



Real-Time Water Quality Annual Report 2018

Iron Ore Company of Canada
Labrador West Network

June 12 to
October 17, 2018



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

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Acknowledgements

The Real-Time Water Quality Monitoring Program (RTWQ) at Wabush Lake is fully funded by the Iron Ore Company of Canada (IOC). The program is made successful by a joint partnership between IOC, Environment and Climate Change Canada (ECCC), and the Newfoundland & Labrador Department of Municipal Affairs and Environment (MAE).

Various individuals from each sector have been diligently involved to ensure this program is a successful operation including, various WRMD staff (MAE), Jody Wentzell (IOC) and various WSC staff (ECCC). In addition to these managers, there have been a team of individuals who work together to ensure the day to day operations of these stations are providing quality data. Maria Murphy (MAE) was responsible for these water quality stations during 2018. Responsibilities included deployment and removal of instruments, maintenance and calibration of the instruments and preparation of monthly deployment reports. Brenda Congram (MAE) is acknowledged for her assistance during deployment and removal procedures in 2018. Tara Clinton and Ryan Pugh are acknowledged for their role in performing Performance Testing and Evaluation (PTE) and in-house servicing of the instruments during Winter 2018-2019.

ECCC staff are essential in the operation of the data logging/communication aspect of the network. Staff of the Meteorological Service of Canada Division – Water Survey of Canada, visit the stations regularly to ensure that the data logging and data transmitting equipment is working properly. ECCC is also the lead on dealing with stage and flow issues.

Introduction

- The real-time water quality monitoring network on Wabush Lake was established during the summer of 2007, a partnership between the Newfoundland & Labrador Department of Municipal Affairs and Environment (MAE) and the Iron Ore Company of Canada (IOC).
- This network consisted of two water quality/quantity stations, one located downstream of the IOC tailings disposal area and one located upstream of the same area.
- The official names of these two stations are *Wabush Lake at Dolomite Road* and *Wabush Lake at Lake Outlet*, hereafter referred to as the Dolomite Road station and the Julienne Narrows station.
- On June 8th, 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 12th, 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.
- These stations measure water quality parameters including water temperature, pH, specific conductivity, dissolved oxygen and turbidity, as well as water quantity parameters stage, and flow. Measurements are recorded on an hourly basis during the deployment period.

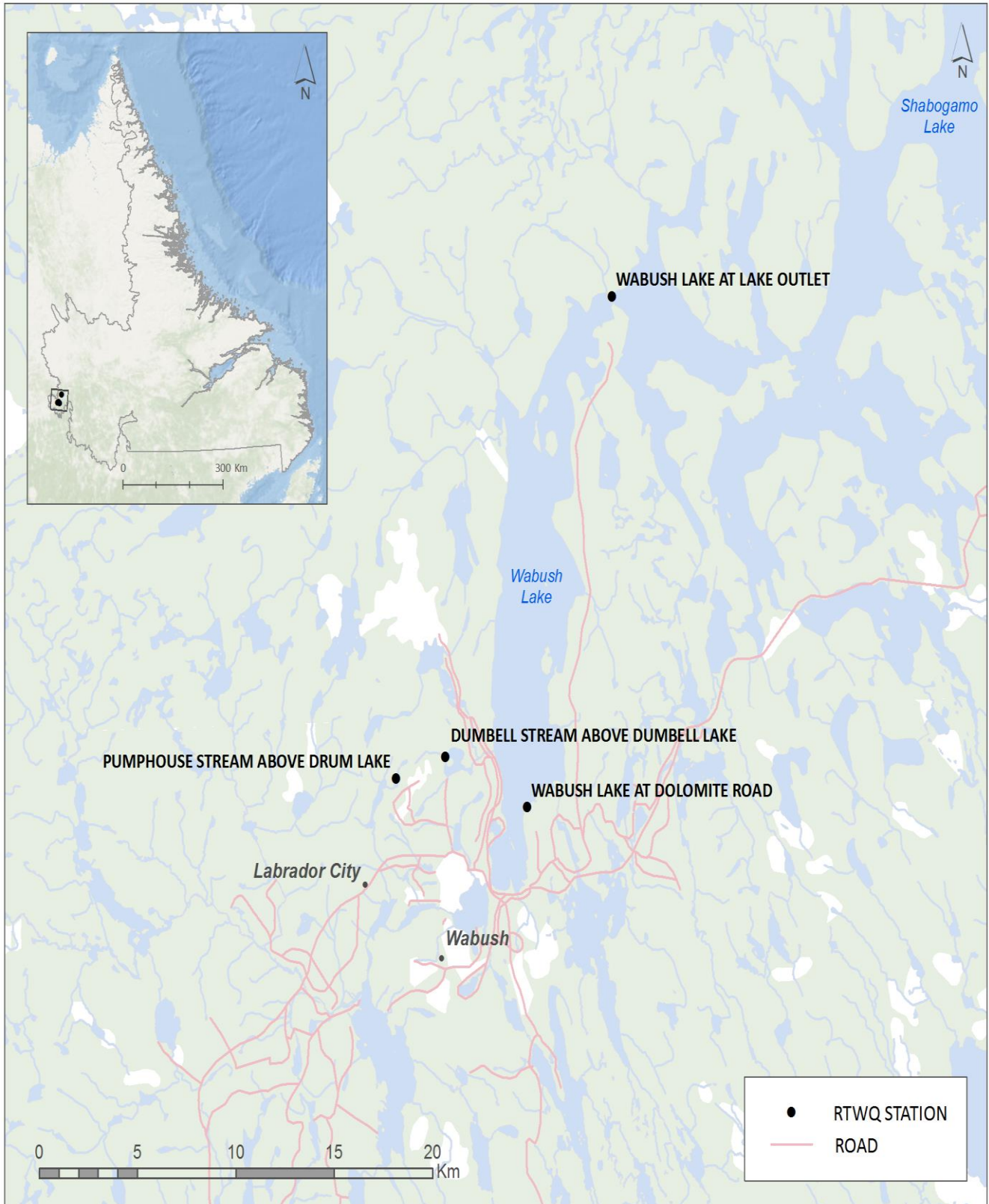


Figure 1: RTWQ Monitoring Stations in Labrador West

- Initial deployment in 2018 was on June 12th and instruments were removed for the winter season on October 16th at Dolomite Road, Dumbell Stream and Pumphouse Steam, and October 17th at Julienne Narrows. The following report depicts and discusses water quality events throughout this time period.
- Due to a logistical issue, the instrument at Julienne Narrows was deployed for 65 days.
- The purpose of this network is to monitor, process, and distribute water quality/quantity data to IOC, MAE and ECCC, for assessment and management of water resources, as well as to provide an early warning for any potential or emerging water issues. Any necessary mitigative measures can then be implemented in a timely manner.
- MAE provides IOC with monthly and annual deployment reports.
- It is important to note that unless otherwise stated on the graphs, small gaps in data are due to the removal of the instrument for maintenance and calibration.

Maintenance and Calibration

- To ensure accurate data collection, maintenance and calibration of the water quality instrumentation are performed preferably on a monthly basis.
- Maintenance includes a thorough cleaning of the instrument and replacement of any small sensor parts that are damaged or unsuitable for reuse. Once the instrument is cleaned, MAE staff carefully calibrate each sensor attachment for pH, specific conductivity, dissolved oxygen and turbidity.
- Installation and removal dates for the 2018 season are summarized in the table below.

Table 1: Water quality instrument deployment start and end dates for 2018

Installation	Removal	Deployment duration (days)
June 12-13	July 23-25	40-43
July 23-25	Sept 10-12	49-50
Sept 12	October 16-17	33-34

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 2).

Table 2: 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. As 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 for the three deployment periods from June 12th to October 17th, 2018 are summarized in Table 3.
- For additional information and explanations of ranking including “N/A” rankings, please refer to the monthly deployment reports.

Table 3: Comparison rankings for IOC RTWQ stations June 12 – October 17, 2018

	Date		Temperature	pH	Specific Conductivity	Dissolved Oxygen	Turbidity
Dolomite Road	13-Jun-18	Deployment	Fair	Excellent	Excellent	Good	Excellent
	23-Jul-18	Removal	Good	Excellent	Excellent	Excellent	Poor
	23-Jul-18	Deployment	Excellent	Excellent	Excellent	Excellent	Poor
	10-Sep-18	Removal	Excellent	Excellent	Good	Excellent	Excellent
	12-Sep-18	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	16-Oct-18	Removal	Excellent	Excellent	Good	Excellent	Excellent
Julienne Narrows	13-Jun-18	Deployment	Good	Good	Excellent	Good	Excellent
	17-Aug-18	Removal	N/A	N/A	N/A	N/A	N/A
	17-Aug-18	Deployment	Excellent	Excellent	Excellent	Excellent	Fair
	11-Sep-18	Removal	Excellent	N/A	Good	Excellent	Excellent
	12-Sep-18	Deployment	Excellent	Excellent	Excellent	Good	Fair
	17-Oct-18	Removal	Excellent	Fair	Excellent	Fair	Poor
Dumbell Stream	12-Jun-18	Deployment	Good	Excellent	Excellent	Good	Excellent
	25-Jul-18	Removal	Excellent	Good	Good	Excellent	N/A
	25-Jul-18	Deployment	Excellent	Excellent	Excellent	Excellent	N/A
	12-Sep-18	Removal	Excellent	Good	Excellent	Excellent	Excellent
	12-Sep-18	Deployment	Good	Excellent	Excellent	Marginal	Excellent
	16-Oct-18	Removal	Good	Good	Good	Poor	Marginal
Pumphouse Stream	12-Jun-18	Deployment	Good	Good	Excellent	Excellent	Poor
	24-Jul-18	Removal	N/A	N/A	N/A	N/A	N/A
	24-Jul-18	Deployment	Good	Excellent	Excellent	Good	Poor
	12-Sep-18	Removal	Good	Excellent	Excellent	Fair	Good
	12-Sep-18	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	16-Oct-18	Removal	Excellent	Marginal	Excellent	Fair	Good

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from June 12th to October 17th, 2018 at the four IOC RTWQ stations.
- With the exception of water quantity data (stage), 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.
- Weather data is collected from a weather station near Moosehead Lake.
- There is a large portion of data missing from Julienne Narrows. This is due to a power loss issue.
- There are two portions of data missing from Pumphouse stream. These are due to equipment and instrument issues.

Wabush Lake Network

- Water temperature ranged from 2.90 to 16.80°C at Julienne Narrows and from 3.70 to 21.70°C at Dolomite Road during the 2018 deployment season the median values were 11.40 °C and 13.40 °C, respectively.
- Water temperature is typically higher at Dolomite Road then Julienne Narrows (Figure 2).

