

Real-Time Water Quality Annual Report

Iron Ore Company of Canada
Labrador West Network

June 15 to
October 14, 2021



Newfoundland
Labrador

Government of Newfoundland & Labrador
Department of Environment & Climate Change
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 Environment & Climate Change (ECC).

Various individuals from each sector have been diligently involved to ensure this program is a successful operation including: various WRMD staff (ECC), 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 (ECC) was responsible for these water quality stations during 2021. Responsibilities included deployment and removal of instruments, maintenance and calibration of the instruments and preparation of monthly deployment reports. Brenda Congram, Jason Barnes and Kyla Brake (ECC) are acknowledged for their assistance during deployment and removal procedures in 2021. Tara Clinton and Leona Hyde are acknowledged for their role in performing Performance Testing and Evaluation (PTE) and in-house servicing of the instruments during winter 2021-2022.

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 transmission 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 in a partnership between the Newfoundland & Labrador Department of Environment, Climate Change & Municipalities (ECCM) 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.

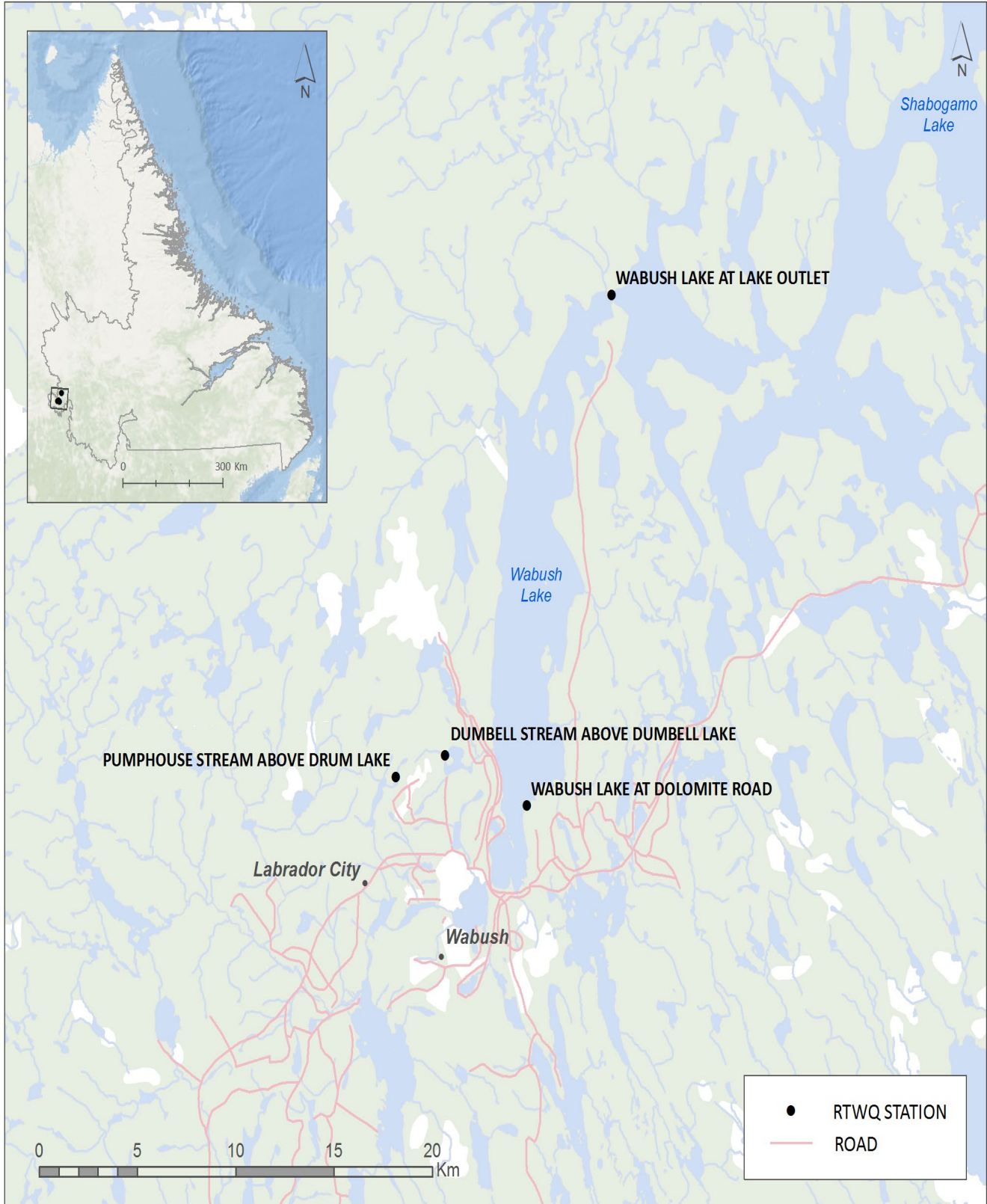


Figure 1: RTWQ Monitoring Stations in Labrador West

- Initial deployment in 2021 was between June 15th - 16th and instruments were removed for the winter season by October 13th at Dolomite Road, Julienne Narrows and Dumbell Stream, and October 14th, 2021 at Pumphouse Stream. The following report depicts and discusses water quality events throughout this time period.
- The purpose of this network is to monitor, process, and distribute water quality/quantity data to IOC, ECC 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.
- ECC 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, ECC staff carefully calibrate each sensor attachment for pH, specific conductivity, dissolved oxygen and turbidity.
- Installation and removal dates for the 2021 season are summarized in the table below.

Table 1: Water quality instrument deployment start and end dates for 2021

<i>Installation</i>	<i>Removal</i>	<i>Deployment duration (days)</i>
June 15-16	July 28-29	43
July 28-29	September 7-9	41-43
September 7-9	October 13-14	34-36

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 two deployment periods from June 15 to October 13-14, 2021 are summarized in Table 3.
- For additional information and explanations of ranking, please refer to the monthly deployment reports.

Table 3: Comparison rankings for IOC RTWQ stations June 15 to October 13-14, 2021

<i>Station</i>	<i>Date</i>		<i>Temperature</i>	<i>pH</i>	<i>Specific Conductivity</i>	<i>Dissolved Oxygen</i>	<i>Turbidity</i>
Dolomite Road	15-Jun-21	Deployment	Good	Excellent	Excellent	Good	Excellent
	28-Jul-21	Removal	Good	Excellent	Good	Good	Excellent
	28-Jul-21	Deployment	Good	Good	Excellent	Excellent	Excellent
	7-Sep-21	Removal	Good	Good	Excellent	Good	Excellent
	7-Sep-21	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	13-Oct-21	Removal	Excellent	Good	Good	Excellent	Excellent
Julienne Narrows	15-Jun-21	Deployment	Good	Excellent	Excellent	Excellent	Good
	28-Jul-21	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
	28-Jul-21	Deployment	Good	Good	Excellent	Excellent	Excellent
	9-Sep-21	Removal	Good	Good	Good	Excellent	Excellent
	9-Sep-21	Deployment	Good	Good	Excellent	Excellent	Excellent
	13-Oct-21	Removal	Excellent	Good	Good	Excellent	Excellent
Dumbell Stream	15-Jun-21	Deployment	Good	Excellent	Excellent	Good	Excellent
	28-Jul-21	Removal	Good	Good	Excellent	Good	Excellent
	28-Jul-21	Deployment	Good	Good	Excellent	Marginal	Excellent
	9-Sep-21	Removal	Good	Good	Excellent	Fair	Excellent
	9-Sep-21	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	13-Oct-21	Removal	Excellent	Excellent	Excellent	Good	Excellent
Pumphouse Stream	15-Jun-21	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	28-Jul-21	Removal	Fair	Good	Excellent	Good	Excellent
	28-Jul-21	Deployment	Excellent	Good	Excellent	Good	Excellent
	8-Sep-21	Removal	Excellent	Good	Good	Excellent	Excellent
	8-Sep-21	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	14-Oct-21	Removal	Excellent	Poor	Good	Excellent	Excellent

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from June 15th to October 13th, 2021 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.

Wabush Lake Network

- Water temperature ranged from 6.30 to 21.80°C at Julienne Narrows during the 2021 deployment season. The median value was 13.70 °C (Figure 2).
- Water temperature ranged from 8.70 to 21.50°C at Dolomite Road during the 2021 deployment season. The median value was 15.50 °C (Figure 2).
- Water temperature steadily decreases after the middle of August and correlates to air temperature. Water temperature is typically higher at Dolomite Road than Julienne Narrows.

**Water and Air Temperature: Wabush Lake Network
June 15 to October 13, 2021**

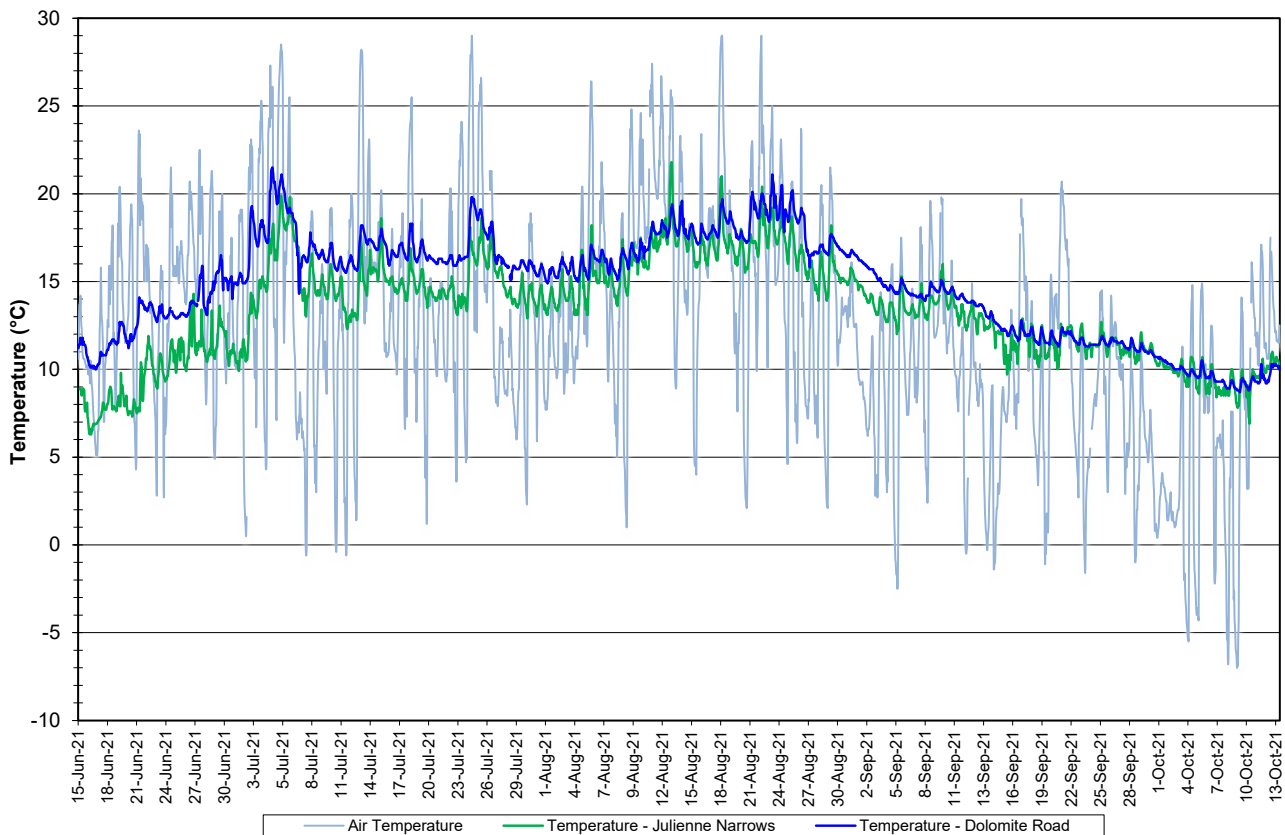


Figure 2: Water and Air Temperature – Wabush Lake Network

- pH ranged from 7.50 to 8.44 pH units at Julienne Narrows and from 7.06 to 8.27 pH units at Dolomite Road (Figure 3) during the 2021 deployment season. The median pH was 7.90 and 7.59 units respectively.
- pH fluctuates daily at both stations. Peaks are observed during late afternoon and early evening. Some decreases in pH are noted when there are increases in stage.
- 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).
- At both stations, there is a slight increase during July and August. pH decreases in September at Dolomite Road.

