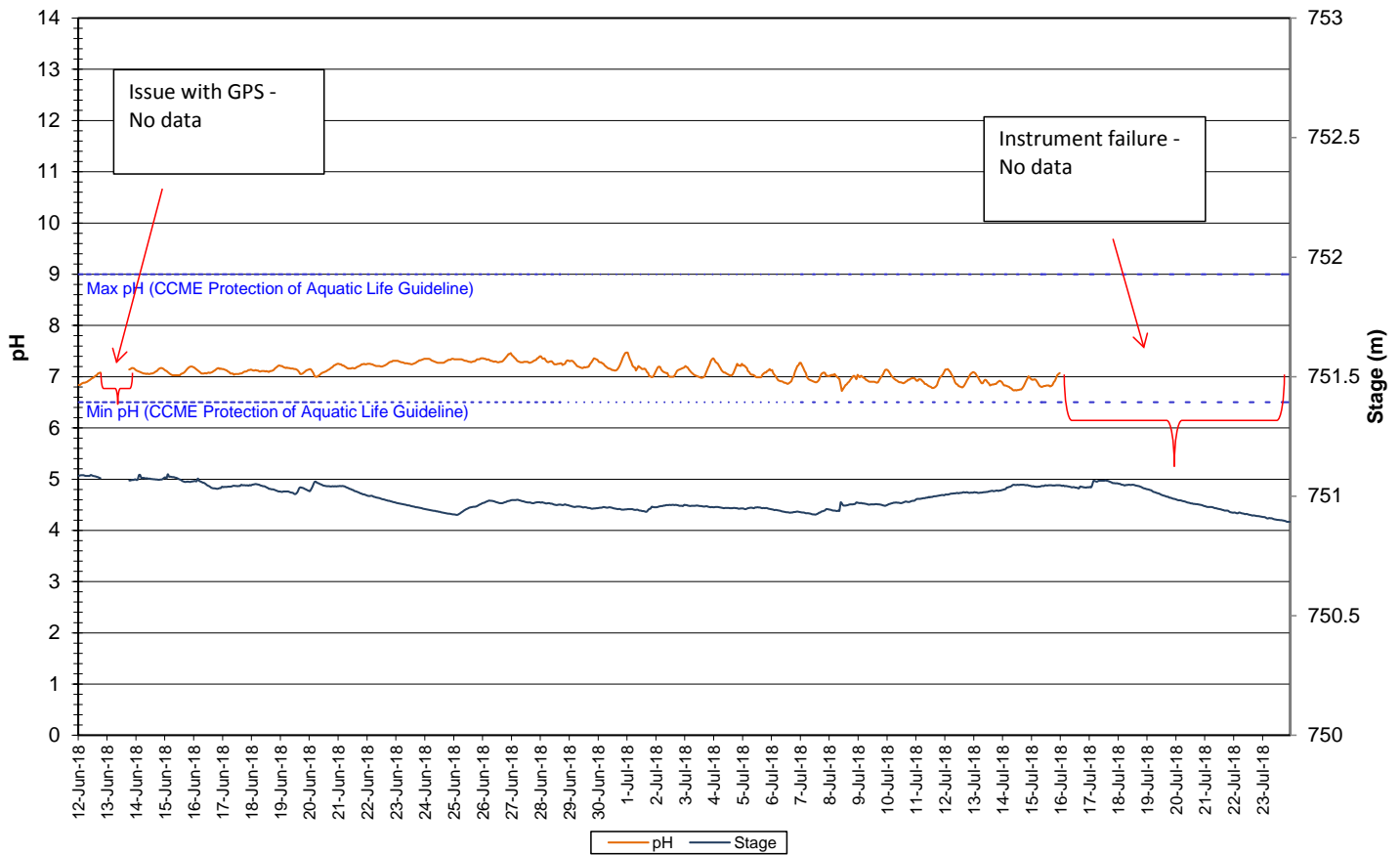


Figure 16: Water pH and stage – Pumphouse Stream

- Specific conductivity ranged from 70.6 to 91.5  $\mu\text{S}/\text{cm}$ , throughout the deployment period (Figure 17).
- Some decreases in specific conductivity correspond to increases in stage. As more water is added to the system from precipitation, the solids in the water are diluted, decreasing conductivity.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Specific Conductivity of Water and Stage Level : Pumphouse Stream above Drum Lake  
June 12 to July 24, 2018