Water and Air Temperature: Wabush Lake Network
June 13 to October 17, 2018

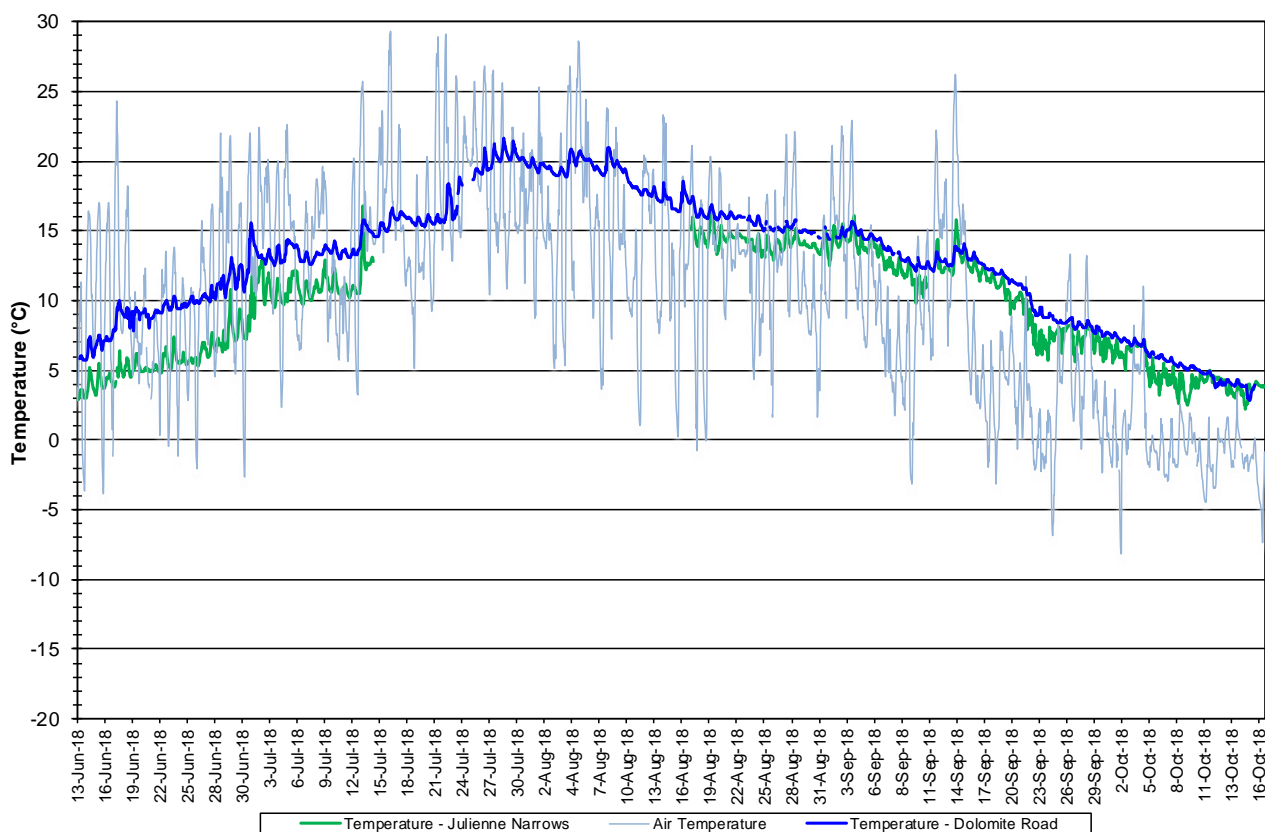


Figure 2: Water and Air Temperature – Wabush Lake Network

- pH ranged from 7.06 to 8.24 pH units at Julienne Narrows and from 6.34 to 7.89 pH units at Dolomite Road (Figure 3) during the 2018 deployment season. The median pH was 7.92 and 7.53 units respectively.
- pH fluctuates daily at both stations. Peaks are observed during late afternoon and early evening.
- All values during the deployment, with the exception of one data point which may be erroneous, are within the CCME Water Quality Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units).
- At both stations there is a slight increase during the first deployment period. pH is then relatively stable for the remainder of the season.

**Water pH and Stage: Wabush Lake Network
June 13 to October 17, 2018**

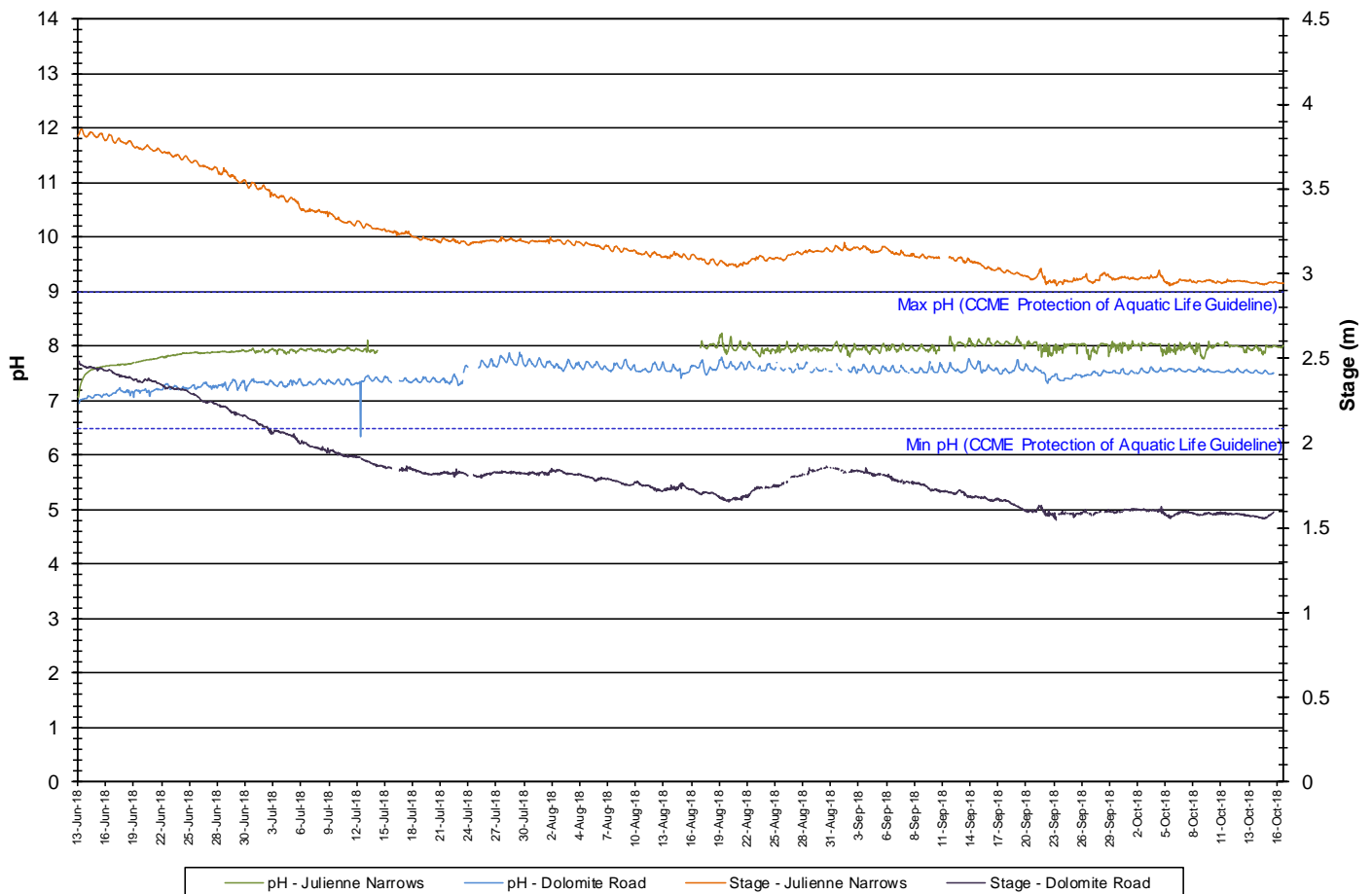


Figure 3: Water pH and Stage – Wabush Lake Network

- Throughout the 2018 deployment season, specific conductivity ranged from 70.0 to 104.6 $\mu\text{s}/\text{cm}$ at Julienne Narrows and from 33.3 to 58.2 $\mu\text{s}/\text{cm}$ at Dolomite Road (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.
- At Julienne Narrows, conductivity fluctuated greatly during the deployment season with a slight increasing trend after the middle of September and into the remainder of the season with fluctuations.
- At Dolomite Road, conductivity increases over the course of the deployment season with a slight decrease in September.
- Overall, stage decreases throughout the deployment season at both stations with slight increases noted in August.
- With the exception of water quantity data (stage), 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.

**Specific Conductivity and Stage: Wabush Lake Network
June 13 to October 17, 2018**

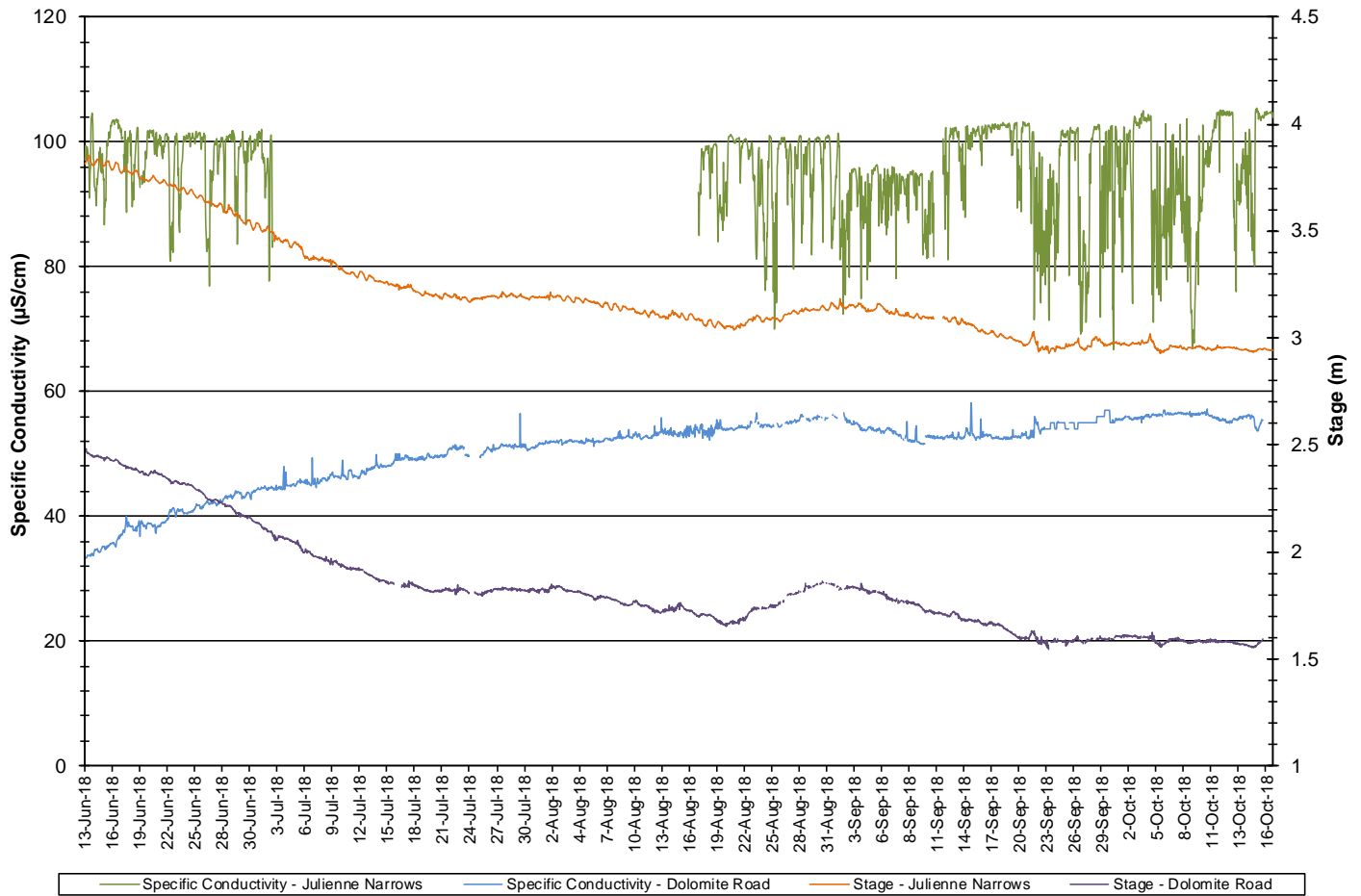


Figure 4: Specific Conductivity and Stage – Wabush Lake Network

- Dissolved oxygen ranged from 82.4 to 101.0% saturation and 9.32 to 11.46 mg/l with a median value of 10.43 mg/L at Julienne Narrows (Figure 5).
- Dissolved oxygen ranged from 80.9 to 102.6% saturation and 8.43 to 11.58 mg/l with a median value of 9.53 mg/L at Dolomite Road (Figure 5).
- Dissolved oxygen fluctuated daily at both stations with decreases observed at night.
- Dissolved oxygen decreases during the summer months when water temperatures are highest. Oxygen levels then gradually increase during the last deployment of the season as water temperatures decrease into fall.
- All values were above the CCME Water Quality Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages of 6.5 mg/l. The majority of values recorded were above the minimum CCME Water Quality Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l. The guidelines are indicated in blue on Figure 5.