**Water pH and Stage: Wabush Lake Network
June 15 to October 13, 2021**

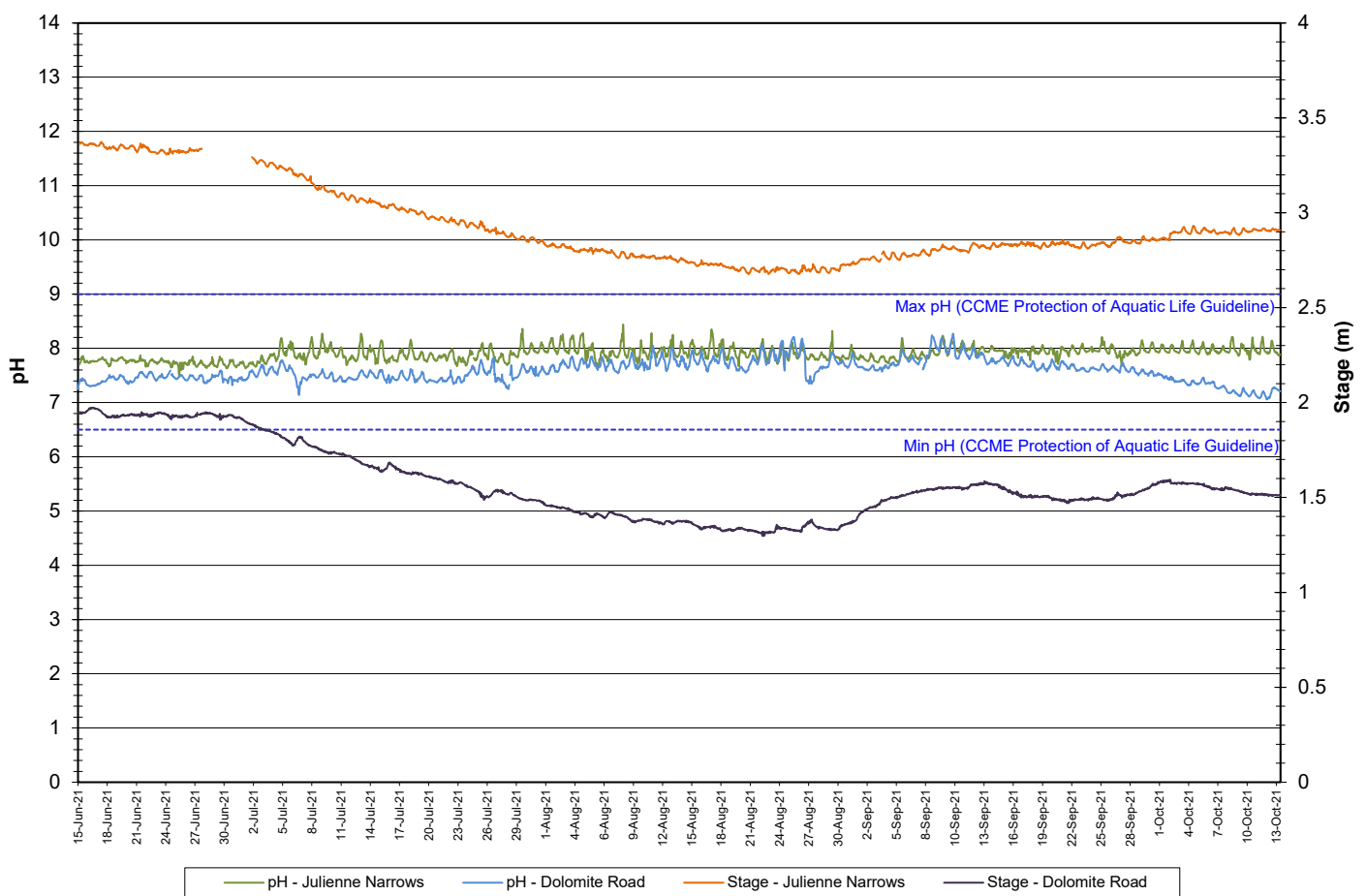


Figure 3: Water pH and Stage – Wabush Lake Network

- Throughout the 2021 deployment season, specific conductivity ranged from 54.6 to 110.6 $\mu\text{S}/\text{cm}$ at Julienne Narrows and from 42.1 to 82.2 $\mu\text{S}/\text{cm}$ 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 throughout the deployment period.
- At Dolomite Road, conductivity increases gradually during the beginning of the deployment season and decreases slightly during the last month of the season. There is greater fluctuation during the first two weeks of August.
- Stage decreases at both stations into September before increasing for the remainder of the 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 and Stage: Wabush Lake Network
June 15 to October 13, 2021**

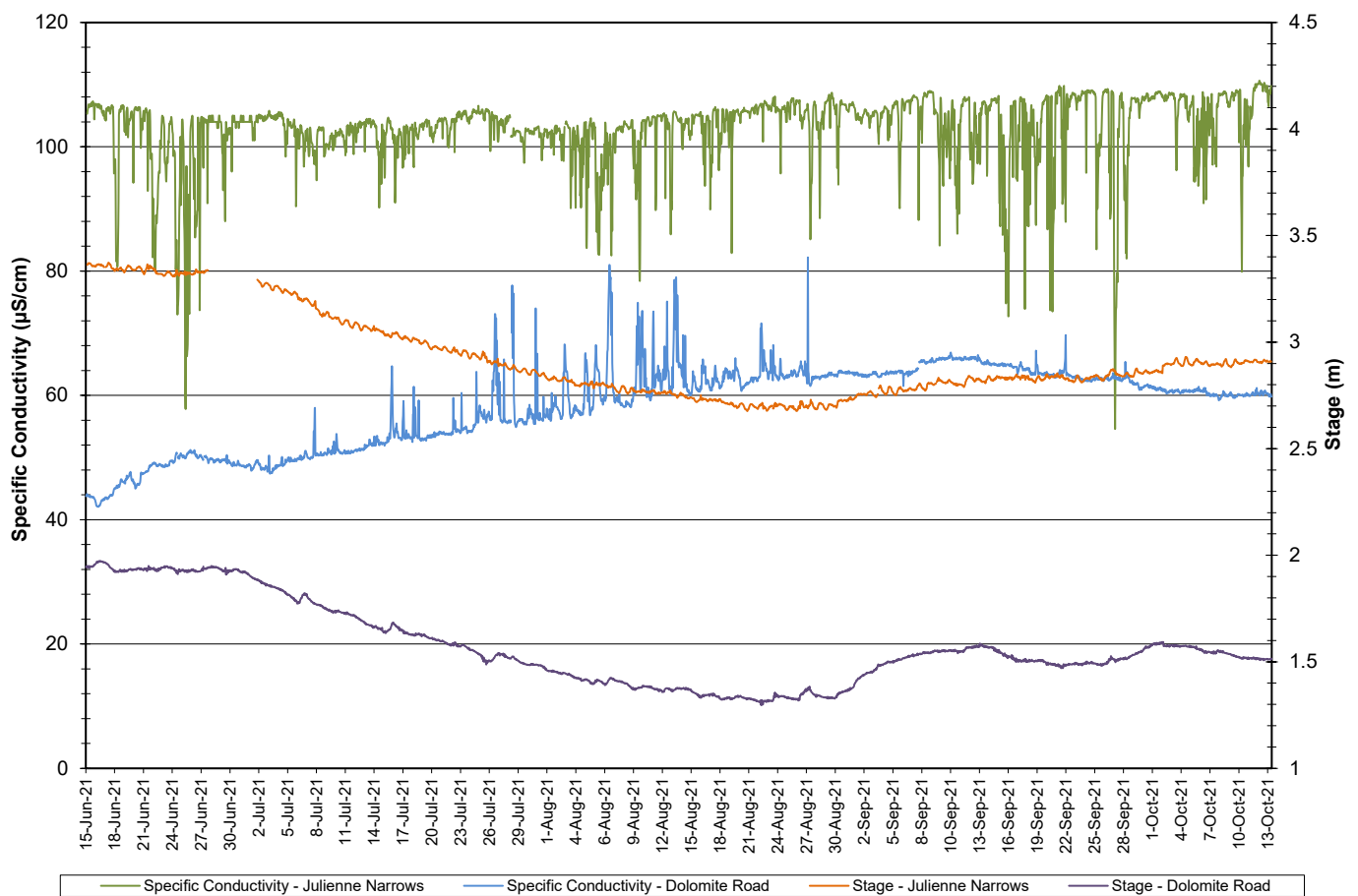


Figure 4: Specific Conductivity and Stage – Wabush Lake Network

- Dissolved oxygen ranged from 82.5 to 113.9% saturation and 8.10 to 11.69 mg/l with a median value of 9.68 mg/L at Julienne Narrows (Figure 5).
- Dissolved oxygen ranged from 79.9 to 110.20% saturation and 7.79 to 10.68 mg/l with a median value of 9.26 mg/L at Dolomite Road (Figure 5).
- Dissolved oxygen fluctuated daily at both stations with decreases observed at night.
- Dissolved oxygen decreases until the end of August, when water temperatures are at their warmest. It then increases, as water temperature decreases into the 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 15 to October 13, 2021**

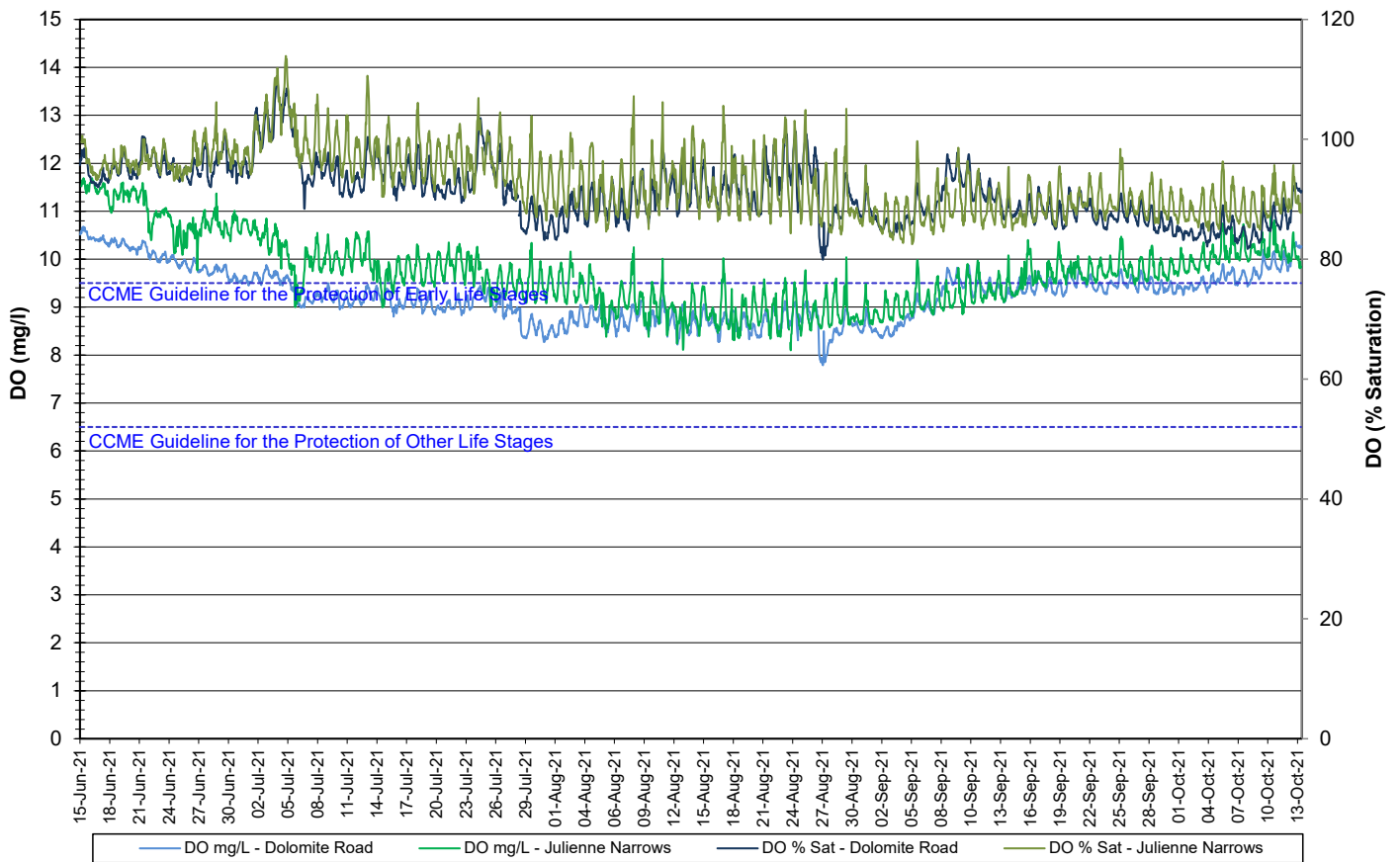


Figure 5: Dissolved Oxygen and Percent Saturation – Wabush Lake Network

- At the Julienne Narrows station, turbidity values ranged from 0.0 to 902.0 NTU with a median value of 0.0 NTU (Figure 6a) indicating low background turbidity.
- There are occasional large spikes in turbidity during this deployment season.

**Water Turbidity and Precipitation: Julienne Narrows
June 15 to October 13, 2021**

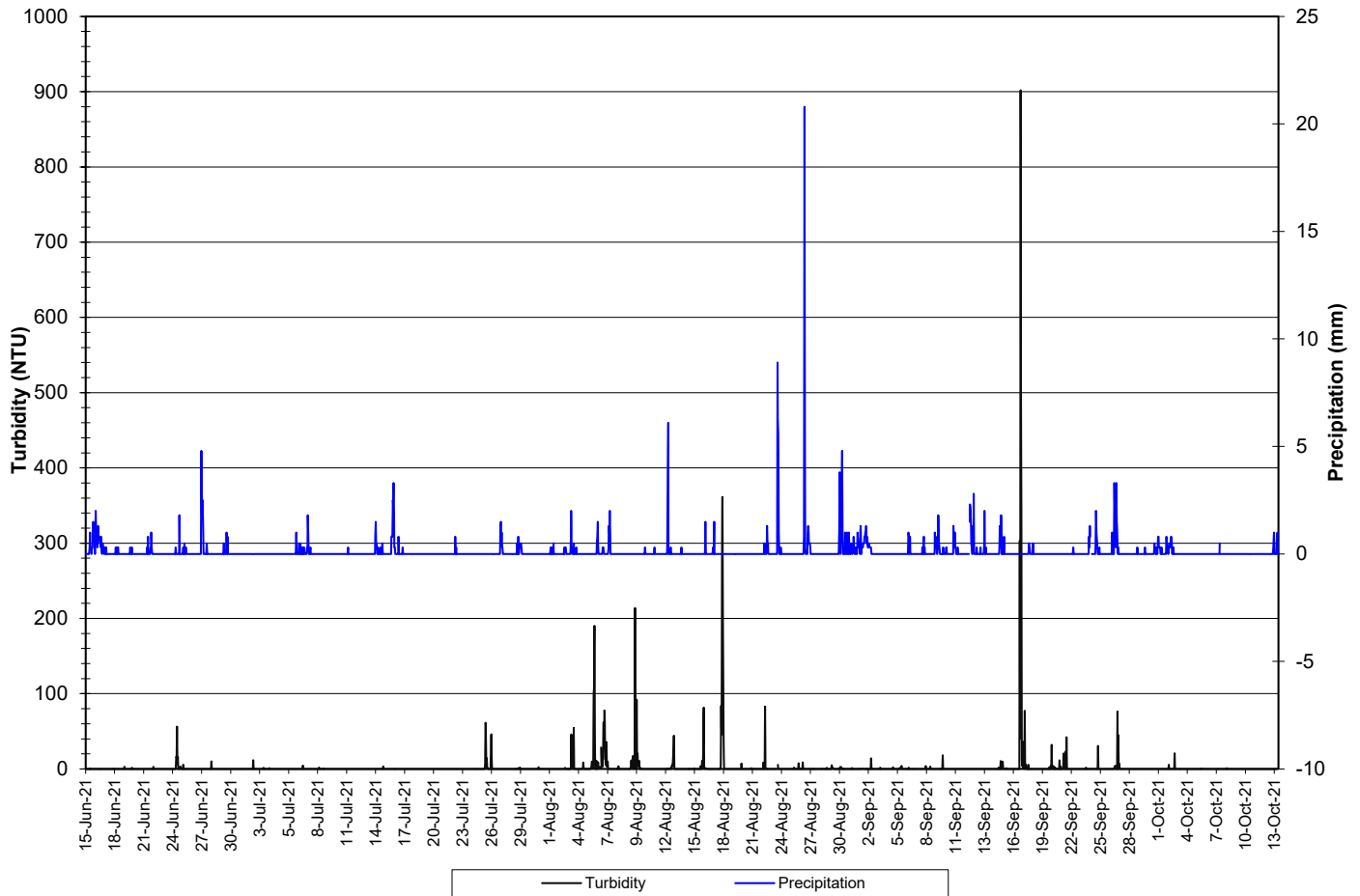


Figure 6a: Water Turbidity and Precipitation: Julienne Narrows

- At the Dolomite Road station, turbidity values ranged from 0.0 to 99.2 NTU, with a median value of 0.5 NTU (Figure 6b).
- Turbidity readings higher than 10 NTU occur occasionally and are of short duration.