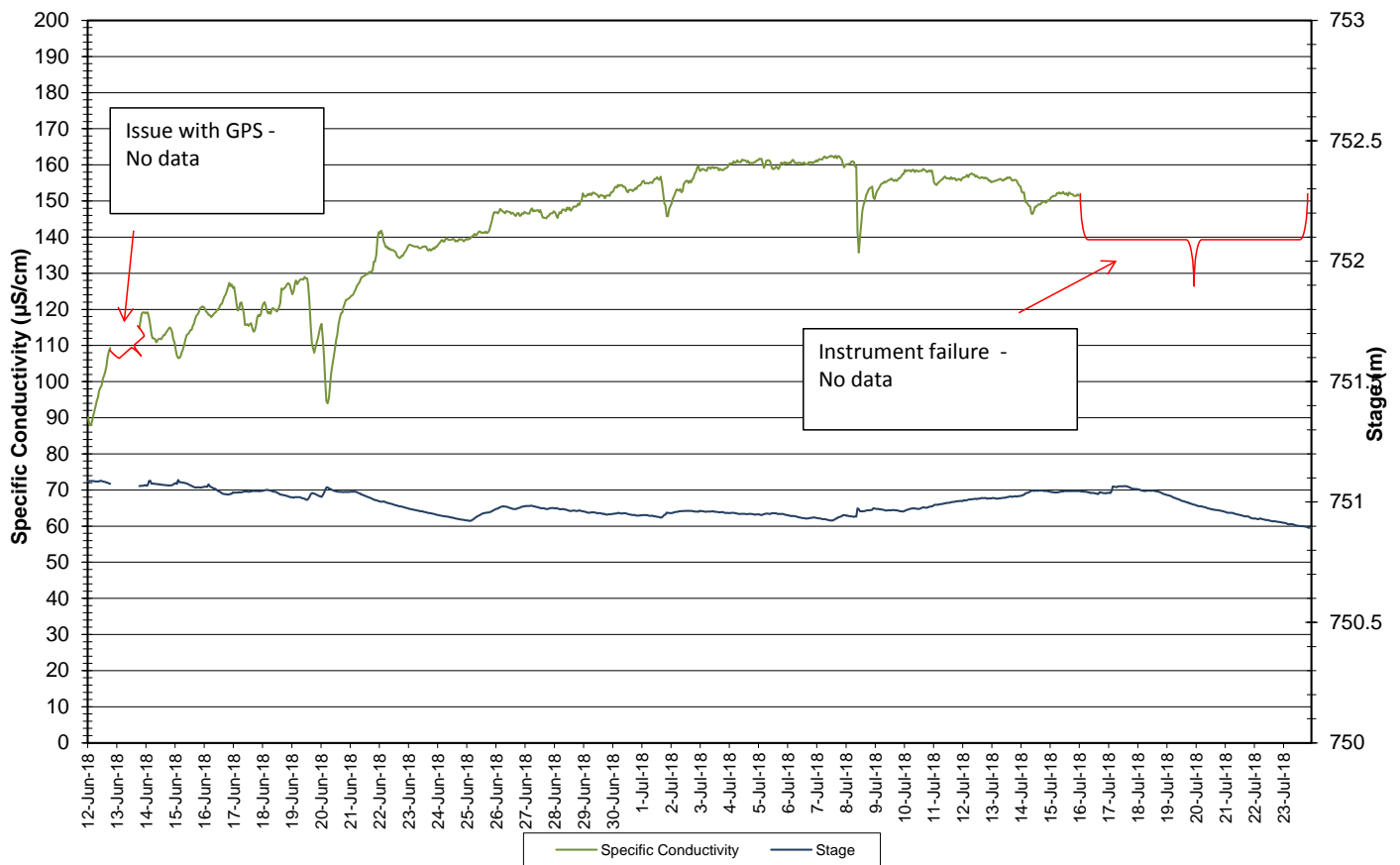