**Dissolved Oxygen and Percent Saturation: Wabush Lake Network
June 13 to October 17, 2018**

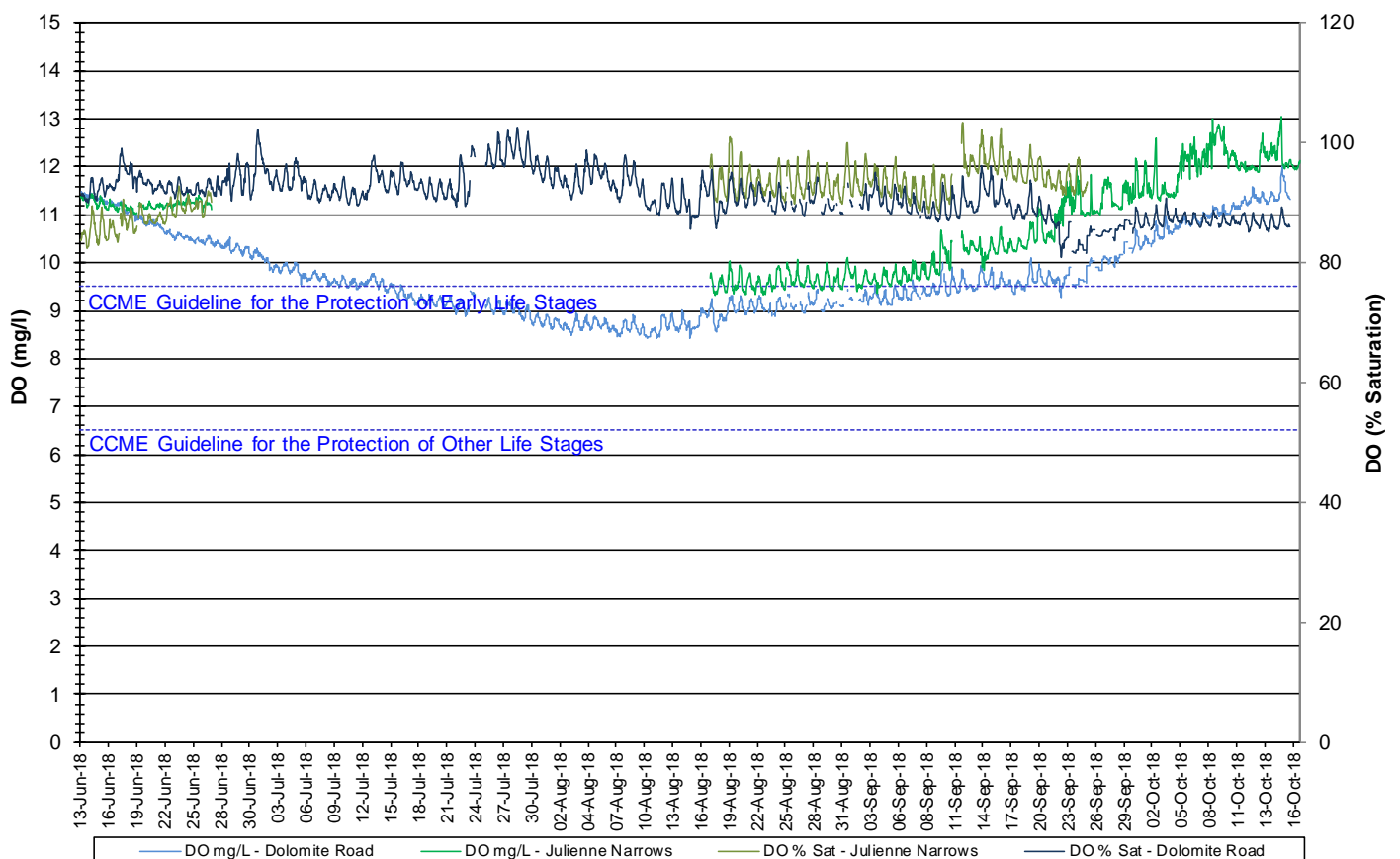


Figure 5: Dissolved Oxygen and Percent Saturation – Wabush Lake Network

- At the Julienne Narrows station, turbidity values ranged from 0.0 to 161.7 NTU with a median value of 0.0 NTU (Figure 6a) indicating low background turbidity.

**Water Turbidity and Precipitation: Julienne Narrows
June 13 to October 17, 2018**

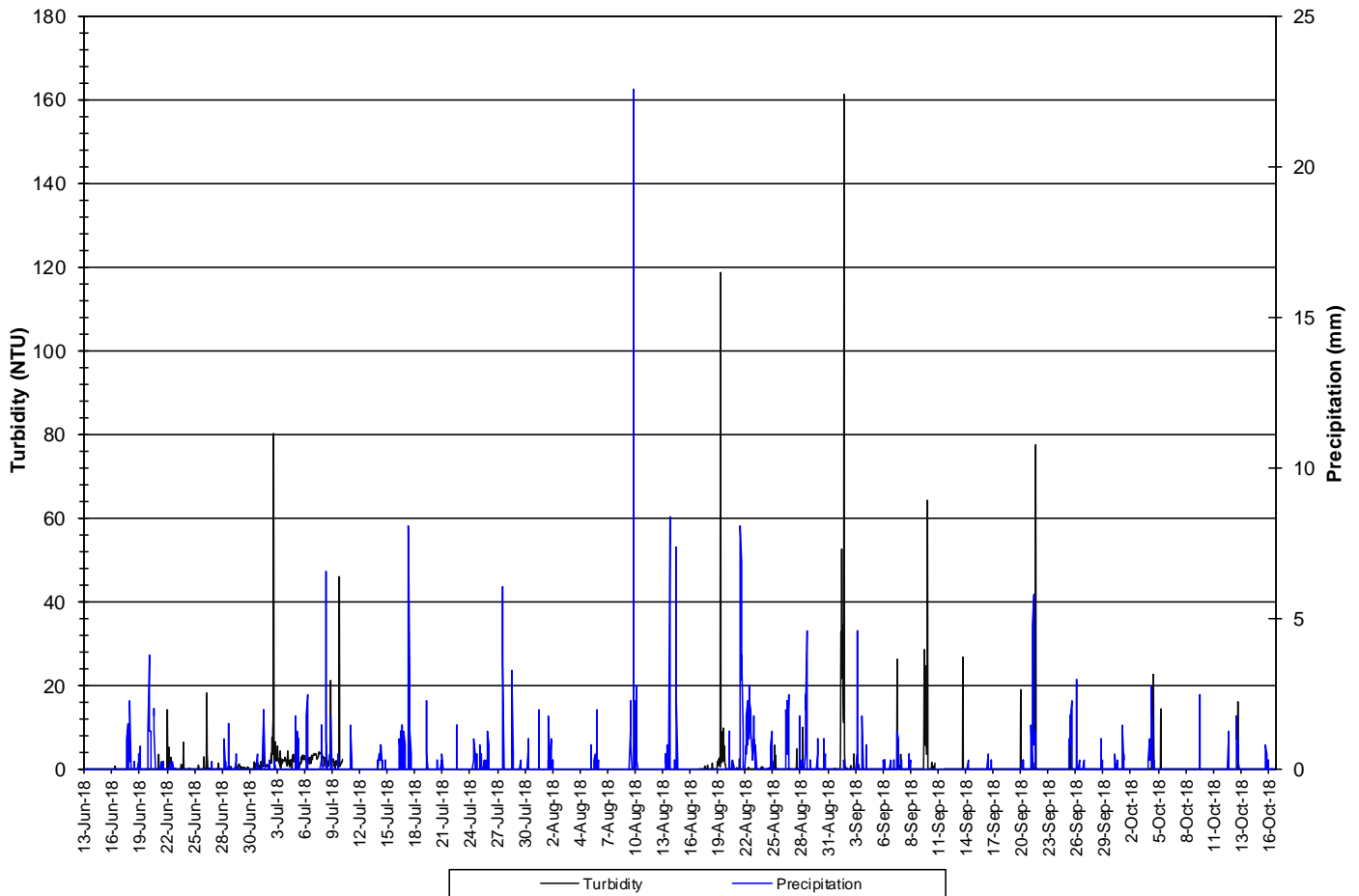


Figure 6a: Water Turbidity and Precipitation - Julienne Narrows

- At the Dolomite Road station, turbidity values ranged from 0.0 to 53.8 NTU, with a median value of 0.0 NTU (Figure 6b).
- These frequent spikes in turbidity at unusual for this station.

**Turbidity and Precipitation : Dolomite Road
June 12 to October 16, 2018**

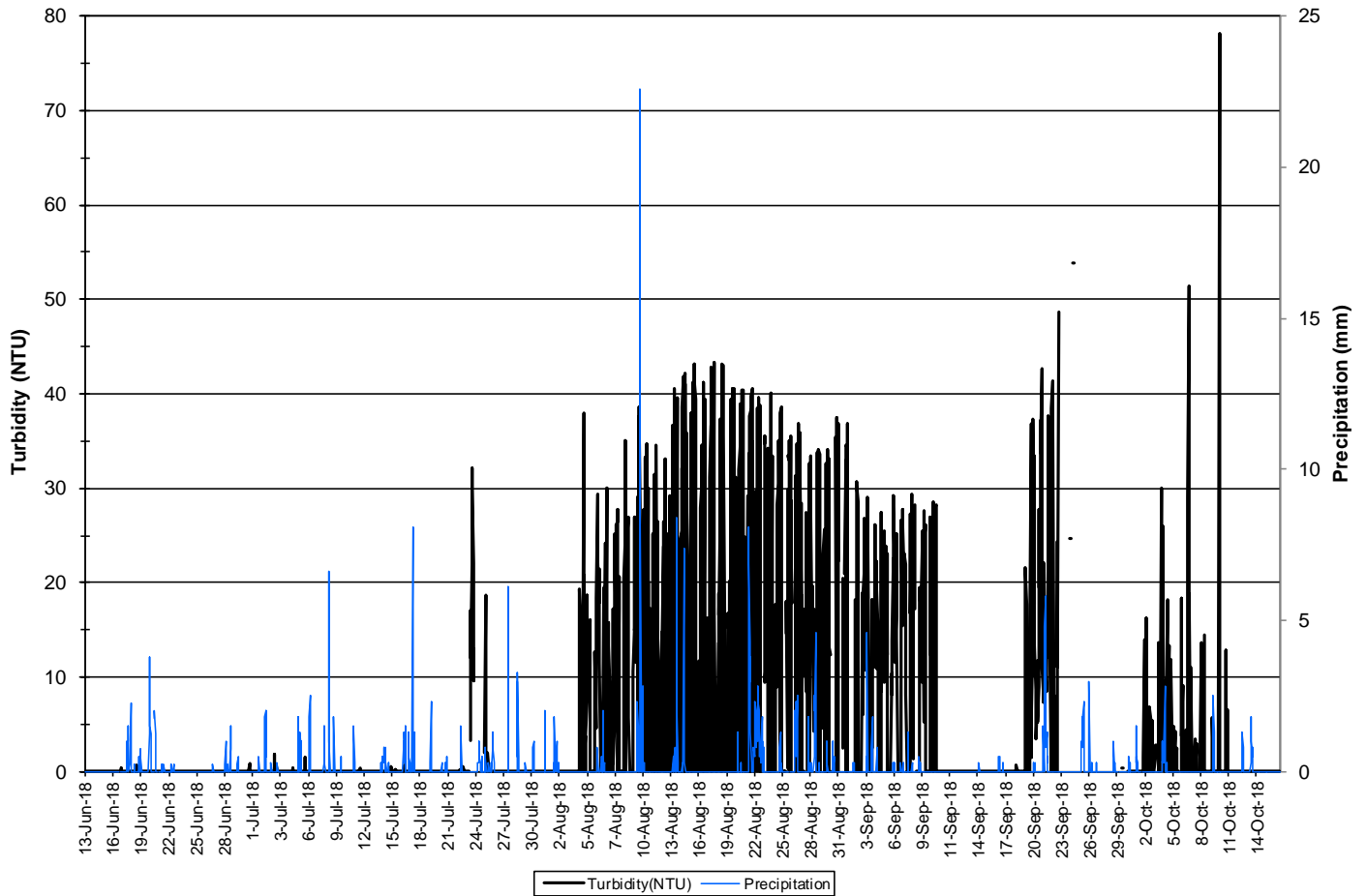


Figure 6b: Turbidity and Precipitation - Dolomite Road

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Julienne Narrows and Dolomite Road (Figure 7).
- Stage decreases after the first deployment period of the season with slight increases in August at both stations, showing an identical trend.
- With the exception of water quantity data (stage), 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.