**Turbidity and Precipitation : Dolomite Road
June 15 to October 13, 2021**

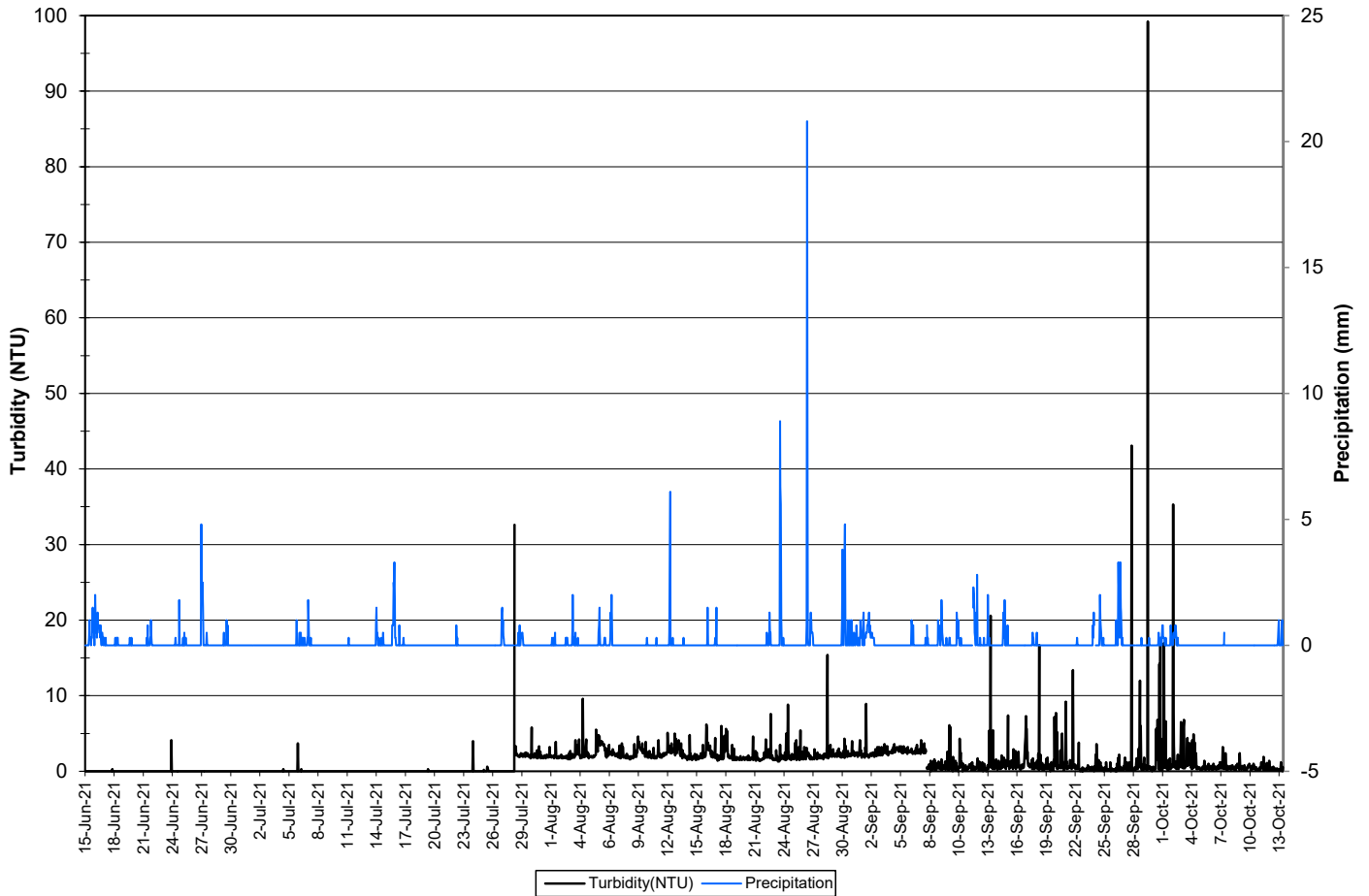


Figure 6b: Turbidity and Precipitation: Dolomite Road

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Julienne Narrows and Dolomite Road (Figure 7).
- At Julienne Narrows, stage decreases until the end of August, it then increases gradually until the end of the deployment season.
- At Dolomite Road, stage decreases until the end of August. It then increases overall for the remainder of the deployment season, with a slight decrease in September.
- 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 15 to October 13, 2021**

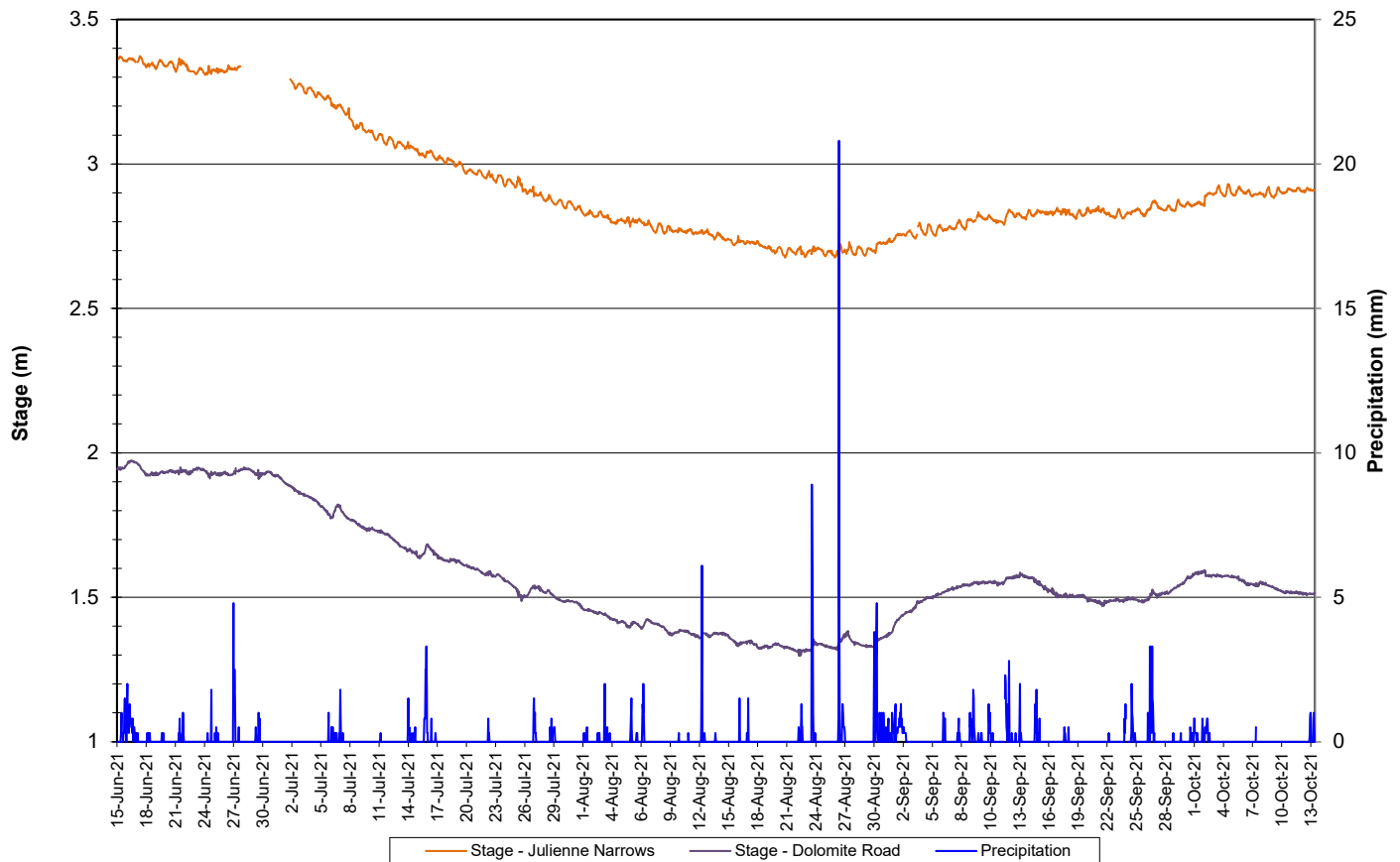


Figure 7: Stage and Precipitation: Wabush Lake Network

Dumbell Stream

- Water temperature ranged from 2.19 to 7.24°C at Dumbell Stream during the 2021 deployment season. The median value was 3.98 °C (Figure 8).
- 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 15 to October 13, 2021**

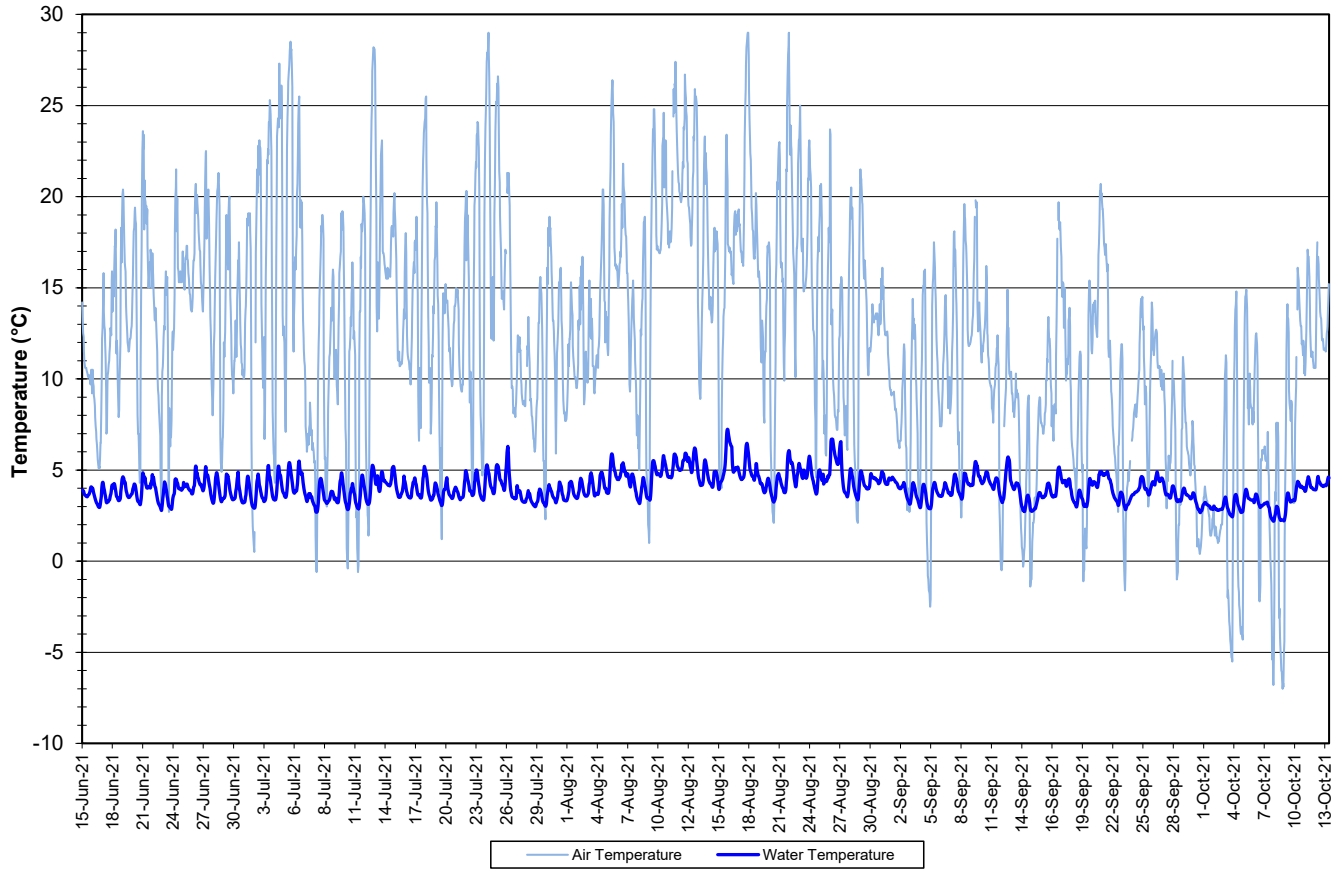


Figure 8: Water and Air Temperature – Dumbell Stream above Dumbell Lake

- pH ranges from 7.32 to 7.99 pH units at Dumbell Stream (Figure 9). The median pH is 7.62 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).
- pH is relatively stable during the deployment season until the sensor begins to show signs of failure and experiences sensor drift September 18th onwards.