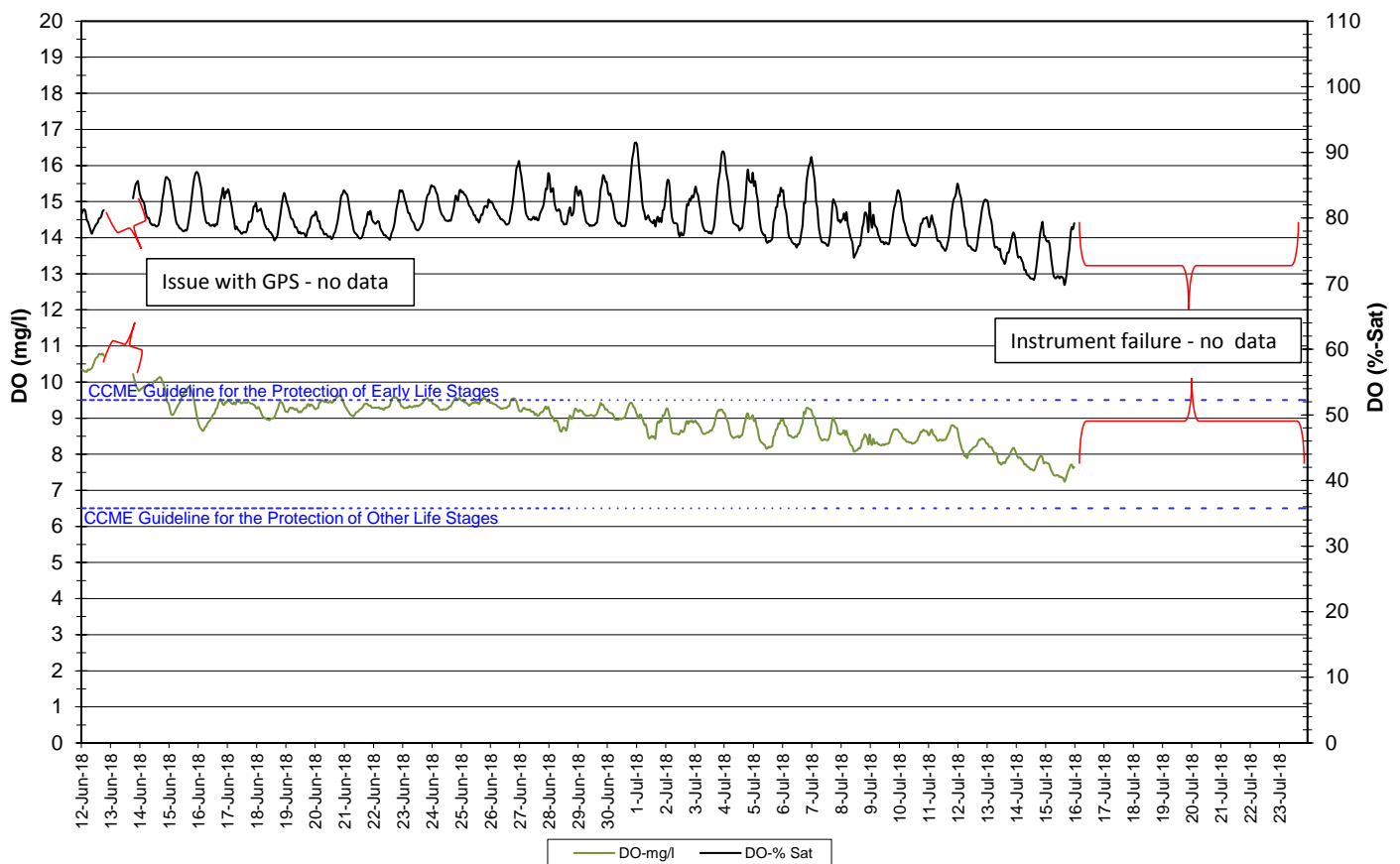