**Stage & Precipitation: Wabush Lake Network
June 13 to October 17, 2018**

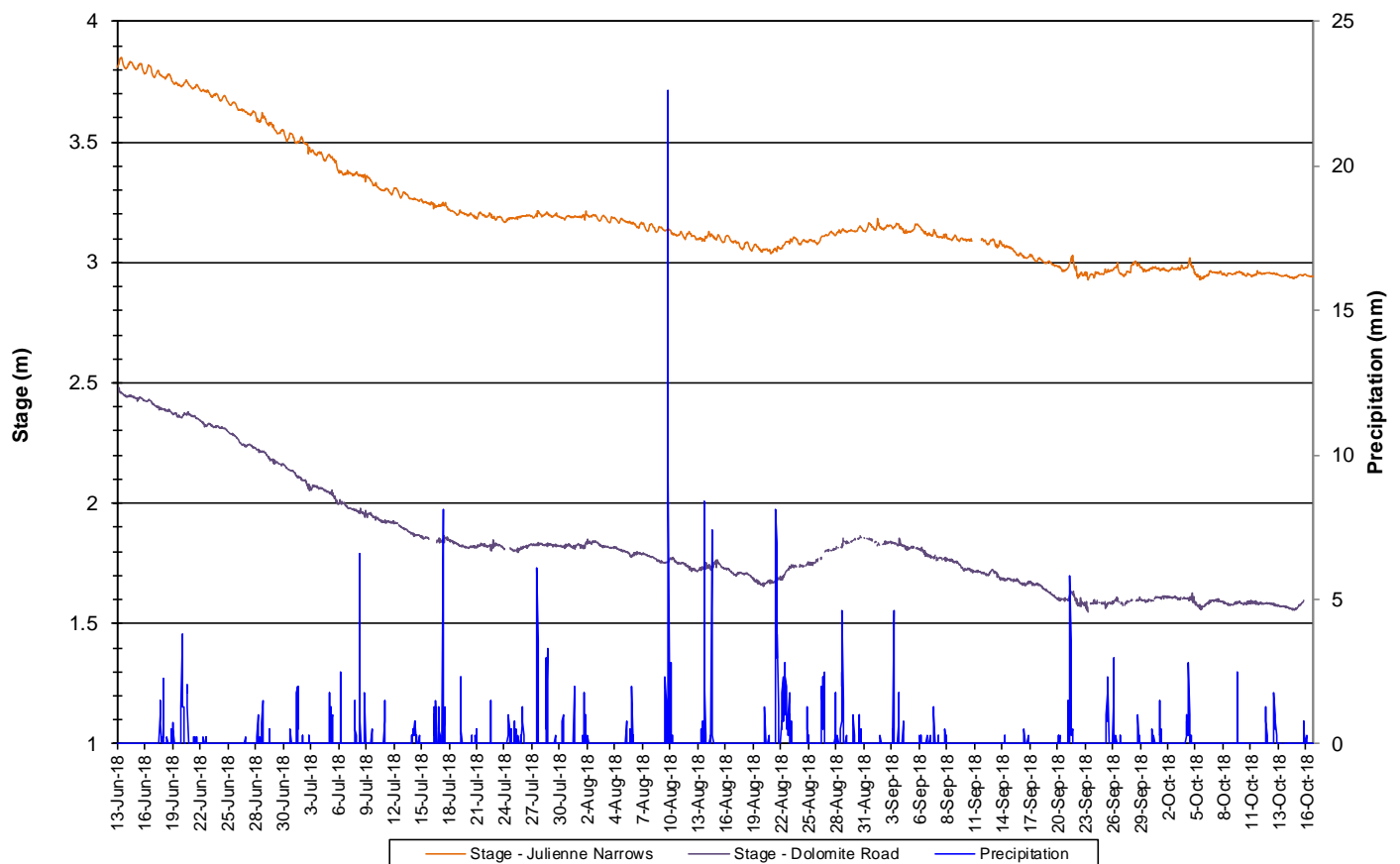


Figure 7: Stage and Precipitation - Wabush Lake Network

Dumbell Stream

- Water temperature ranged from 0.51 to 7.04°C at Dumbell Stream during the 2018 deployment season. The median value was 4.06 °C (Figure 8).
- Water temperature increases during the summer months and then decreases as air temperatures cool into the fall. Water temperature at this station remains within a small range throughout the season and is impacted less than the other stations by air temperature values.

Water and Air Temperature : Dumbell Stream above Dumbell Lake
June 12 to October 16, 2018

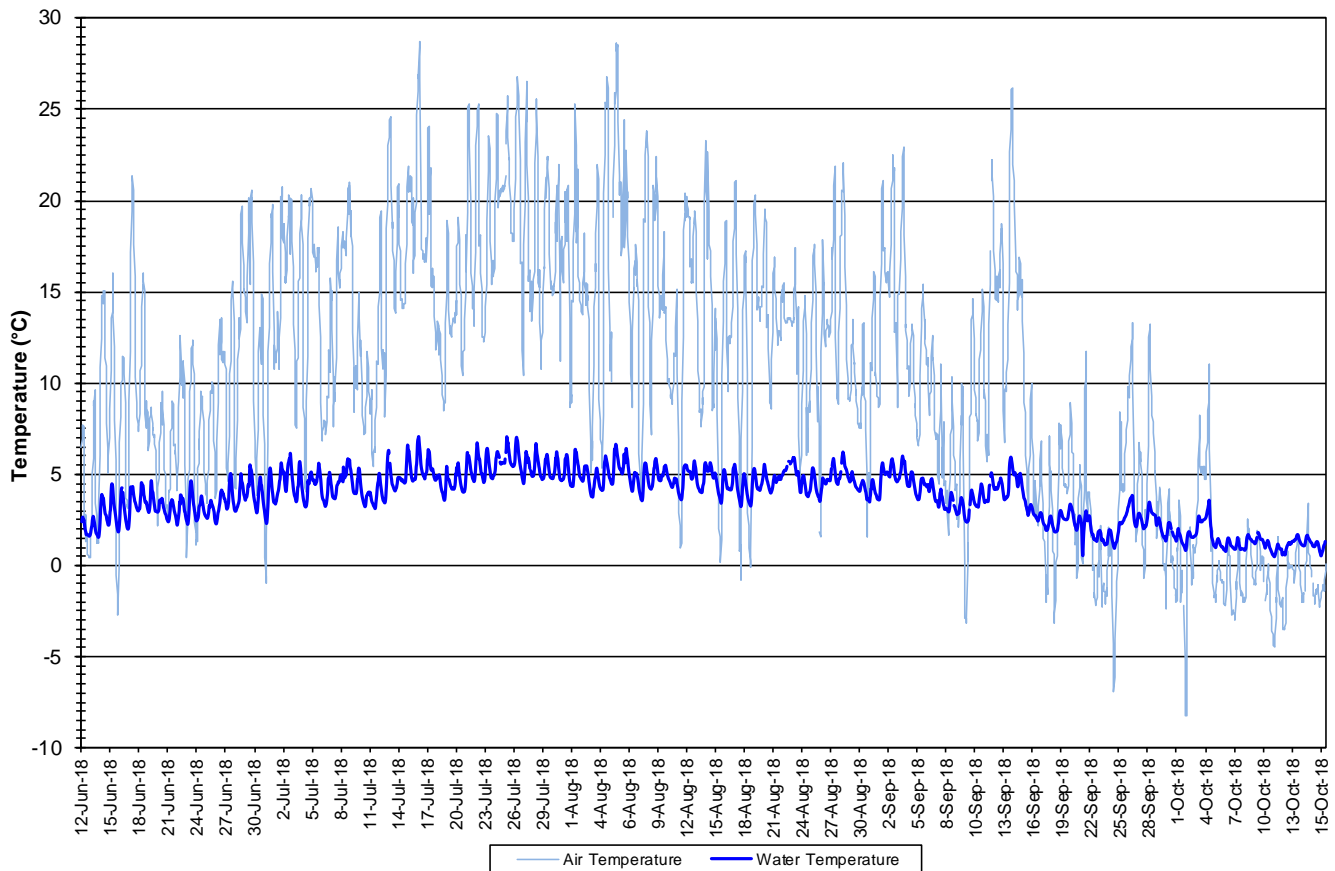


Figure 8: Water and Air Temperature – Dumbell Stream above Dumbell Lake

- pH ranges from 7.32 to 7.89 pH units at Dumbell Stream (Figure 9). The median pH is 7.69 units.
- pH fluctuates daily. Peaks are observed during late afternoon and into early evening.
- All values during the deployment are within the CCME Water Quality Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units).
- There is a slight decrease at the start of the second deployment period and an increase after this period. This could be due to a calibration or sensor issue.

**Water pH and Stage : Dumbell Stream above Dumbell Lake
June 12 to October 16, 2018**

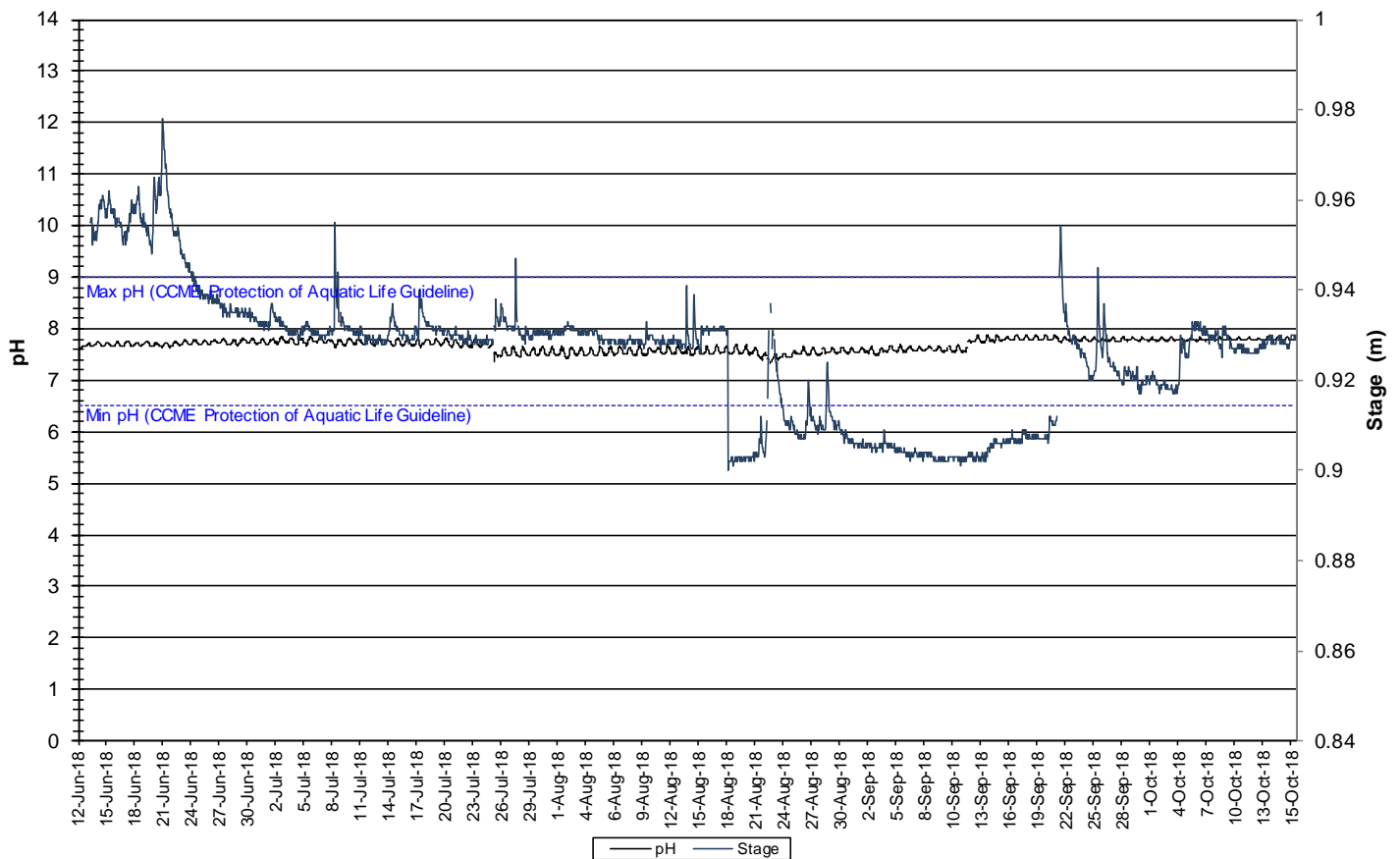


Figure 9: Water pH and Stage – Dumbell Stream above Dumbell Lake

- Throughout the 2018 deployment season, specific conductivity ranged from 57.0 to 75.0 $\mu\text{S}/\text{cm}$ at Dumbell Stream (Figure 10).
- Decreases in specific conductivity frequently 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 instances are identified on the graph in red.
- Overall, specific conductivity increased very gradually throughout the deployment season, with periodic fluctuations related to stage.
- With the exception of water quantity data (stage), 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.