**Water pH and Stage : Dumbell Stream above Dumbell Lake
June 15 to October 13, 2021**

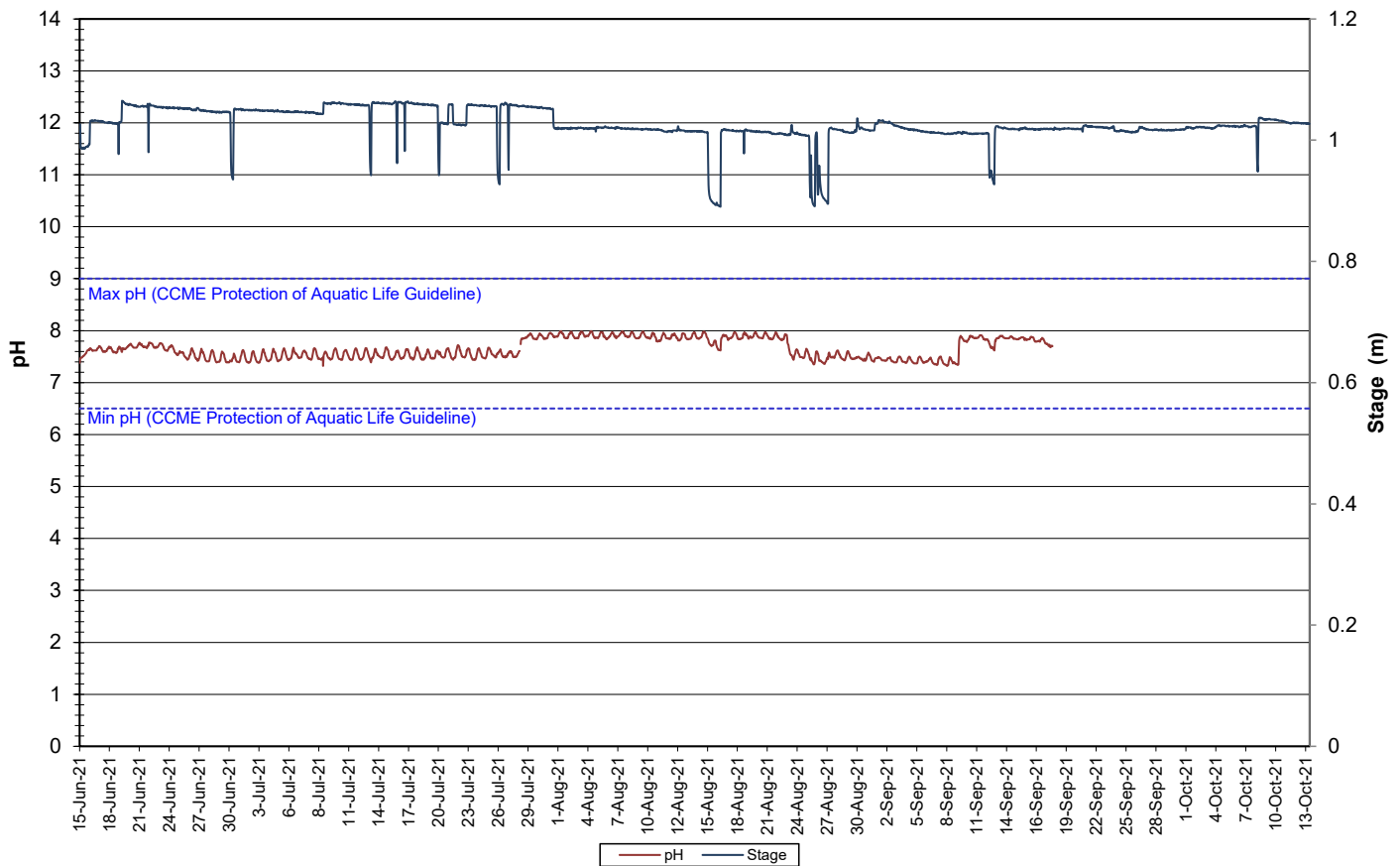


Figure 9: Water pH and Stage – Dumbell Stream above Dumbell Lake

- Throughout the 2021 deployment season, specific conductivity ranged from 84.7 to 183.7 $\mu\text{S}/\text{cm}$ at Dumbell Stream (Figure 10).
- 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 15 to October 13, 2021**

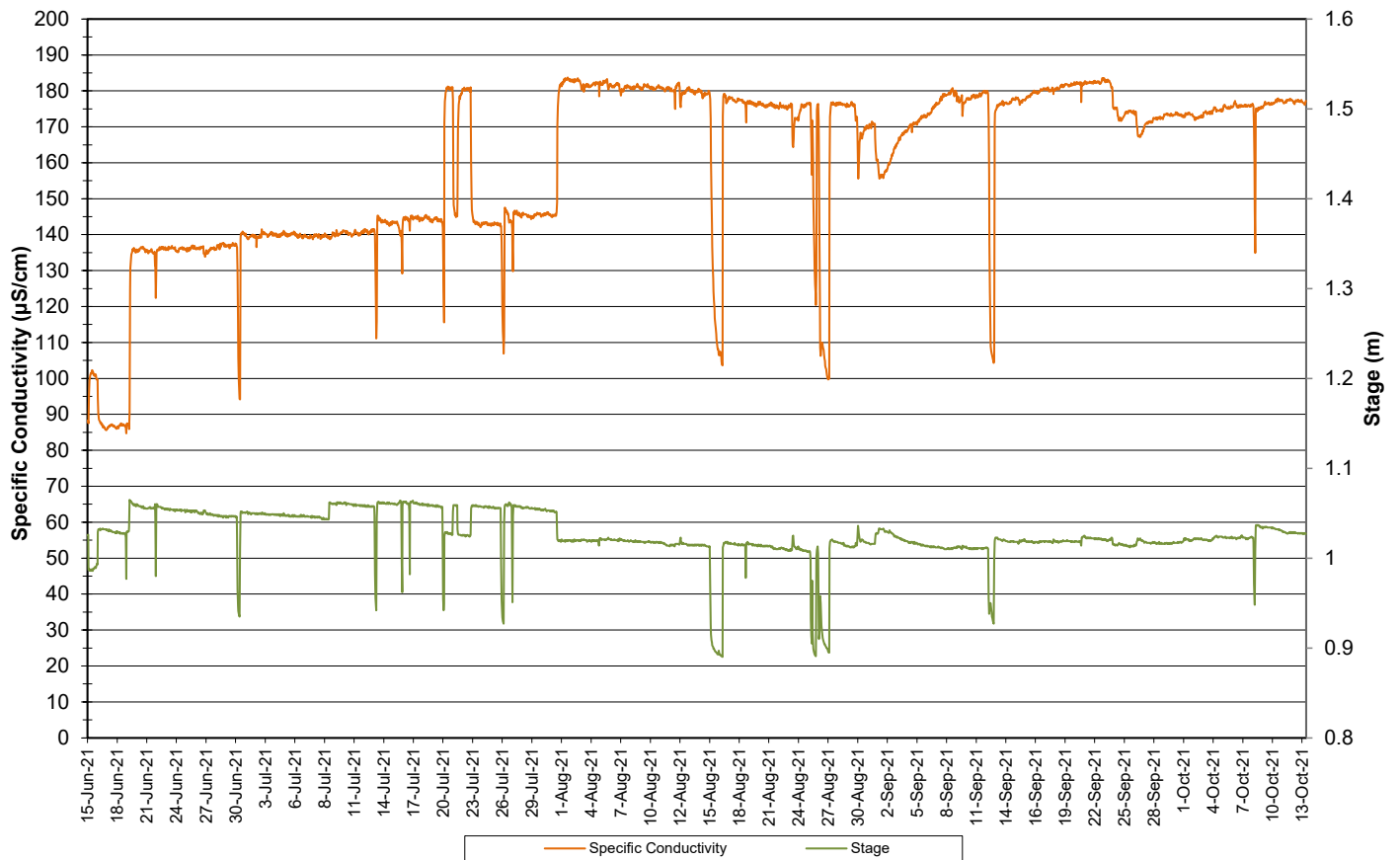


Figure 10: Specific Conductivity and Stage – Dumbell Stream above Dumbell Lake

- Dissolved oxygen ranged from 84.5 to 97.1% saturation and from 10.64 to 12.88 mg/l, with a median value of 12.14 mg/l (Figure 11).
- Dissolved oxygen fluctuated daily with decreases observed at night. Dissolved oxygen increased slightly at the end of the deployment season when water temperature was decreasing in the fall.
- Dissolved oxygen decreased slightly after the second deployment period. This could be due to a slight calibration error.
- 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 15 to October 13, 2021**

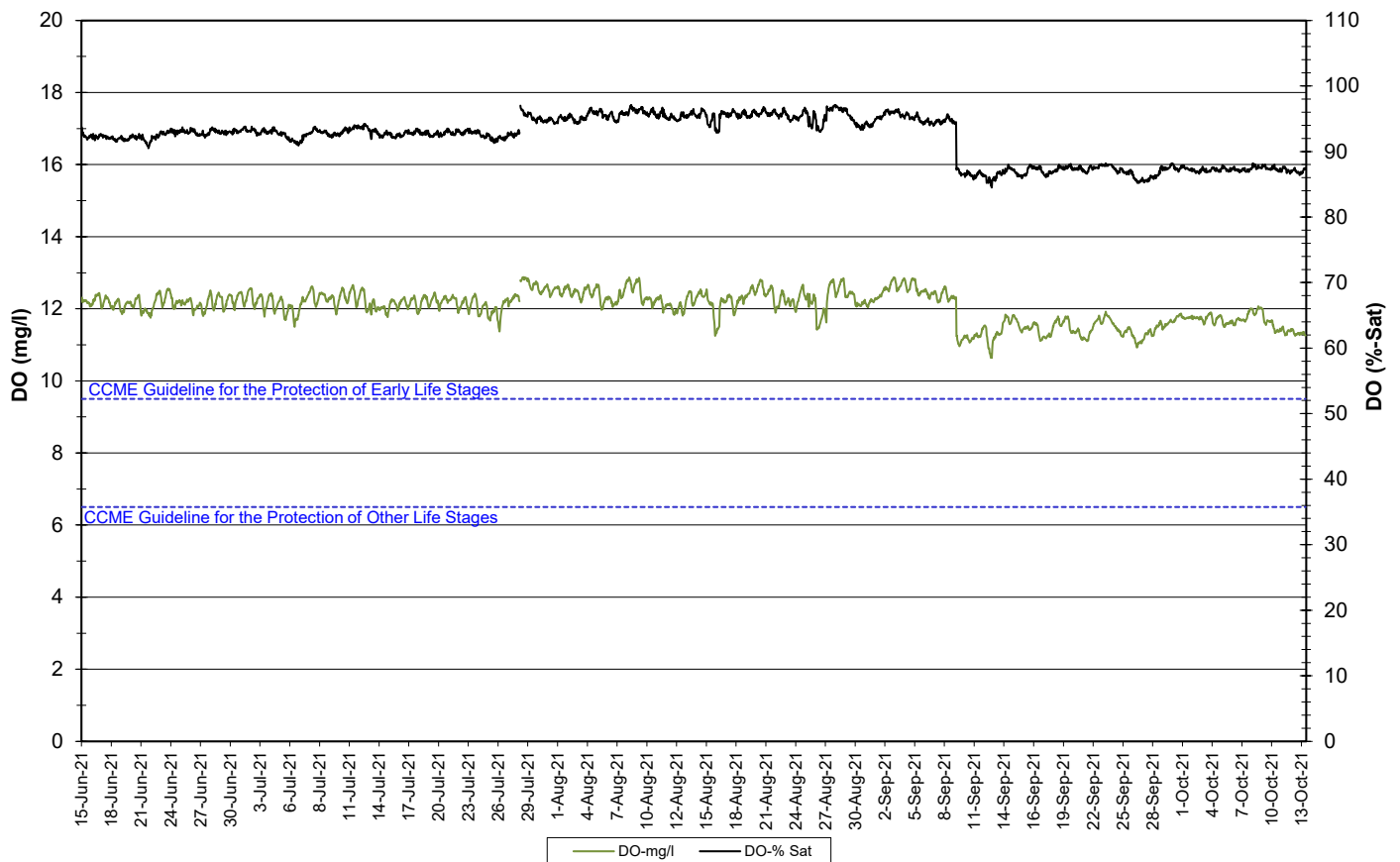


Figure 11: Dissolved Oxygen and Percent Saturation – Dumbell Stream above Dumbell Lake

- Turbidity values range from 0.0 to 31.7NTU, with a median value of 0.0 NTU (Figure 12) indicating very low background turbidity.
- Turbidity readings greater than 5 NTU occur occasionally and are of short duration.