Figure 17: Specific Conductivity and stage – Pumphouse Stream

- The saturation of dissolved oxygen ranged from 70.6 to 91.5% while the dissolved oxygen ranged from 7.55 to 10.55 mg/l with a median value of 9.10 mg/l (Figure 18).
- All values recorded at Pumphouse Stream were above the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota of Other Life Stages of 6.5 mg/l. The majority of values were below the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota of Early Life Stages of 9.5 mg/l. The guidelines are indicated in blue on Figure 18.
- Dissolved oxygen decreased slightly during this deployment period as water temperature increased.
- Dissolved oxygen fluctuated daily with decreases observed at night.

**Dissolved Oxygen Concentration and Saturation : Pumphouse Stream above Drum Lake  
June 12 to July 24, 2018**

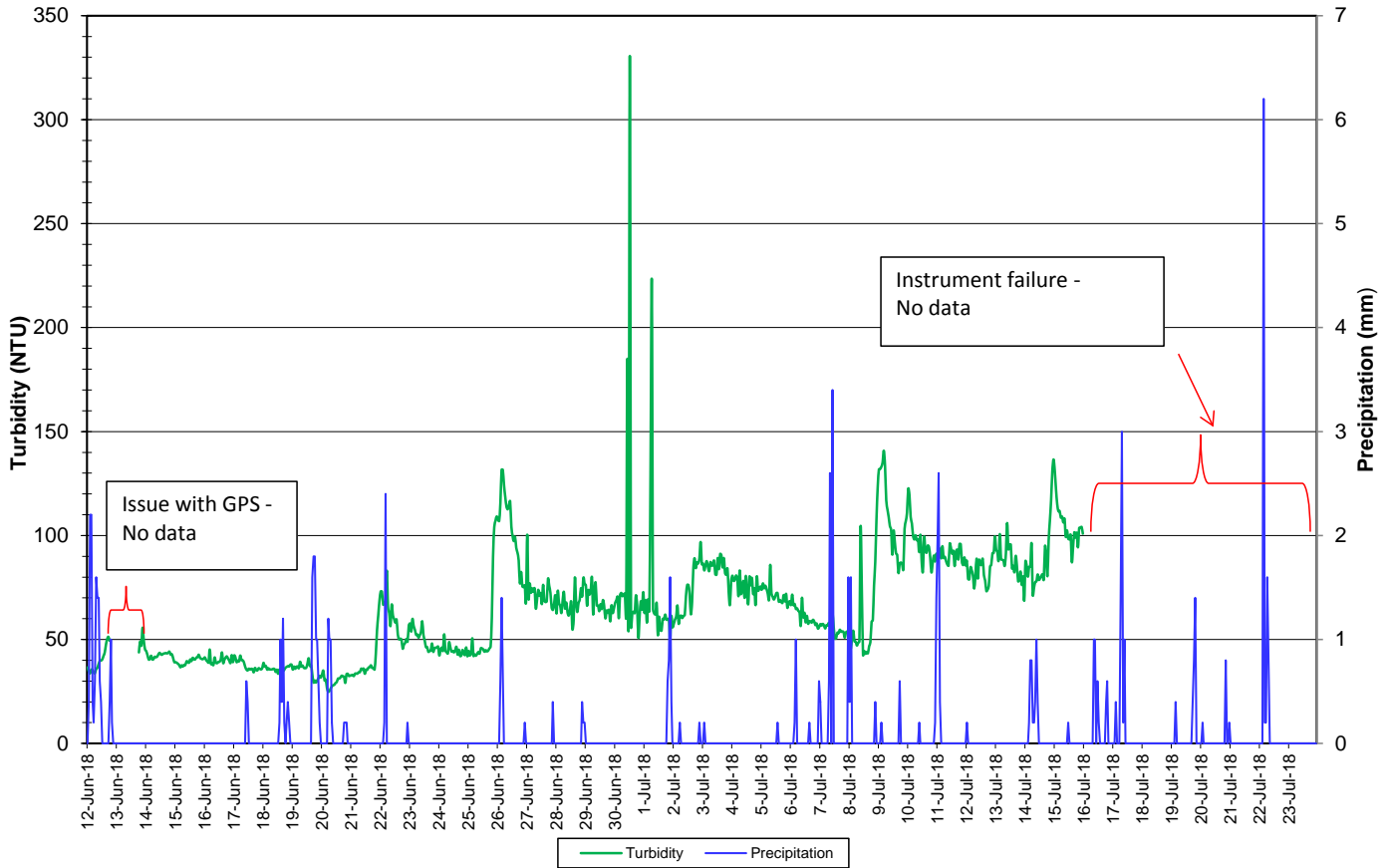


**Figure 18: Dissolved oxygen – Pumphouse Stream**



- Turbidity values range from 24.9 to 330.6 NTU throughout the deployment period (Figure 19). The median value was 61.6 NTU.
- In some instances, turbidity spikes can be attributed to precipitation events.