**Specific Conductivity of Water and Stage: Dumbell Stream above Dumbell Lake
June 12 to October 16, 2018**

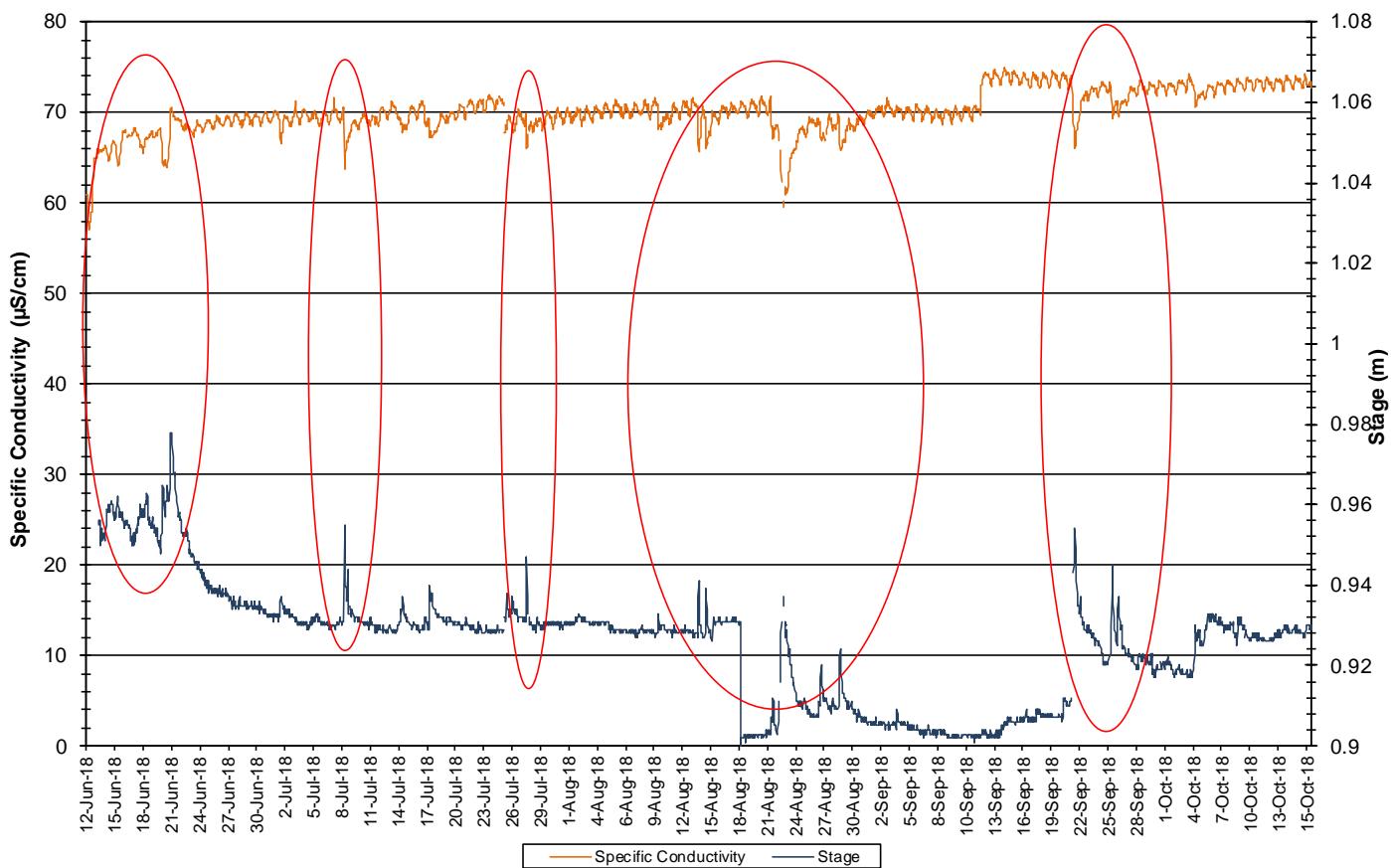


Figure 10: Specific Conductivity and Stage – Dumbell Stream above Dumbell Lake

- Dissolved oxygen ranged from 87.2 to 98.4% saturation and from 10.92 to 13.88 mg/l, with a median value of 11.82 mg/l (Figure 11).
- Dissolved oxygen fluctuated daily with decreases observed at night.
- Dissolved oxygen increased during the later portion of the deployment season when water temperature was decreasing in the fall.
- All values were above the CCME Water Quality Guidelines for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages (6.5 mg/l) and Early Life Stages (9.5 mg/l). The guidelines are indicated in blue on Figure 11.

**Dissolved Oxygen Concentration and Saturation : Dumbell Stream at Dumbell Lake
June 12 to October 16, 2018**

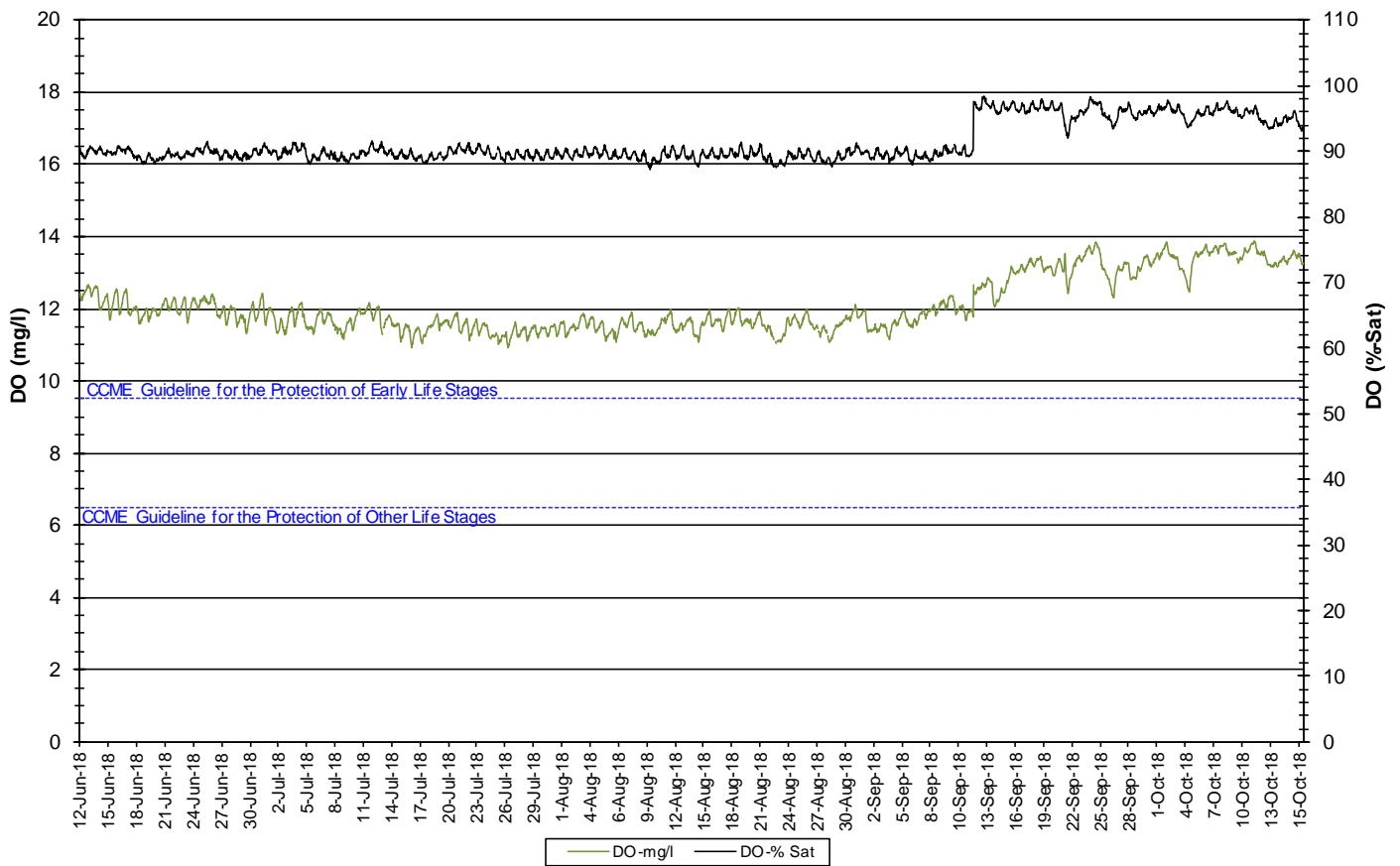


Figure 11: Dissolved Oxygen and Percent Saturation – Dumbell Stream above Dumbell Lake

- Turbidity values range from 0.0 to 28.6 NTU, with a median value of 0.0 NTU (Figure 12a & 12b) indicating very low background turbidity.
- Turbidity readings greater than 0NTU occur occasionally and are of short duration.

**Water Turbidity and Precipitation : Dumbell Stream above Dumbell Lake
June 12 to October 16, 2019**

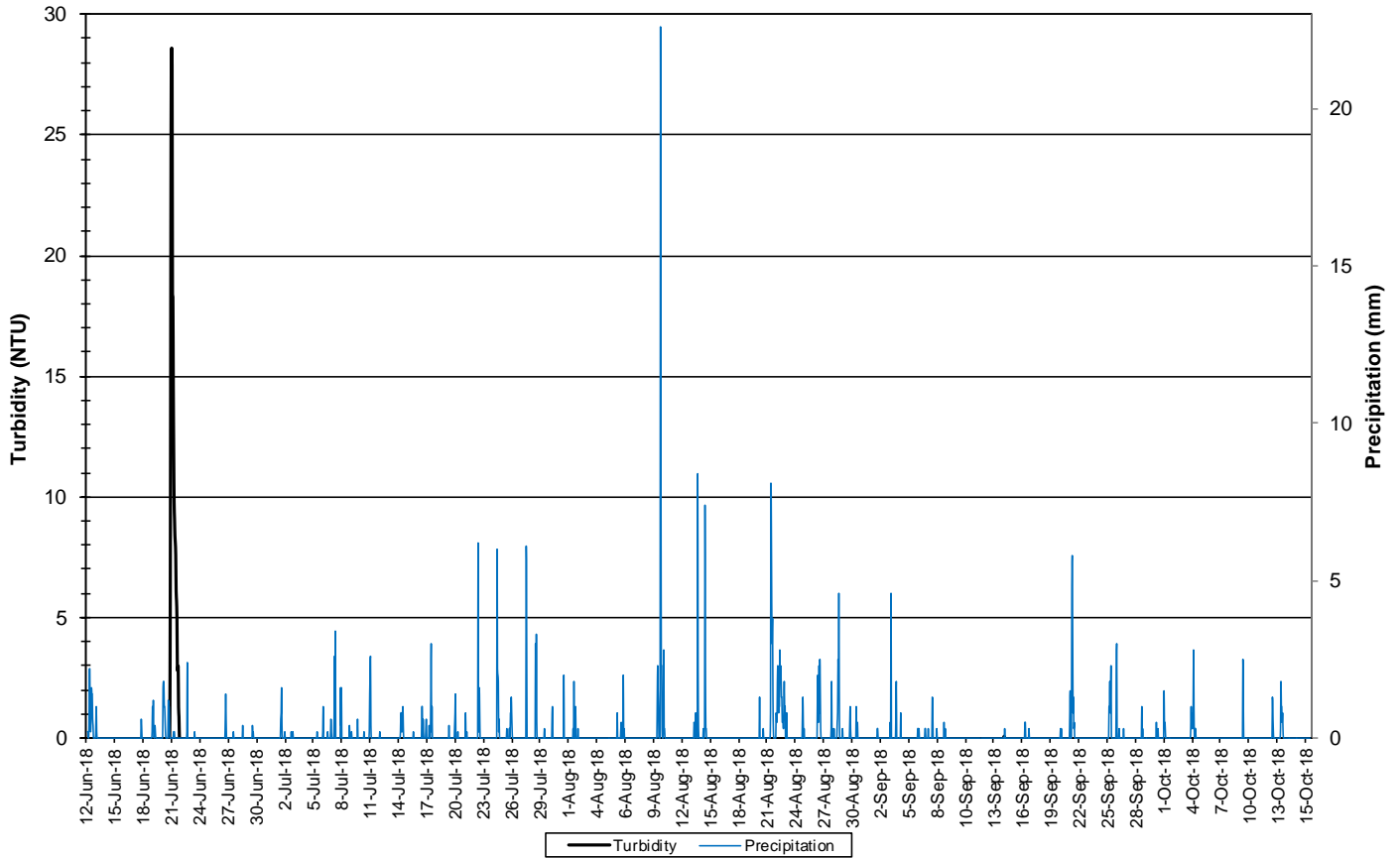


Figure 12a: Turbidity and Precipitation – Dumbell Stream above Dumbell Lake

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Dumbell Stream (Figure 13). Precipitation has a direct effect on stage at this location.
- Stage gradually decreases over the course of the deployment season, with increases noted during and after precipitation events.
- With the exception of water quantity data (stage), 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.