**Water Turbidity and Precipitation : Dumbell Stream above Dumbell Lake
June 15 to October 13, 2021**

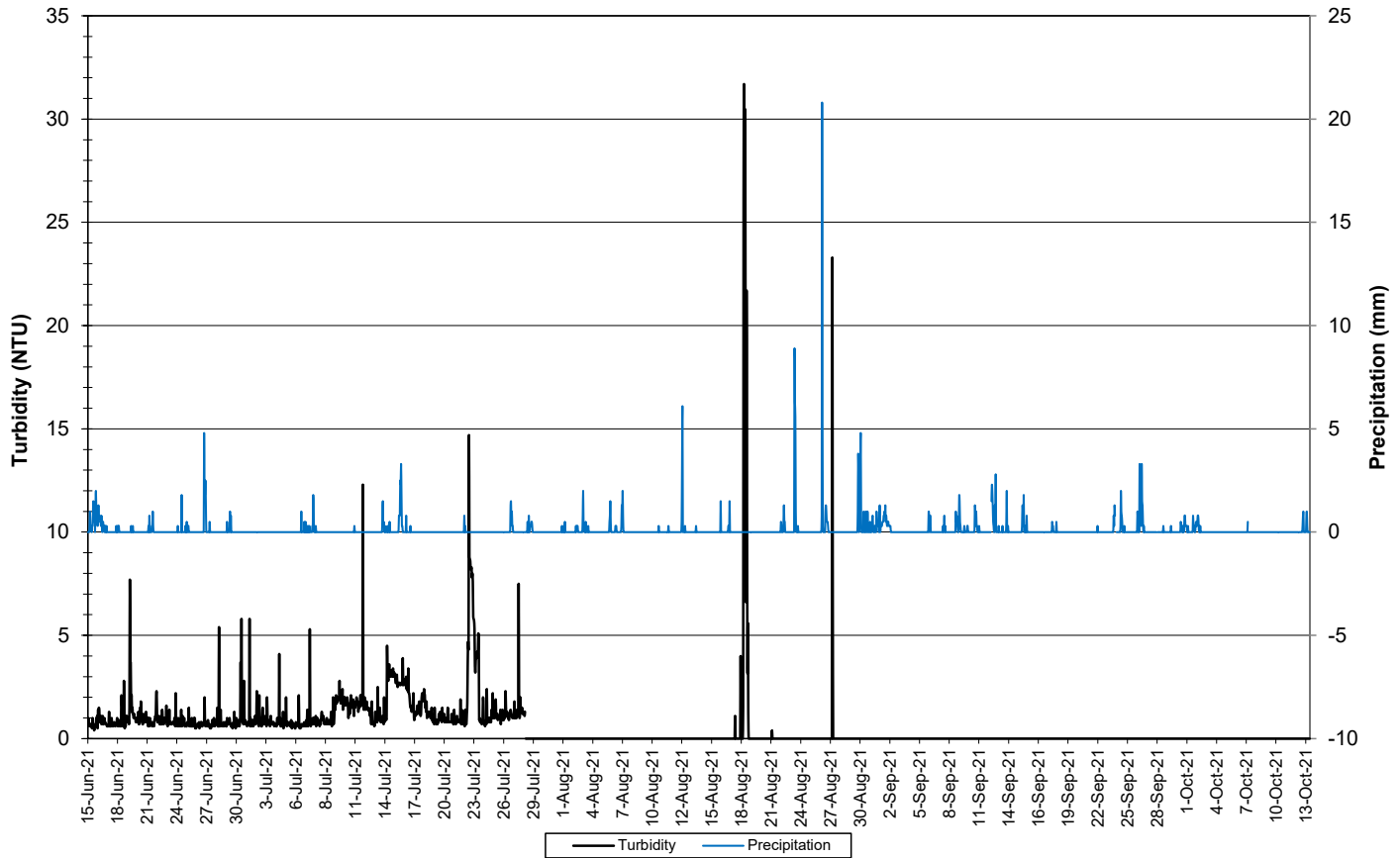


Figure 12: Turbidity and Precipitation – Dumbell Stream above Dumbell Lake

- 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.
- 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 15 to October 13, 2021**

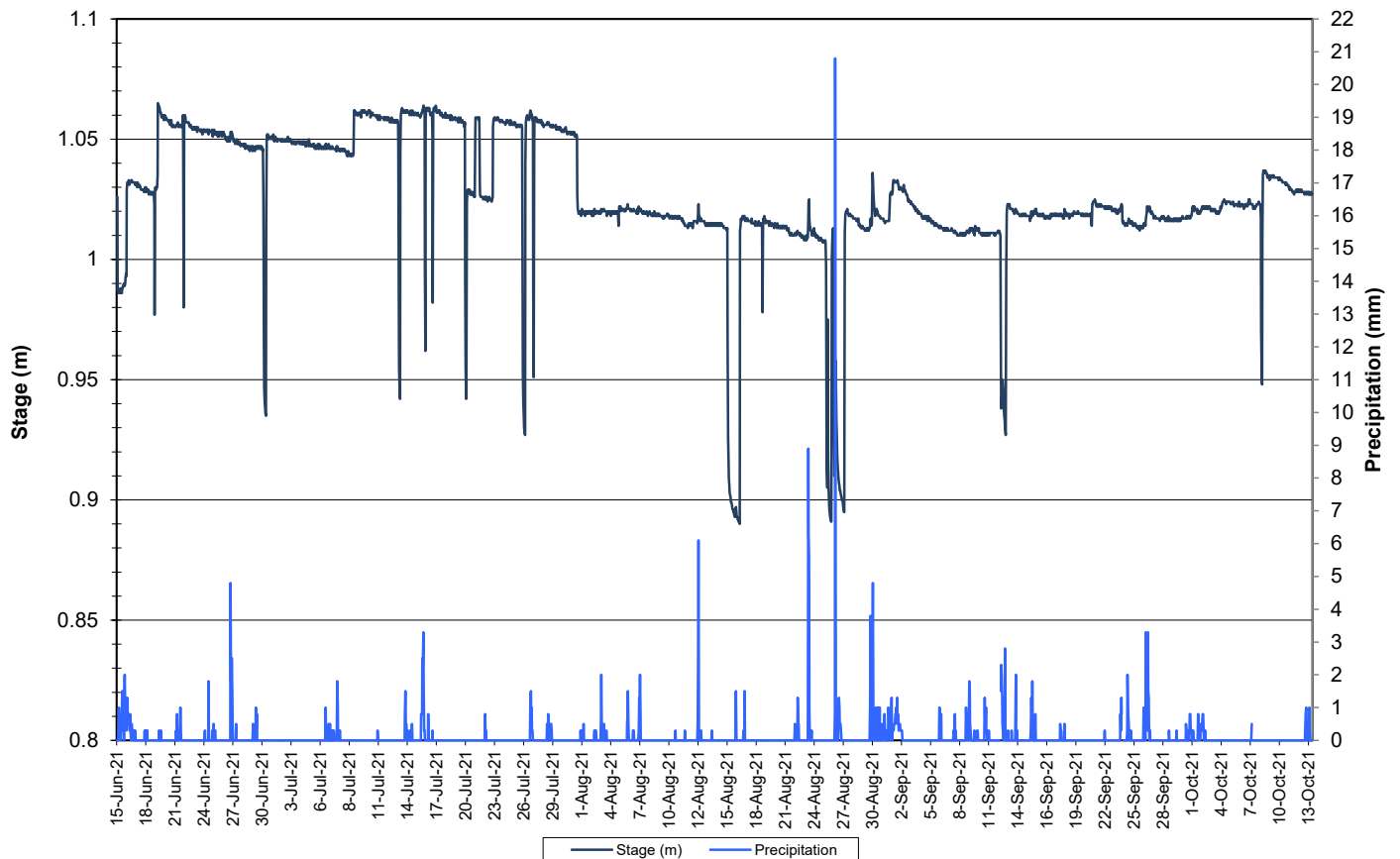


Figure 13: Stage and Precipitation – Dumbell Stream above Dumbell Lake

Pumphouse Stream

- Water temperature ranged from 2.70 to 19.30°C at Pumphouse Stream during the 2021 deployment season. The median value was 9.00°C (Figure 14).
- Water temperature corresponded closely with air temperature fluctuations, decreasing steadily after August as air temperature cooled in to the fall. There a slight increase during the last week of deployment, again, corresponding with air temperature.

**Water and Air Temperature : Pumphouse Stream above Drum Lake
June 16 to October 14, 2021**

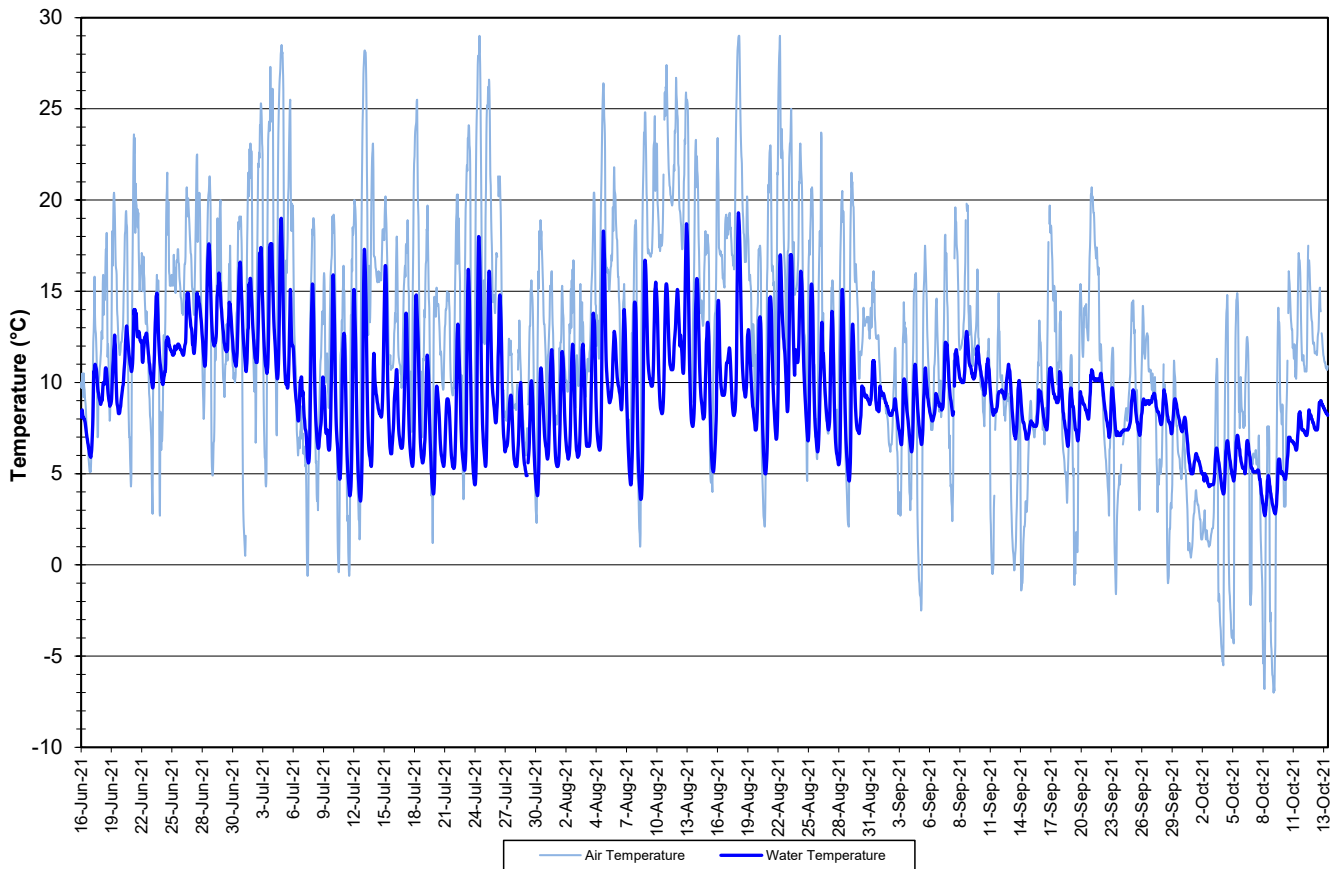


Figure 14: Water and Air Temperature – Pumphouse Stream above Drum Lake

- pH ranged from 6.84 to 7.87 pH units at Dumbell Stream (Figure 15). The median pH was 7.74 units.
- pH fluctuated daily. Peaks were observed during late afternoon into the early evening. pH decreases during rainfall events. The pH sensor failed during the last deployment period so the data was removed.
- 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).

**Water pH and Precipitation: Pumphouse Stream above Drum Lake
June 16 to October 14, 2021**

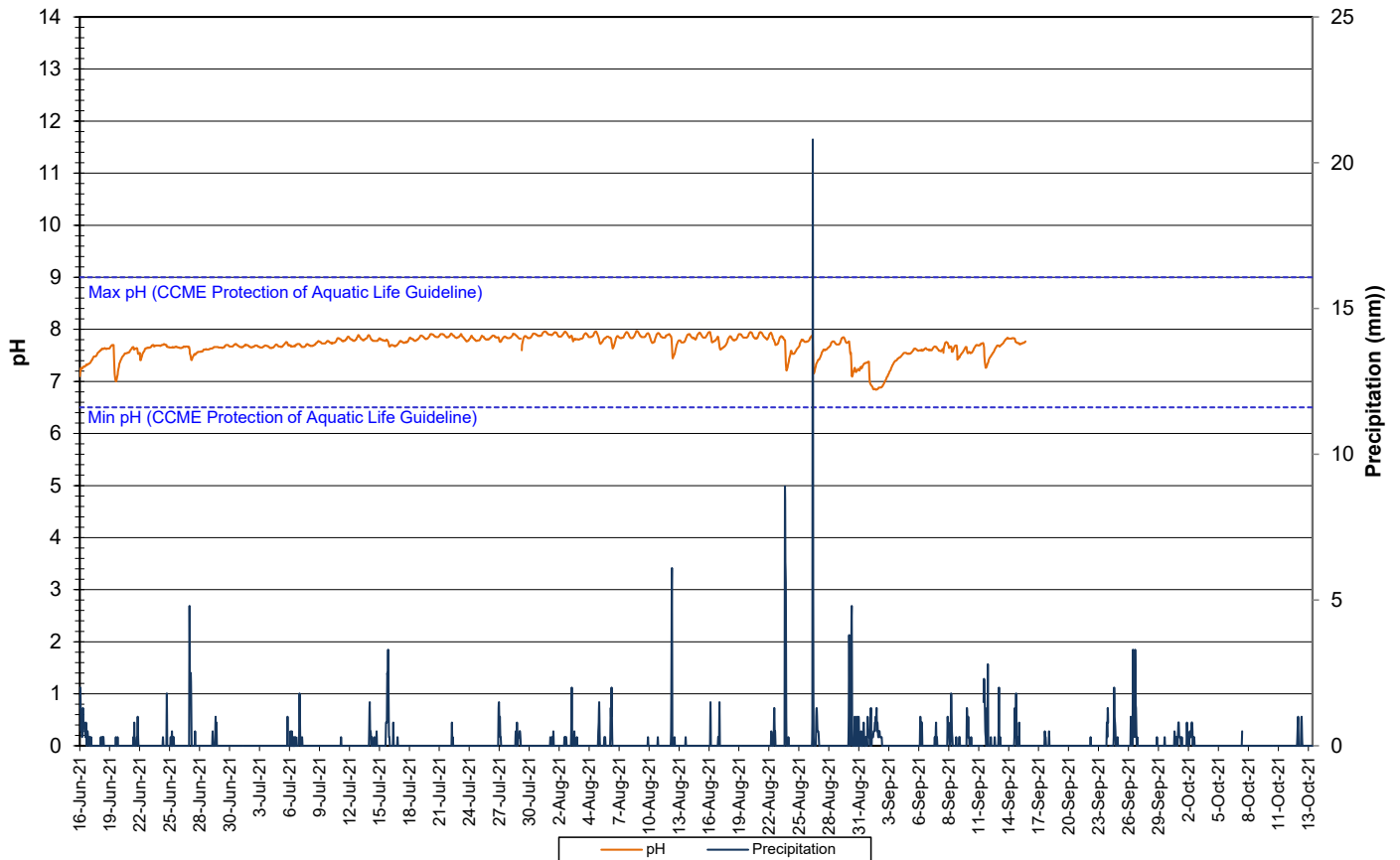


Figure 15: Water pH and Precipitation – Pumphouse Stream above Drum Lake

- Throughout the 2021 deployment season, specific conductivity ranged from 68.8 to 316.0 $\mu\text{S}/\text{cm}$ 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. Stage data was not available for a large portion of the deployment season, thus specific conductivity is graphed with precipitation.
- Overall, specific conductivity gradually decreases throughout the deployment season, with sharp decreases noted during increases in 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: Pumphouse Stream above Drum Lake
June 16 to October 14, 2021**