**Water Turbidity and Precipitation : Pumphouse Stream above Drum Lake  
June 12 to July 24, 2018**

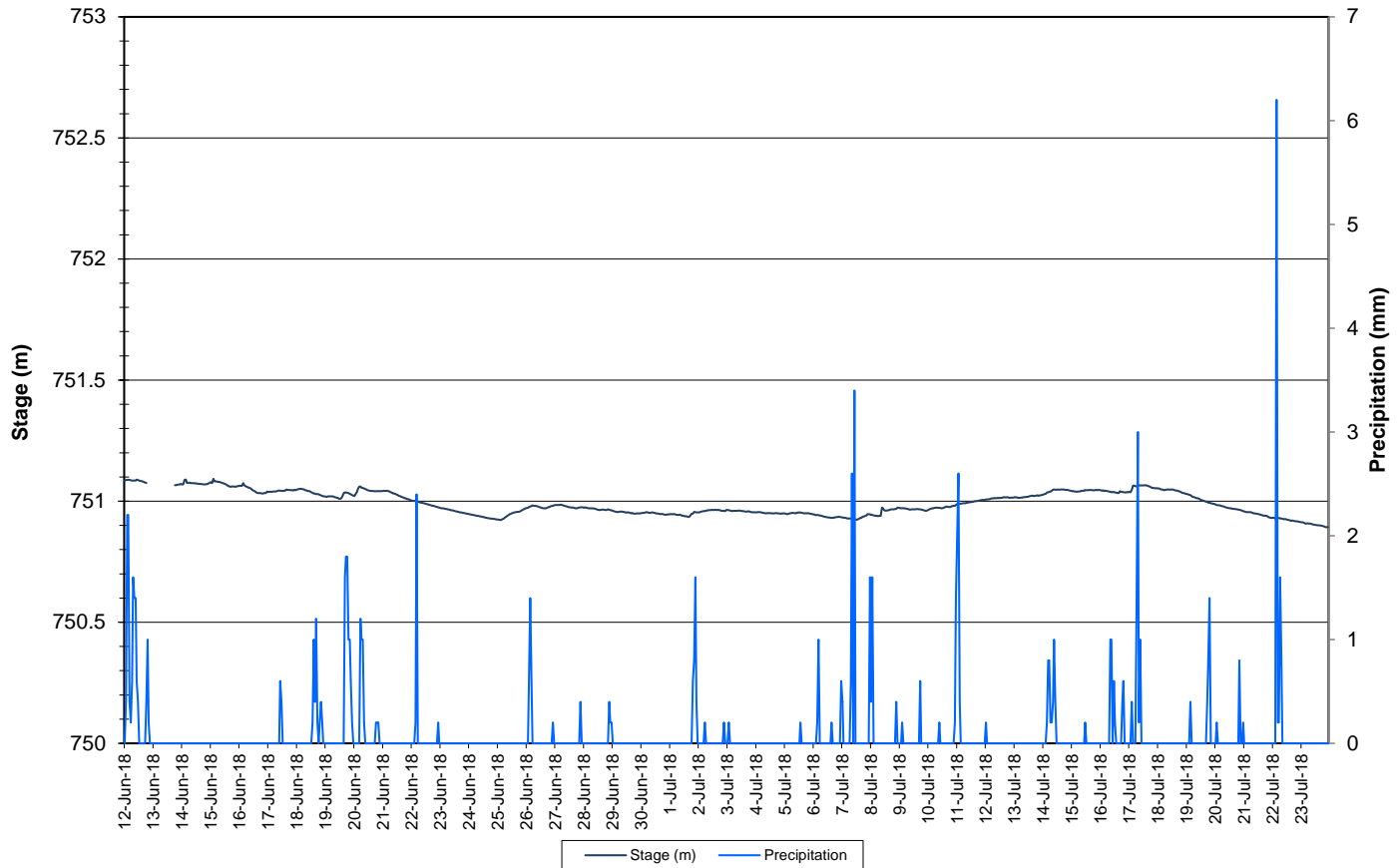


**Figure 19: Turbidity and precipitation – Pumphouse Stream**

(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Pumphouse Stream (Figure 20).
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Stage & Precipitation: Pumphouse Stream  
June 12 to July 24, 2018**



**Figure 20: Stage and precipitation – Pumphouse Stream  
(Weather data collected from climate station on TLH between Churchill Falls and Labrador City)**

## Conclusions

- Instruments were deployed June 12-13<sup>th</sup> and removed by July 25<sup>th</sup>, 2018, except for the Julienne Narrows station. There is a large portion of data missing from the Julienne Narrows station due to a power issue. This was rectified on August 17<sup>th</sup>.
- In most cases, precipitation events or increase/decreases in water level could be used to explain the data fluctuations. Most values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH and dissolved oxygen.
- Water temperature corresponded with air temperature at Julienne Narrows, Dolomite Road and Pumphouse Stream. The temperature typically ranged between 3.10 and 18.40°C, at these three stations, while Dumbell ranged lower at 1.56 to 7.04 °C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 6.34 and 8.11. Fluctuations were noted between day and night.
- Specific conductivity differed between the two Wabush Lake stations. This can be attributed to varying concentrations of iron ore tailings deposited between the stations. Specific conductivity ranged from 33.3 µs/cm to 102.0 µs/cm at the Wabush Lake stations, 57.0 to 71.9 µs/cm at Dumbell Stream and 70.6 to 91.5 µs/cm at Pumphouse Stream.
- At all four stations, all dissolved oxygen values were above the minimum CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages of 6.5 mg/L. When dissolved oxygen values are compared to the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/L, Pumphouse Stream was generally below the guideline while Julienne Narrows, Dolomite Road and Dumbell Stream were above the guideline. This is not uncommon as water temperatures were increasing during this period.
- Turbidity at Dolomite Road was low for the majority of the deployment period. The median value was 0.0 NTU. Turbidity values at Julienne Narrows were higher than at Dolomite Road with a few large spikes. Turbidity at Dumbell Stream remained at 0.0 NTU for the majority of the deployment period with some spikes. The median value was 0.0 NTU. Turbidity at Pumphouse Stream was elevated throughout the deployment period with some high spikes. Some can be attributed to precipitation events. The median value was 61.6 NTU.
- Stage decreased at Dolomite Road and Julienne Narrows during this deployment period. At Dumbell Stream, stage decreased overall, with small increases noted after precipitation events. At Pumphouse Stream, stage fluctuated and showed increases after precipitation events.
- With the exception of water quantity data (Stage and Flow), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

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### Appendix 1

#### Air Temperature and Precipitation: TLH between Churchill Falls and Labrador City June 12 to July 25, 2018