**Stage and Precipitation: Dumbell Stream
June 12 to October 16, 2019**

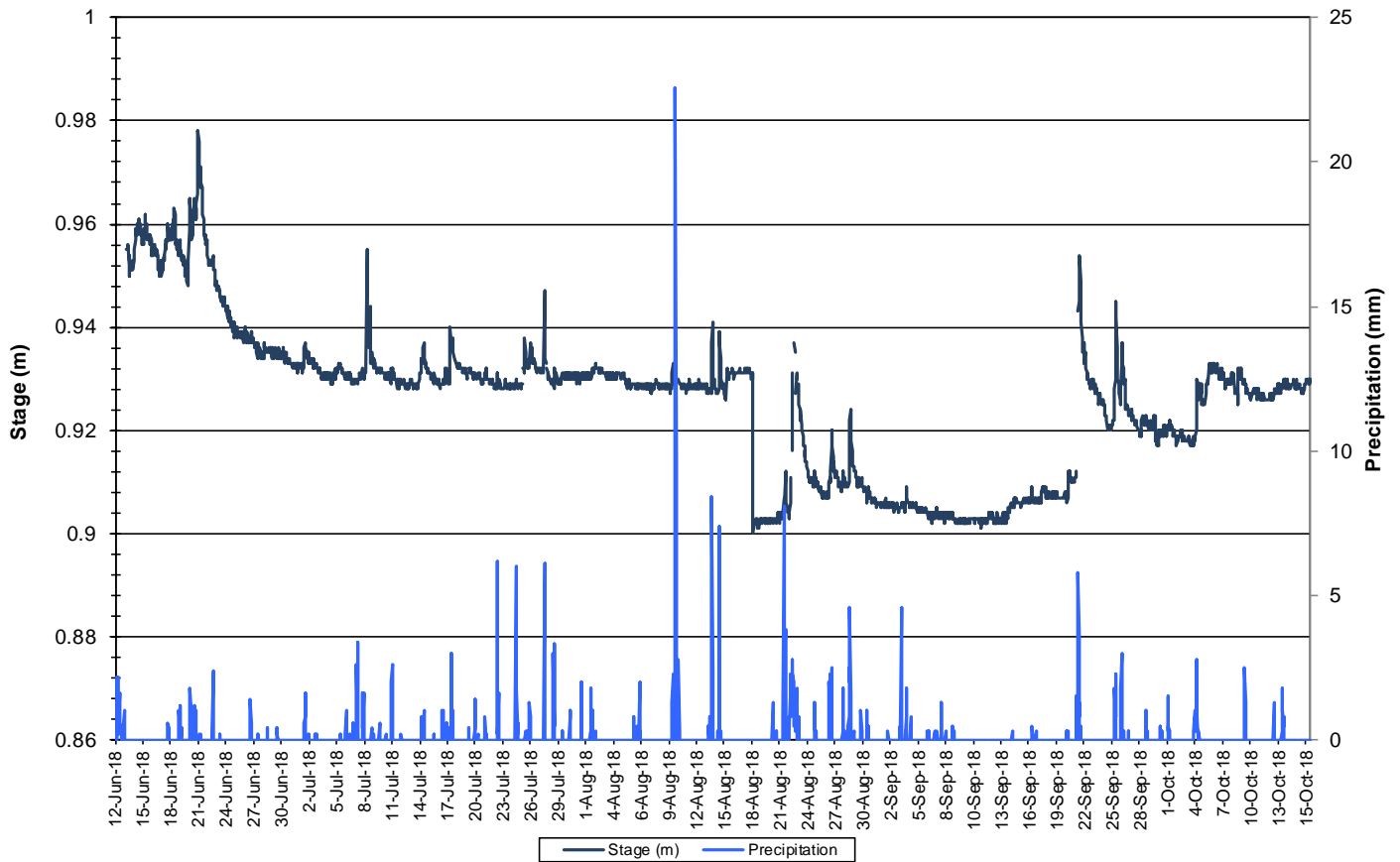


Figure 13: Stage and Precipitation – Dumbell Stream above Dumbell Lake

Pumphouse Stream

- Water temperature ranged from 1.00 to 20.70°C at Pumphouse Stream during the 2018 deployment season. The median value was 11.70 °C (Figure 14).
- Water temperature corresponded closely with air temperature fluctuations, decreasing steadily after August as air temperature cooled in to the fall.

**Water and Air Temperature : Pumphouse Stream above Drum Lake
June 12 to October 16, 2018**

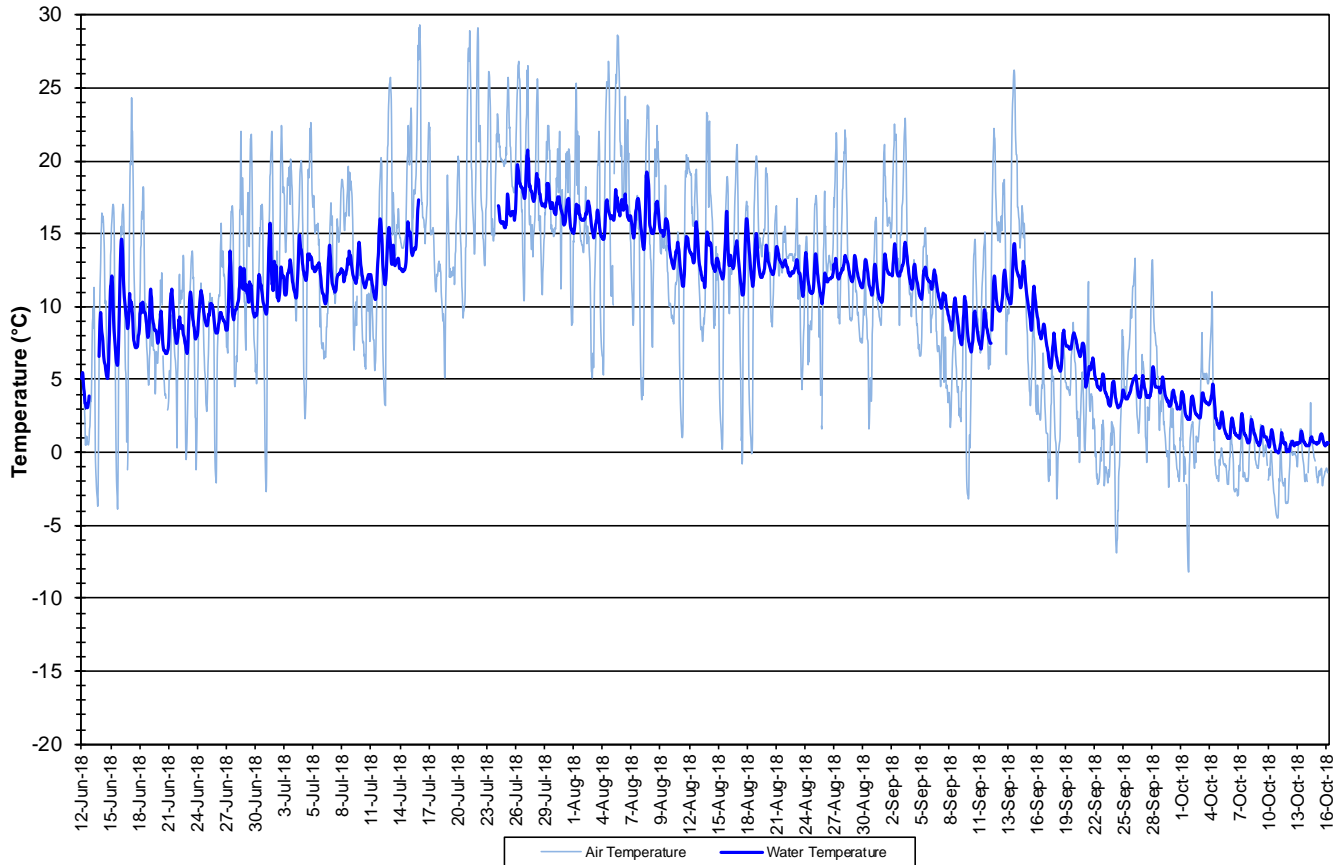


Figure 14: Water and Air Temperature – Pumphouse Stream above Drum Lake

- pH ranged from 6.34 to 8.05 pH units at Dumbell Stream (Figure 15). The median pH was 7.31 units.
- pH fluctuated daily. Peaks were observed during late afternoon into the early evening. Overall, pH increases slightly over the course of this deployment season.
- The majority of values during the deployment are within the CCME Water Quality Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units).

**Water pH and Precipitation: Pumphouse Stream above Drum Lake
June 12 to October 16, 2018**

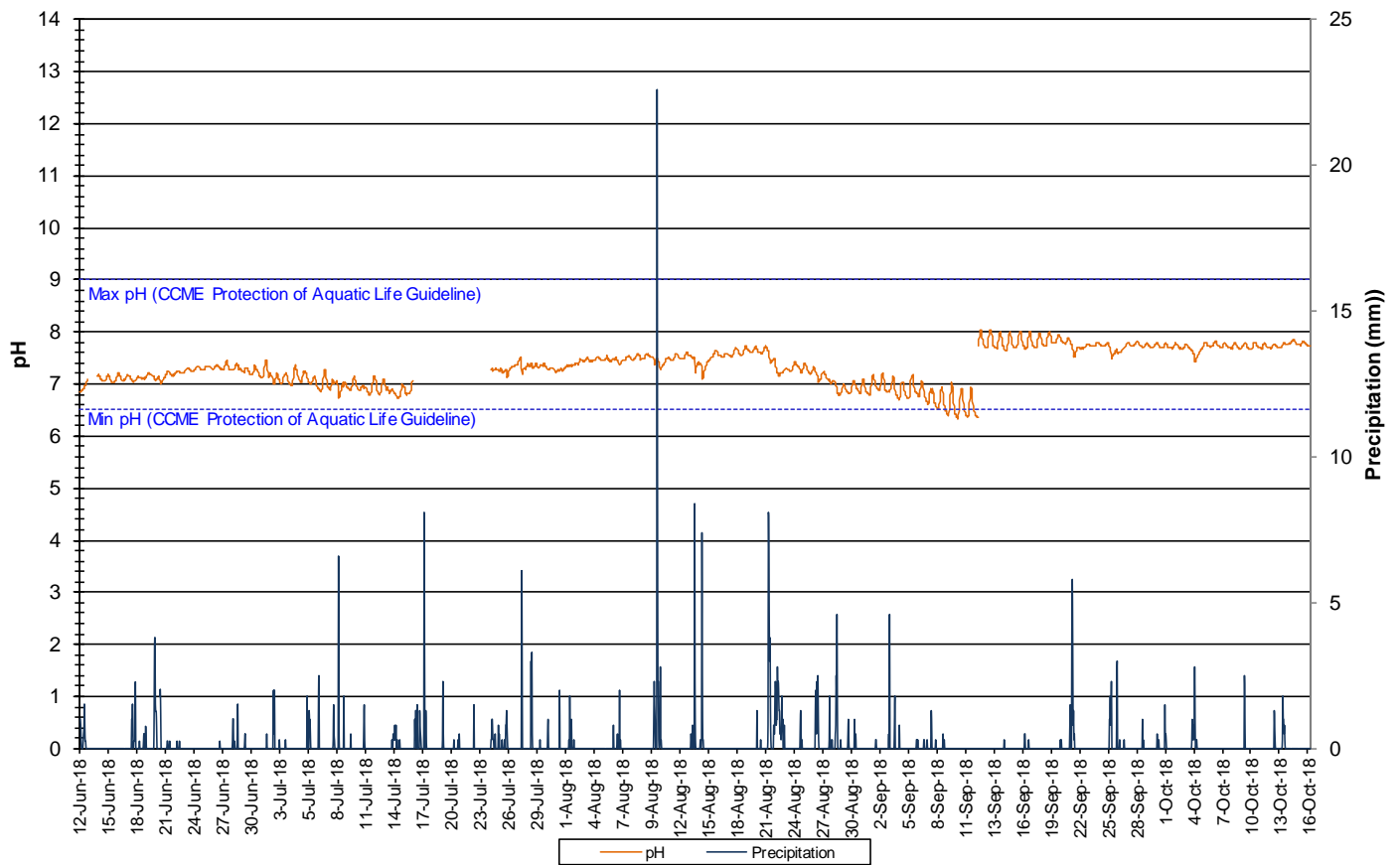


Figure 15: Water pH and Stage – Pumphouse Stream above Drum Lake

- Throughout the 2018 deployment season, specific conductivity ranged from 69.8 to 103.2 $\mu\text{S}/\text{cm}$ at Pumphouse Stream (Figure 16).
- Drops in specific conductivity frequently correspond to increases in stage. As more water is added to the system from precipitation, the solids in the water are diluted, decreasing conductivity.
- Overall, specific conductivity gradually increased throughout the deployment season.
- With the exception of water quantity data (stage), 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.