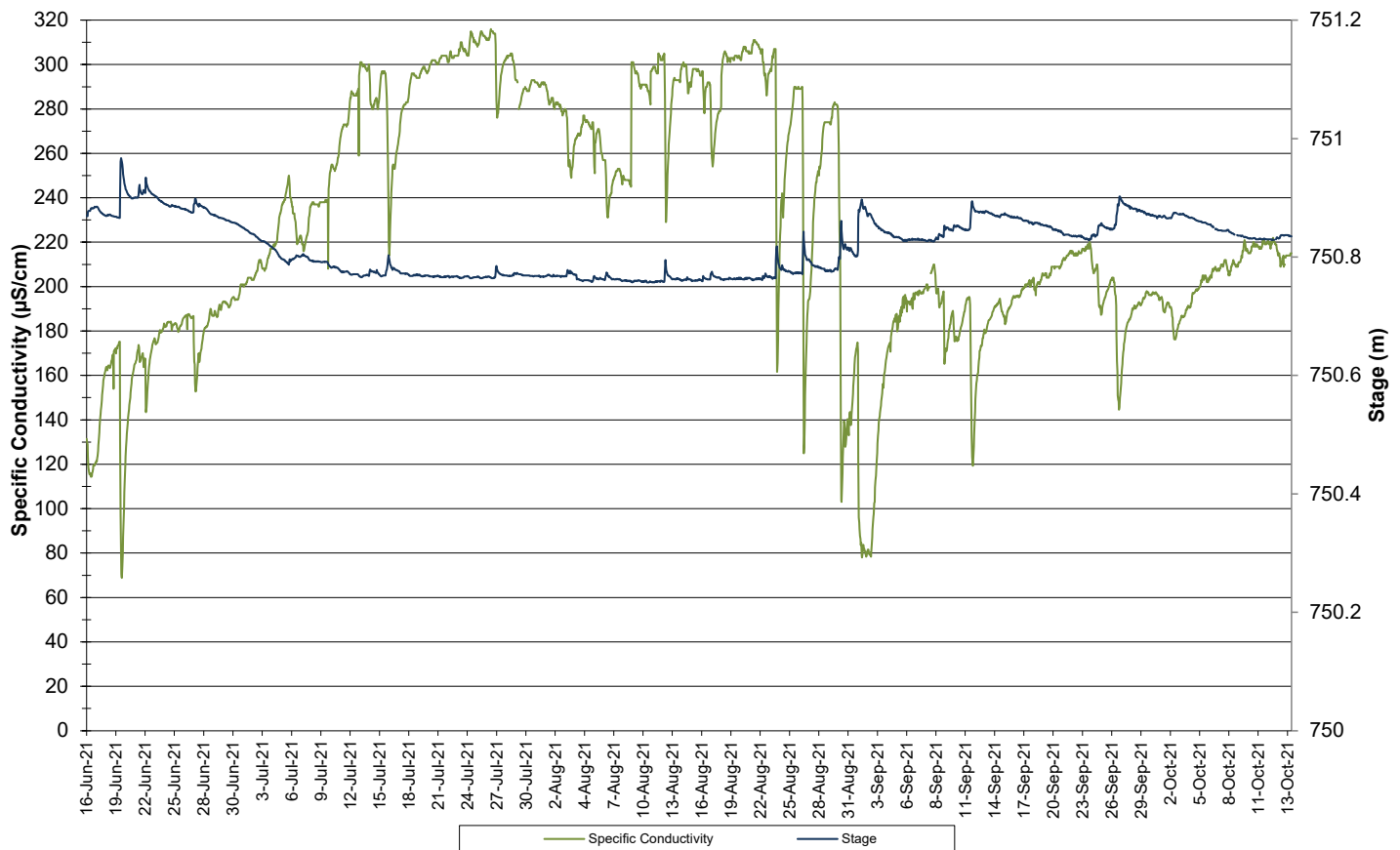


Figure 16: Specific Conductivity and Precipitation – Pumphouse Stream above Drum Lake

- Dissolved oxygen ranged from 70.2 to 97.8% saturation and 7.60 to 11.09 mg/l with a median value of 9.47 mg/l (Figure 17).
- Dissolved oxygen fluctuated daily with decreases observed at night.
- Dissolved oxygen displayed an inverse relationship to increases/decreases in water temperature.
- 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 17.

**Dissolved Oxygen Concentration & Saturation and Water Temperature:
Pumphouse Stream above Drum Lake
June 16 to October 14, 2021**

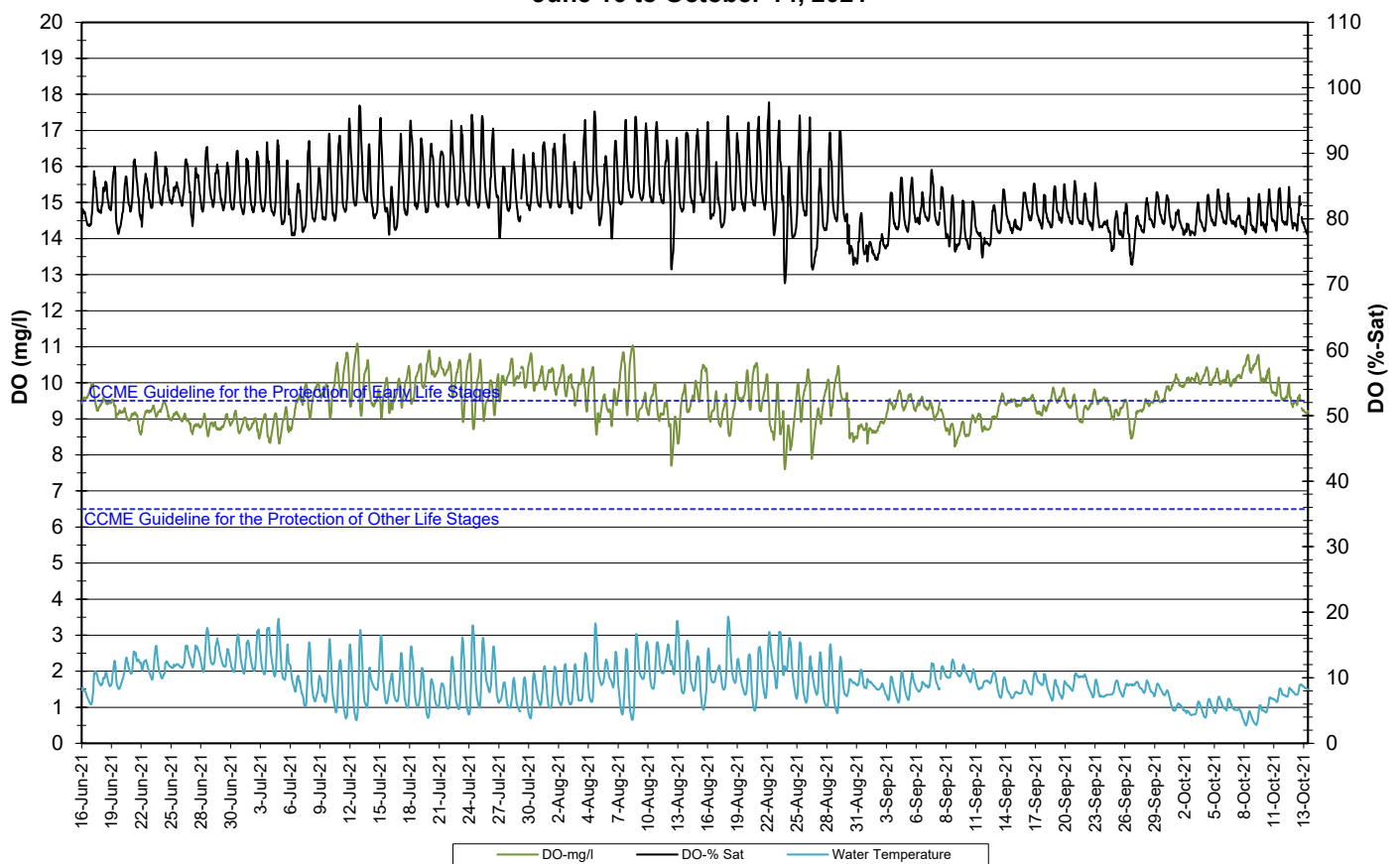


Figure 17: Dissolved Oxygen and Percent Saturation – Pumphouse Stream above Drum Lake

- Turbidity values range from 0.0 to 439.0 NTU, with a median value of 0.0 NTU (Figure 18a & 18b).
- The median turbidity value is 0.0 NTU, indicating that there is low background turbidity. There are a few large spikes, but turbidity values greater than 40.0 NTU occur infrequently and for short periods.