**Specific Conductivity of Water and Stage Level : Pumphouse Stream above Drum Lake
June 12 to October 16, 2018**

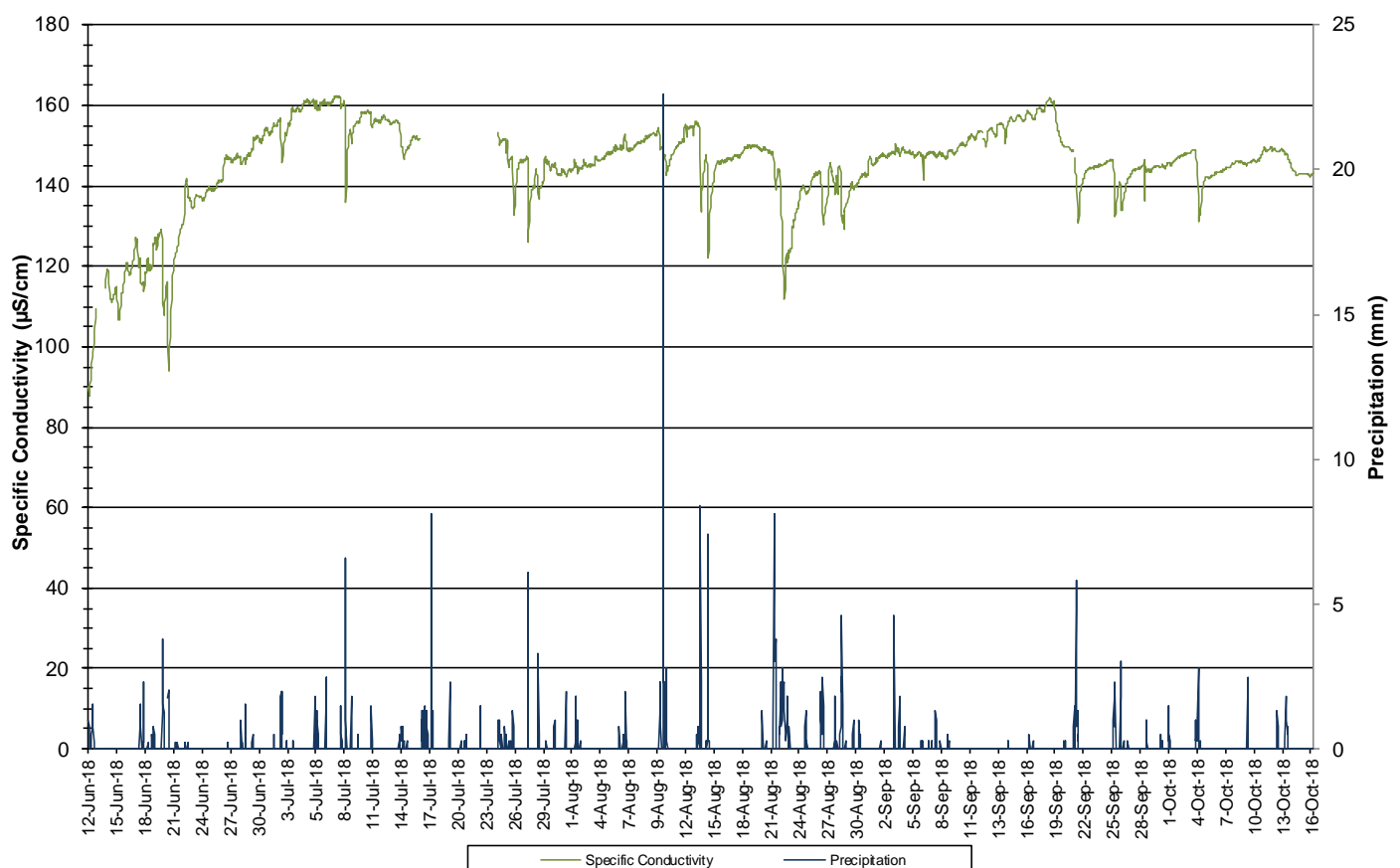


Figure 16: Specific Conductivity and Stage – Pumphouse Stream above Drum Lake

- Dissolved oxygen ranged from 69.8 to 103.2% saturation and 7.07 to 12.44 mg/l with a median value of 9.28 mg/l (Figure 17).
- Dissolved oxygen fluctuated daily with decreases observed at night.
- Dissolved oxygen increased during the later portion of the deployment season when water temperature was decreasing in the fall. This is a normal seasonal trend.
- All values were above the CCME Water Quality Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages of 6.5 mg/l. Most values recorded were below the minimum guideline for early life stages of 9.5 mg/l until water temperatures dropped and oxygen levels began to rise in September. The guidelines are indicated in blue on Figure 11.

**Dissolved Oxygen Concentration and Saturation : Pumphouse Stream above Drum Lake
June 12 to October 16, 2018**

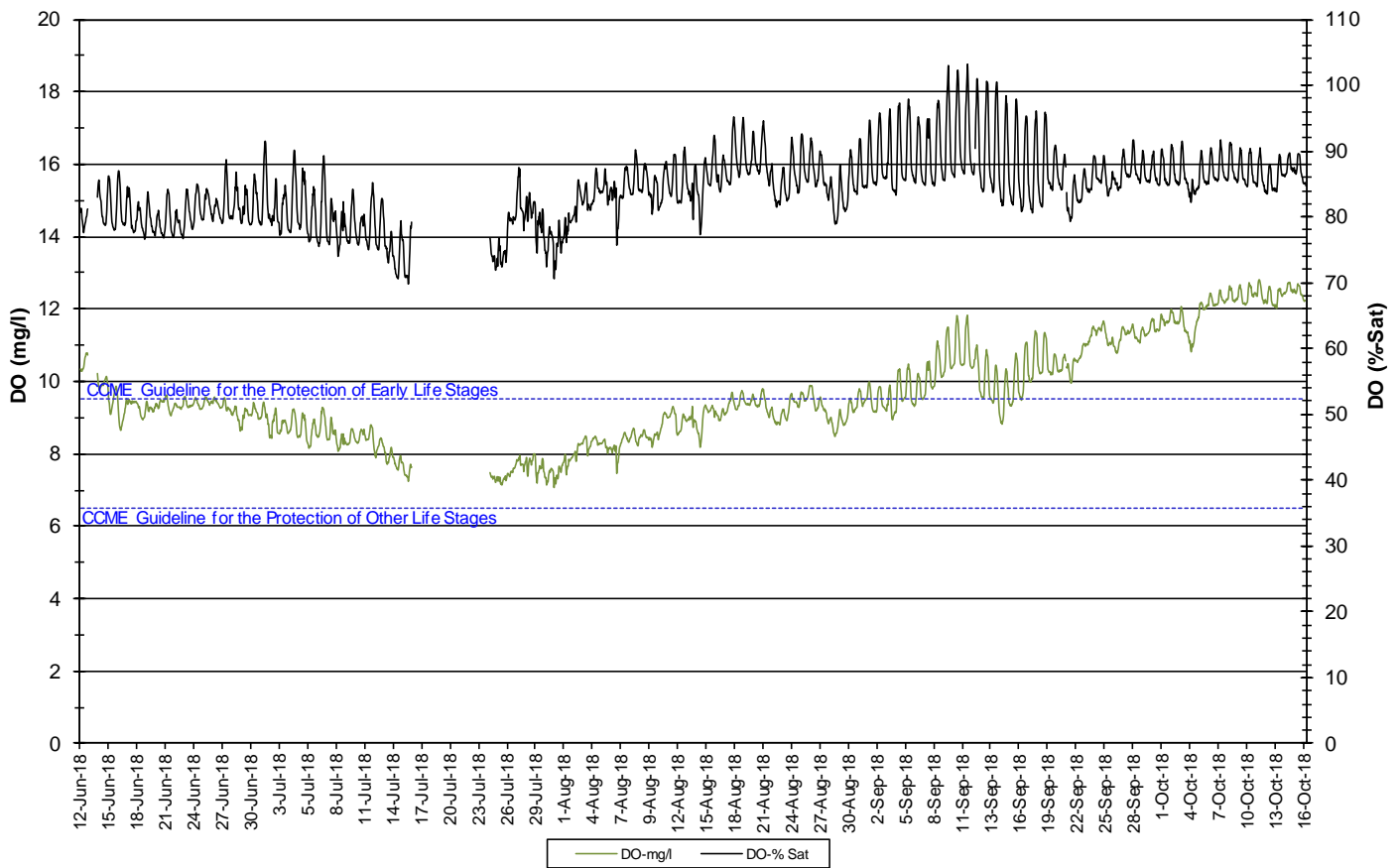


Figure 17: Dissolved Oxygen and Percent Saturation – Pumphouse Stream above Drum Lake

- Turbidity values range from 4.8 to 330.6 NTU, with a median value of 33.0 NTU (Figure 18a & 18b).
- There was some level of turbidity throughout the entire deployment season.

**Water Turbidity and Precipitation : Pumphouse Stream above Drum Lake
June 12 to October 16, 2018**

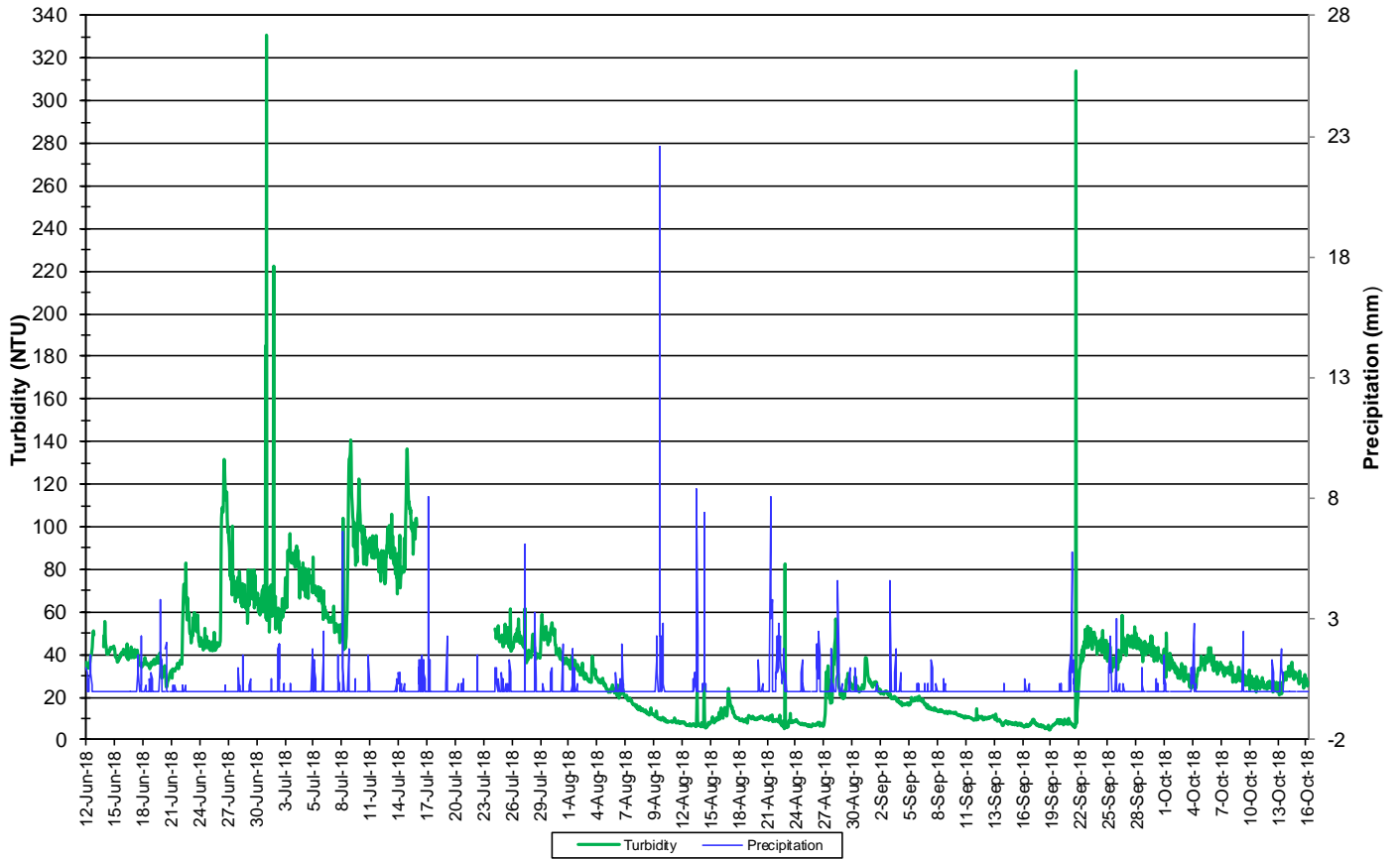


Figure 18a: Turbidity and Precipitation – Pumphouse Stream above Drum Lake

Water Turbidity <140 NTU and Precipitation : Pumphouse Stream above Drum Lake June 12 to October 16, 2018