**Water Turbidity and Precipitation : Pumphouse Stream above Drum Lake
July 16 to October 29, 2020**

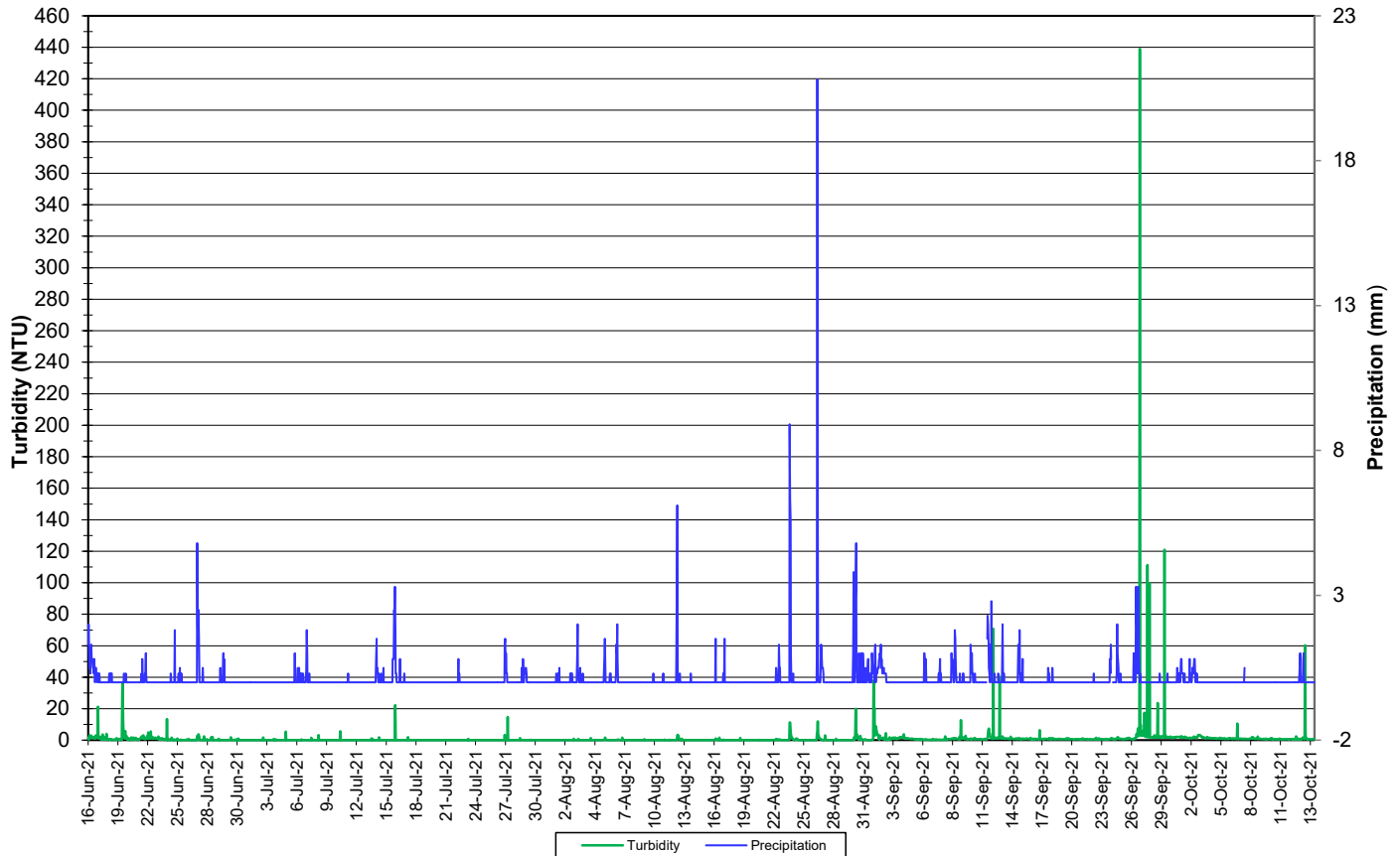


Figure 18a: Turbidity and Precipitation – Pumphouse Stream above Drum Lake

**Water Turbidity <50 NTU and Precipitation : Pumphouse Stream above Drum Lake
June 16 to October 14, 2021**

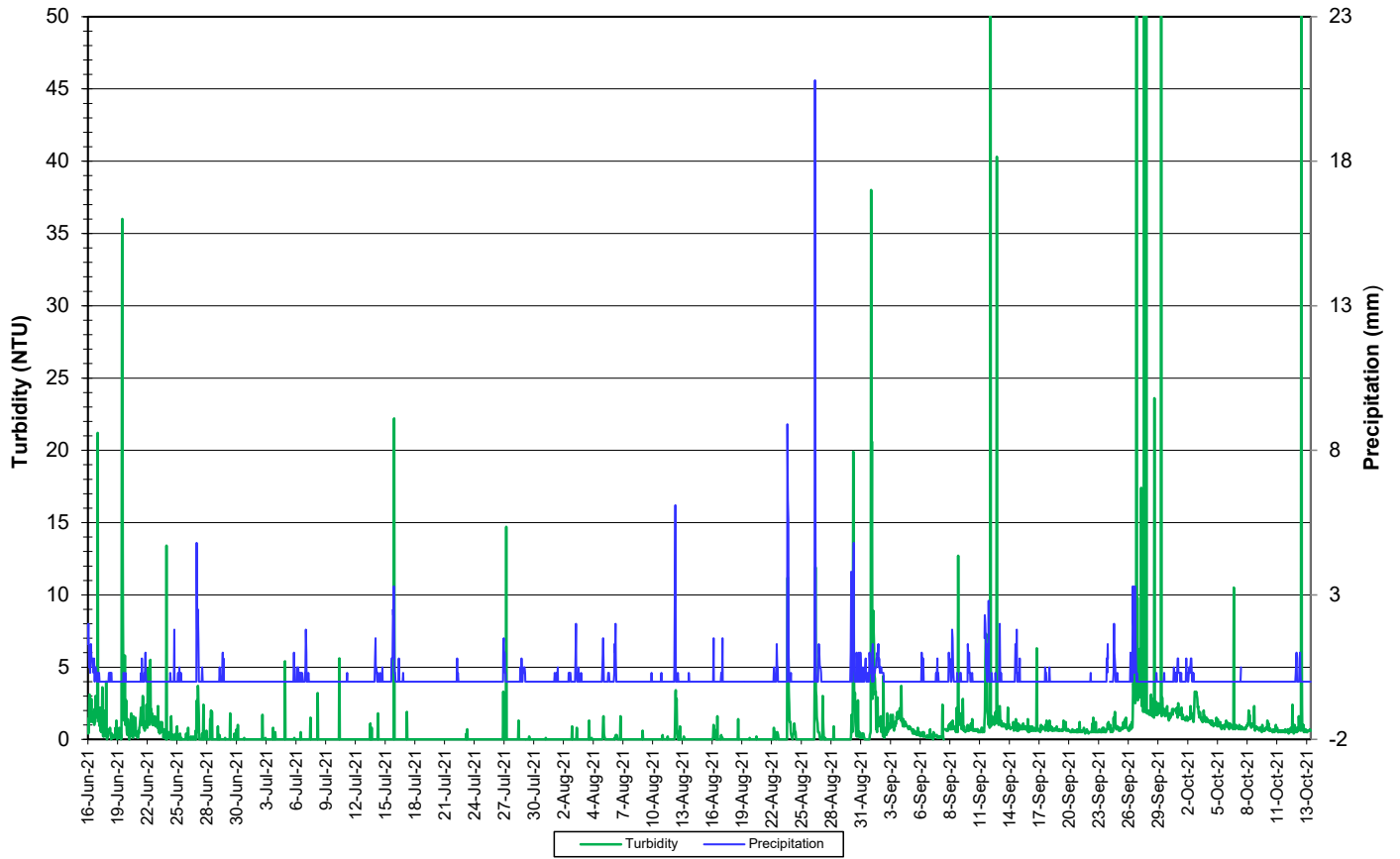


Figure 18b: Turbidity <50 NTU and Precipitation – Pumphouse Stream above Drum lake

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Dumbell Stream (Figure 19).
- Stage data shows slight increases 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 16 to October 14, 2021**

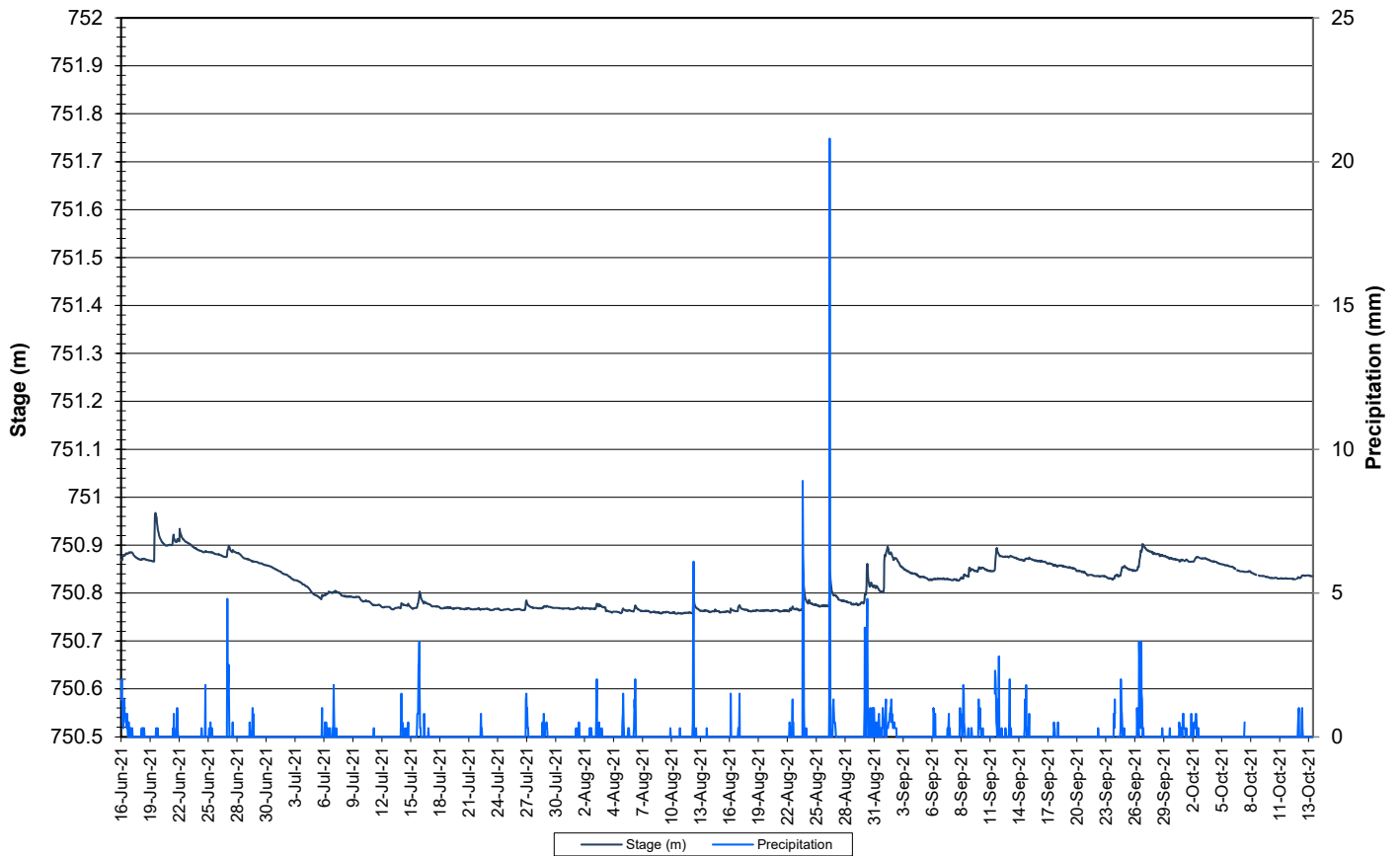


Figure 19: Stage and Precipitation – Pumphouse Stream above Drum Lake

Conclusions

- Instruments at the water quality monitoring stations in Labrador West were deployed on June 15th and removed on October 13-14th, 2021. They were then removed for the winter season.
- Instruments were deployed for periods of 34 to 43 days before maintenance and calibration.
- 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 2021 except for a few minor issues. These instruments will undergo PTE's during the winter.
- Water temperature followed the seasonal trend of increasing during the summer and decreasing into the fall. Water temperature was cooler at Dumbell Stream, but increases/decreases followed the same trends as air temperature.
- All pH values were within the acceptable range of the CCME Water Quality Guidelines for Protection of Aquatic Life. Some data was removed due to sensor drift.
- 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 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 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. Background turbidity levels at Dumbell Stream and Pumphouse Stream were both low, with median values of 0.0 NTU.

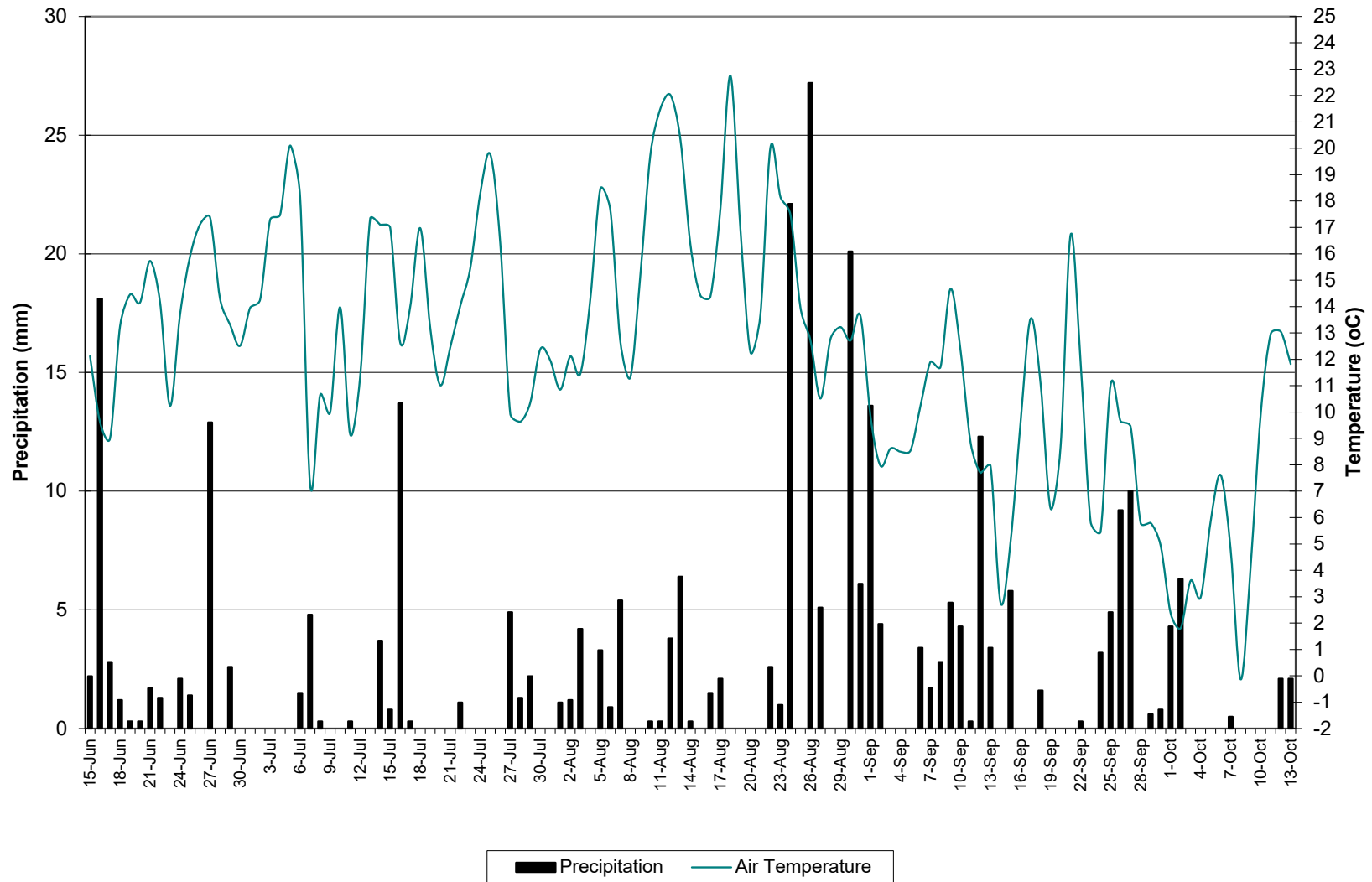
Path Forward

- All field instruments will undergo Performance Testing, and Evaluations (PTEs) during the winter of 2021-2022. ECC will inform IOC of any instrument performance issues.
- ECC staff will deploy real time water quality instruments in spring 2022 when ice conditions allow and perform regular site visits throughout the 2022 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.
- ECC will update IOC staff on any changes to procedures with handling, maintenance and calibration of the real-time instruments.
- ECC 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 ECC, 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

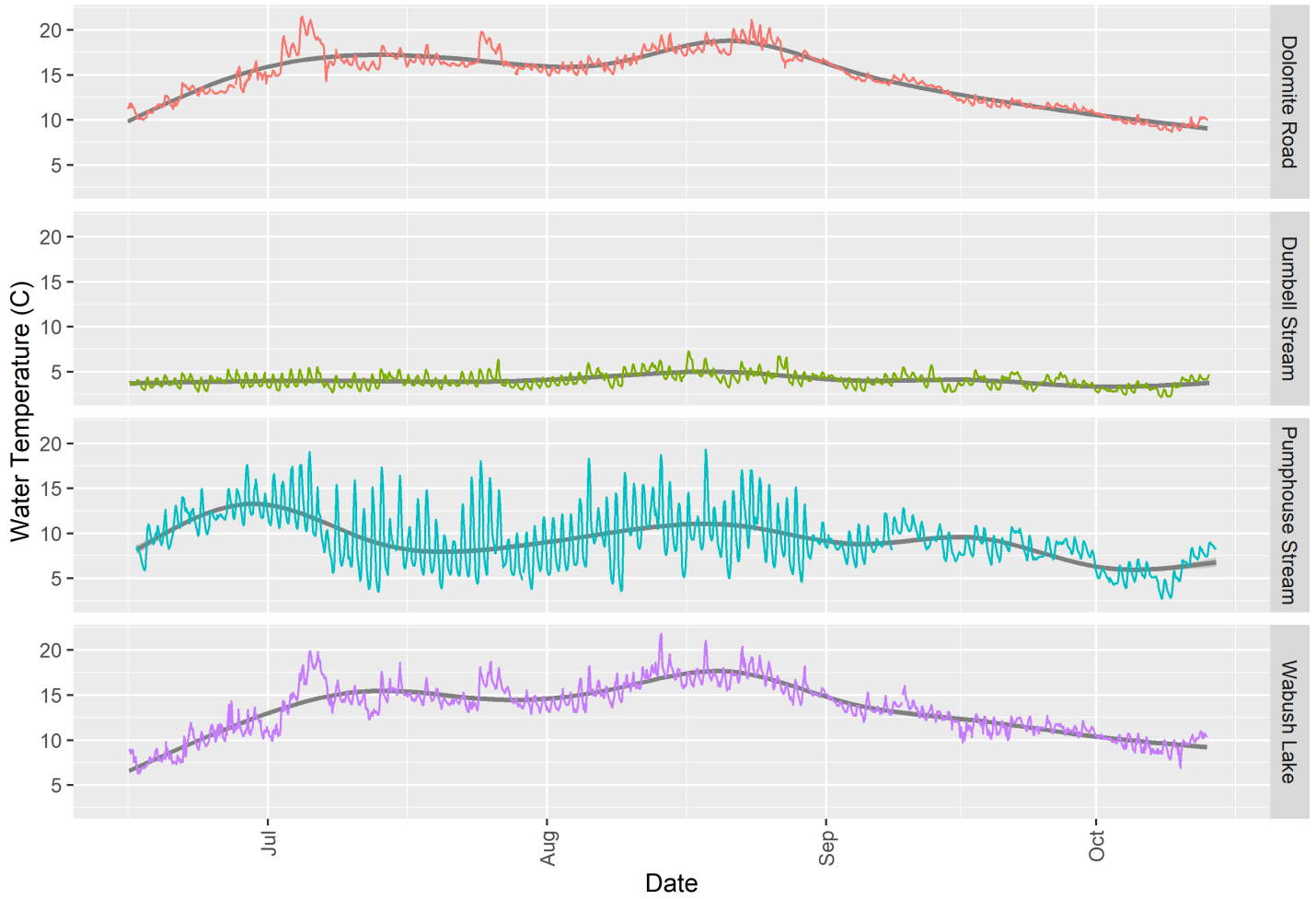
**Air Temperature and Precipitation: Moosehead Lake, NL
June 15 to October 13, 2021**