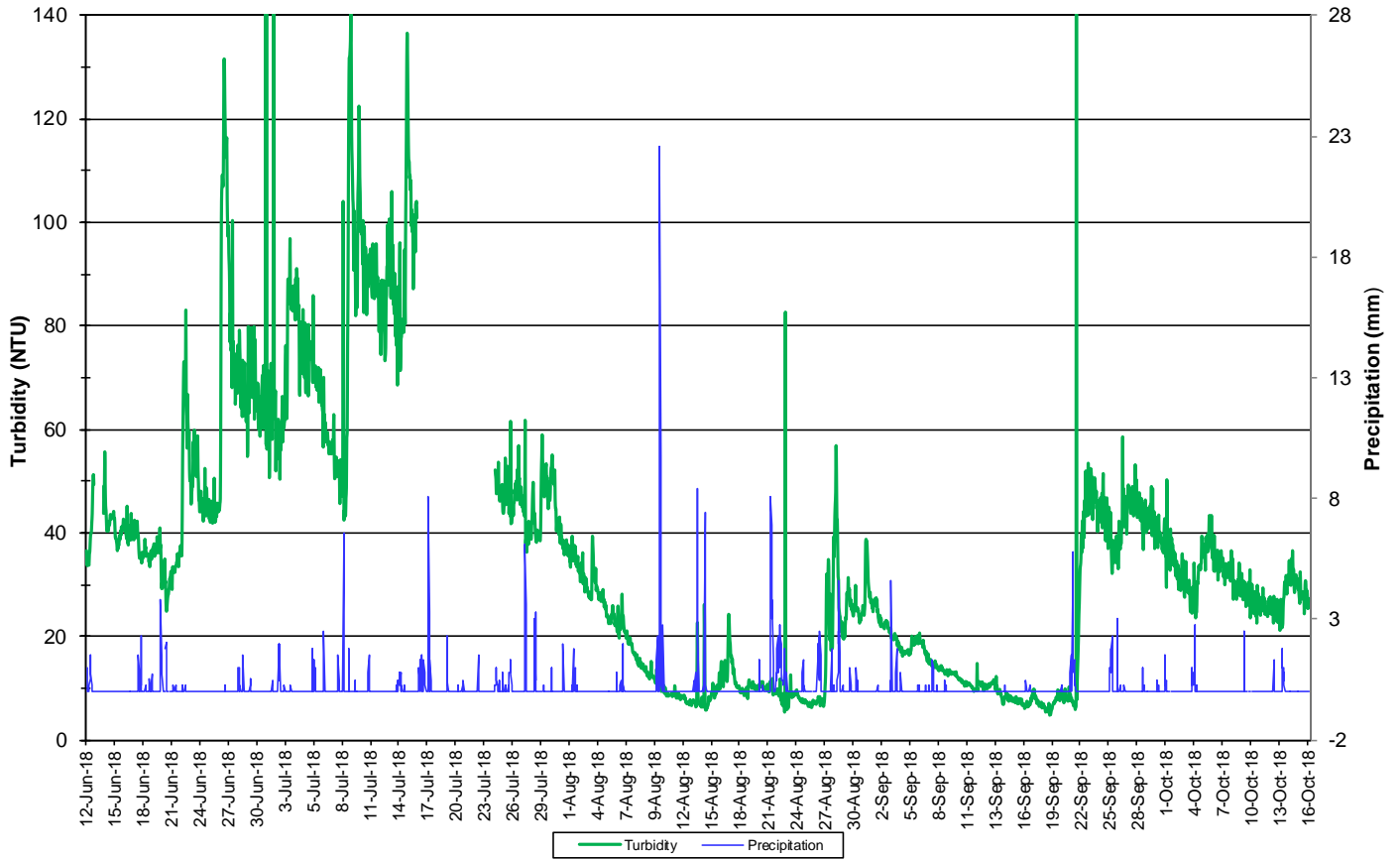


Figure 18b: Turbidity <140 NTU and Precipitation – Pumphouse Stream above Drum lake

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Dumbell Stream (Figure 19).
- Stage shows a slight and gradual decrease over the course of the deployment season, with fluctuations noted during and after precipitation events.
- With the exception of water quantity data (stage), 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.

**Stage & Precipitation: Pumphouse Stream above Drum Lake
June 12 to October 16, 2018**

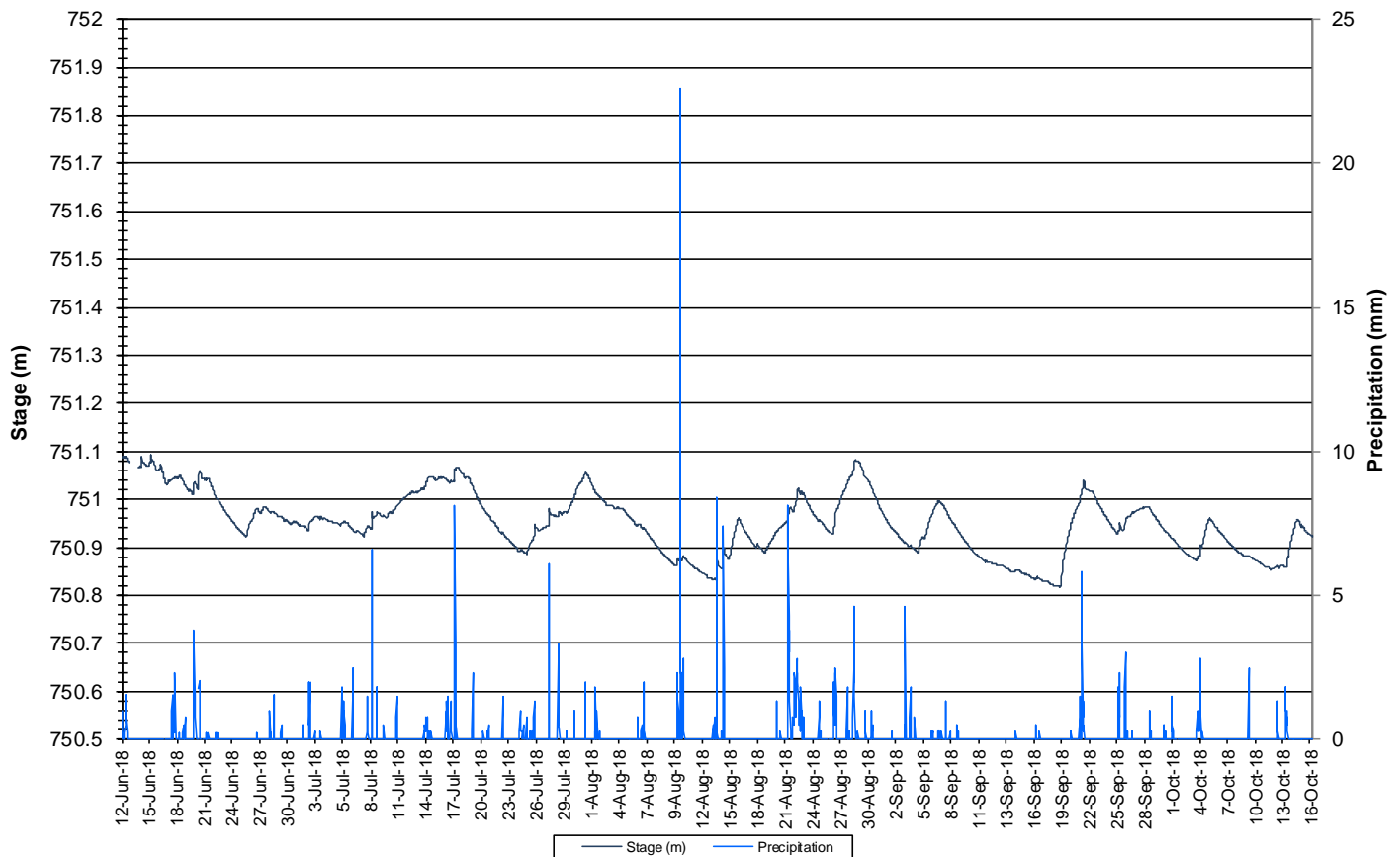


Figure 19: Stage and Precipitation – Pumphouse Stream above Drum Lake

Conclusions

- Instruments at the water quality monitoring stations in Labrador West were deployed on June 12th /13th and removed on October 16th/17th, 2018. They were then removed for the winter season.
- Instruments were deployed for periods of 33 to 50 days before maintenance and calibration. The second deployment at Julienne Narrows was 65 days due to a logistical issue.
- In most cases, weather related events or increases/decreases in water level could be used to explain the fluctuations.
- Most values recorded were within ranges as suggested by the CCME Water Quality Guidelines for the Protection of Aquatic Life.
- The instruments performed well in 2018 except for a few minor issues. These instruments will undergo PTE's during the winter. Data gaps were caused by station issues and were not related to the instrument. The field cable at Julienne Narrows failed and was replaced.
- Water temperature followed the seasonal trend of increasing during the summer and decreasing into the fall. Water temperature corresponded closely with air temperature at all stations except Dumbell.
- The majority of pH values were within the acceptable range of the CCME Water Quality Guidelines for Protection of Aquatic Life.
- Specific conductivity differed between the two Wabush Lake stations. This can be attributed to varying concentrations of iron ore tailings, which are deposited into Wabush Lake downstream of Dolomite Road and upstream of Julienne Narrows. Dumbell Stream and Pumphouse Stream are small streams in which conductivity values responded to increases in stage with corresponding decreases in values.
- For the minimum dissolved oxygen CCME Water Quality Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l, the majority of values at the two Wabush Lake stations were above the guideline. At Dumbell Stream, all values were above this guideline. At Pumphouse Stream, the majority of values were below this guideline.
- All values were above the dissolved oxygen CCME Water Quality Guideline for the Protection of Aquatic Life for Cold water Biota at Other Life Stages of 6.5 mg/l at all stations.
- Turbidity values varied greatly between the two Wabush Lake stations with values remaining lower at Dolomite road. From August to September, there were a number of turbidity spikes at Dolomite Road, the cause for this is unknown.
- Turbidity at Dumbell Stream remained at 0.0 NTU for the majority of the season.
- There was some level of turbidity constantly at Pumphouse Stream. Values were all above 4 NTU.

Path Forward

- All field instruments will undergo Proficiency, Testing, and Evaluation (PTE) during the winter of 2018-2019. MAE will inform IOC of any instrument performance issues.
- MAE staff will deploy real time water quality instruments in spring 2019 when ice conditions allow and perform regular site visits throughout the 2019 deployment season for calibration and maintenance of the instruments.
- If necessary, deployment techniques will be evaluated and adapted to each site, ensuring secure and suitable conditions for RTWQ monitoring.
- MAE will update IOC staff on any changes to procedures with handling, maintenance and calibration of the real-time instruments.
- MAE will continue to work on its Automatic Data Retrieval System, to incorporate new capabilities in data management and data display.
- Open communication will continue to be maintained between MAE, ECCC and IOC employees involved with the agreement, in order to respond to emerging issues on a proactive basis.
- IOC will continue to be informed of data trends and any significant water quality events in the form of email and/or monthly deployment reports, when the deployment season begins. IOC will also receive an annual report, summarizing the events of the deployment season.

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Appendix 1

**Average Daily Air Temperature and Precipitation: Moosehead Lake, NL
June 13 to October 17, 2018**