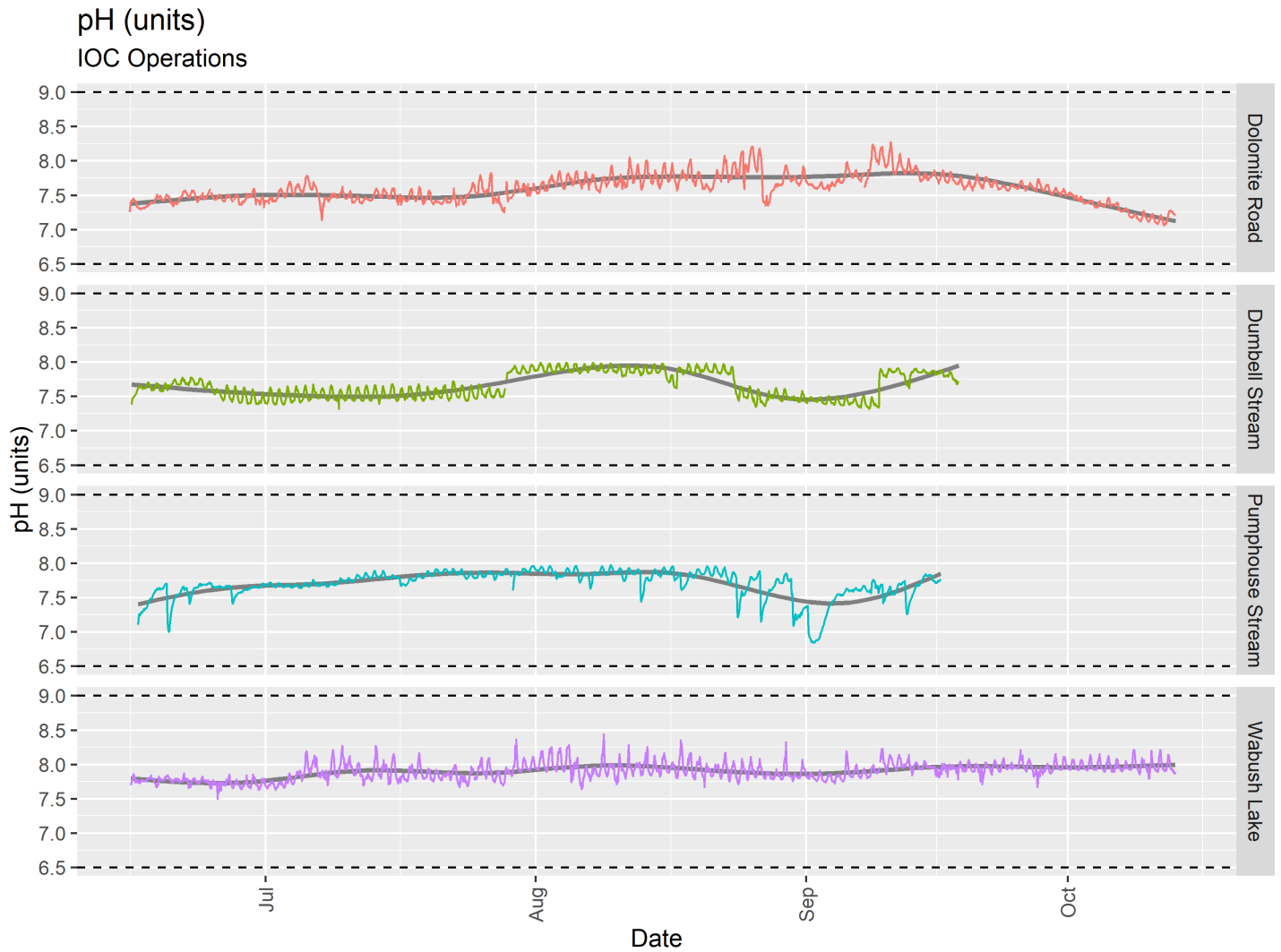
Appendix 2
Station to Station Quick View

Water Temperature (C)

IOC Operations



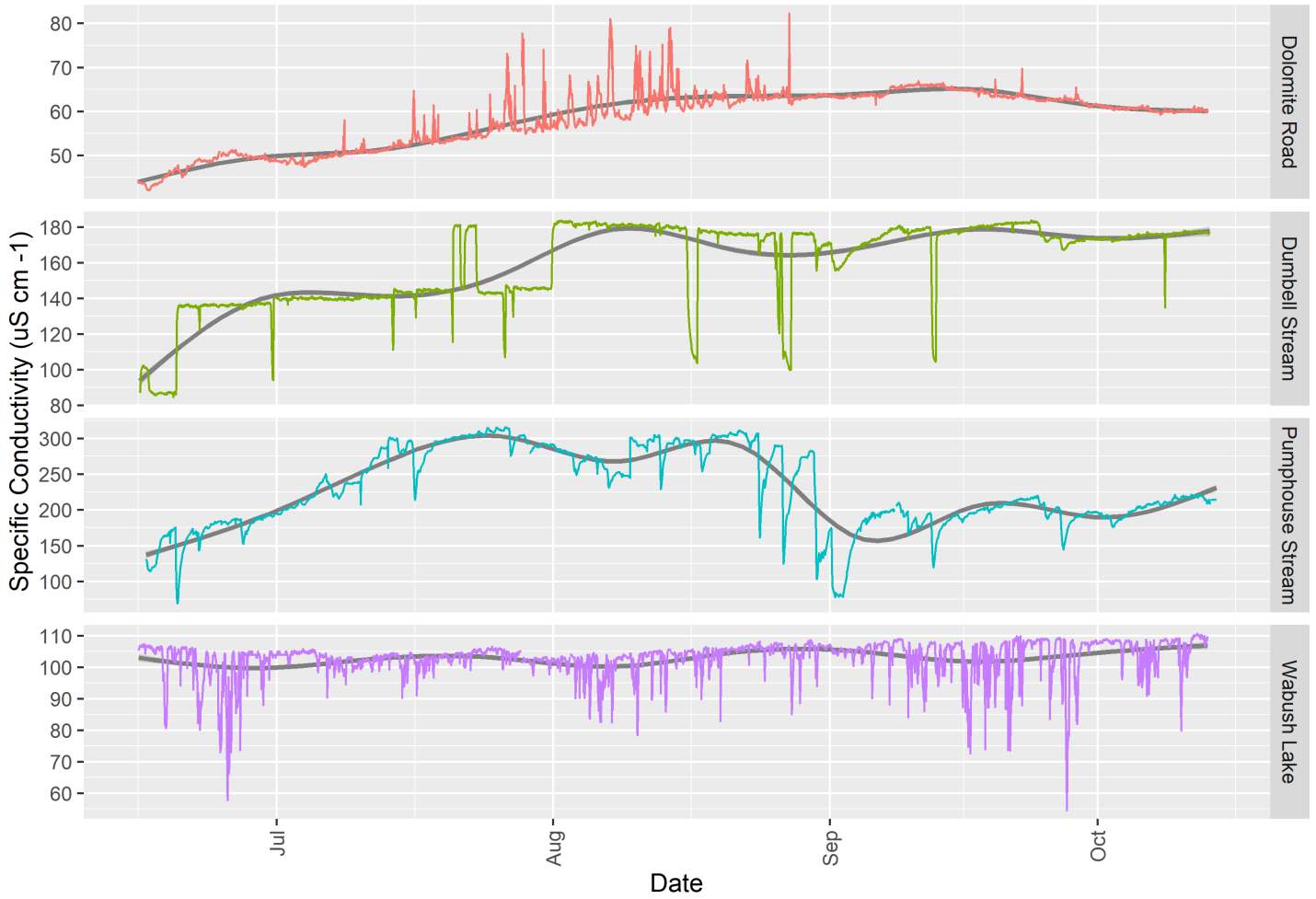
Temperature (°C)				
	Dolomite Road	Dumbell Stream	Pumphouse Stream	Julienne Narrows (Wabush Lake)
Min	8.70	2.19	2.70	6.30
Max	21.50	5.72	19.30	21.80
Median	15.50	3.65	9.00	13.70



pH				
	Dolomite Road	Dumbell Stream	Pumphouse Stream	Julienne Narrows (Wabush Lake)
Min	7.06	7.32	6.84	7.50
Max	8.27	7.99	7.97	8.44
Median	7.59	7.62	7.74	7.90

Specific Conductivity (uS cm⁻¹)

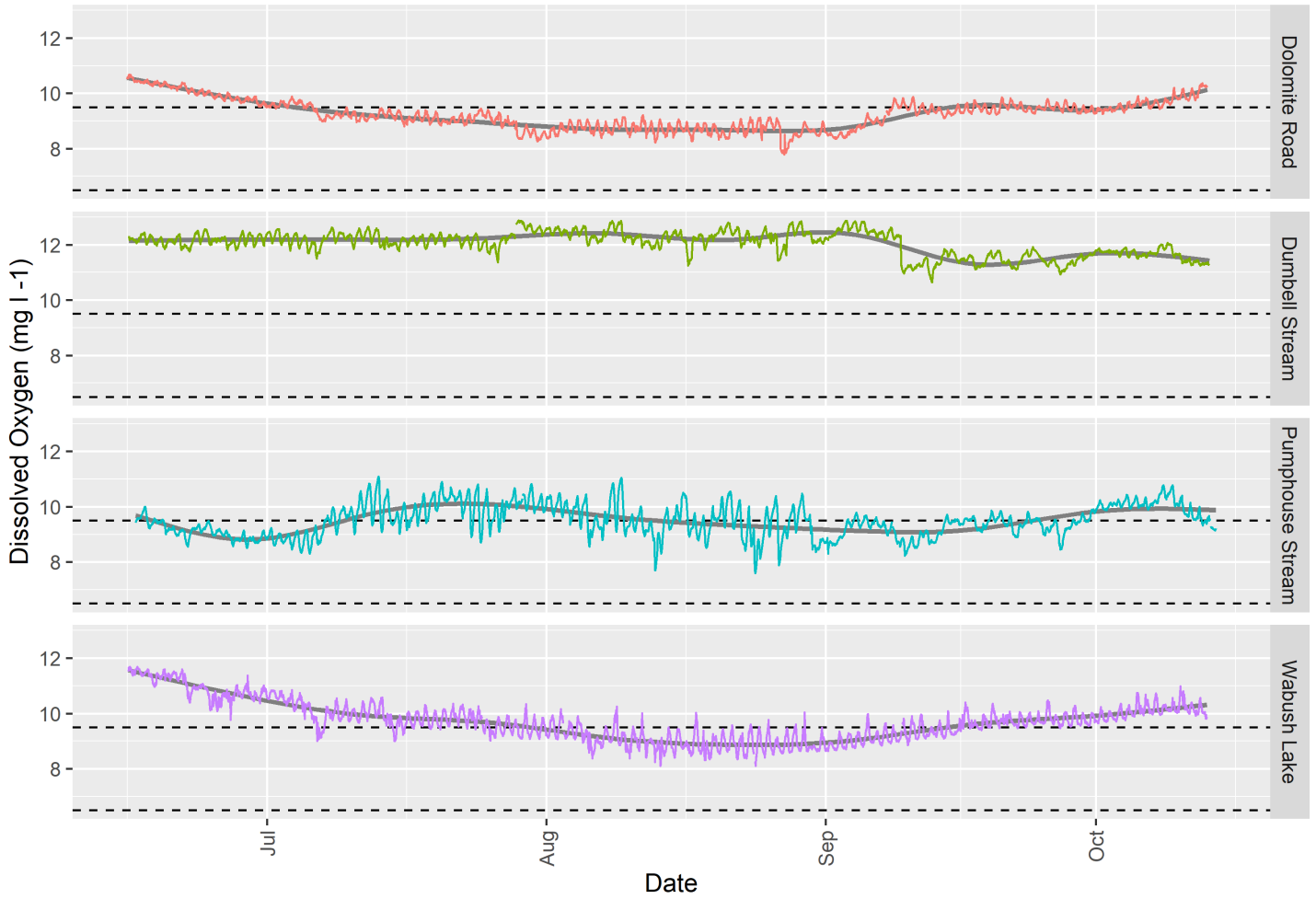
IOC Operations



Specific Conductivity (µs/cm)				
	Dolomite Road	Dumbell Stream	Pumphouse Stream	Julienne Narrows (Wabush Lake)
Min	42.1	84.7	68.8	54.6
Max	82.2	183.7	316.0	110.60
Median	60.5	173.0	216.0	104.2

Dissolved Oxygen (mg l⁻¹)

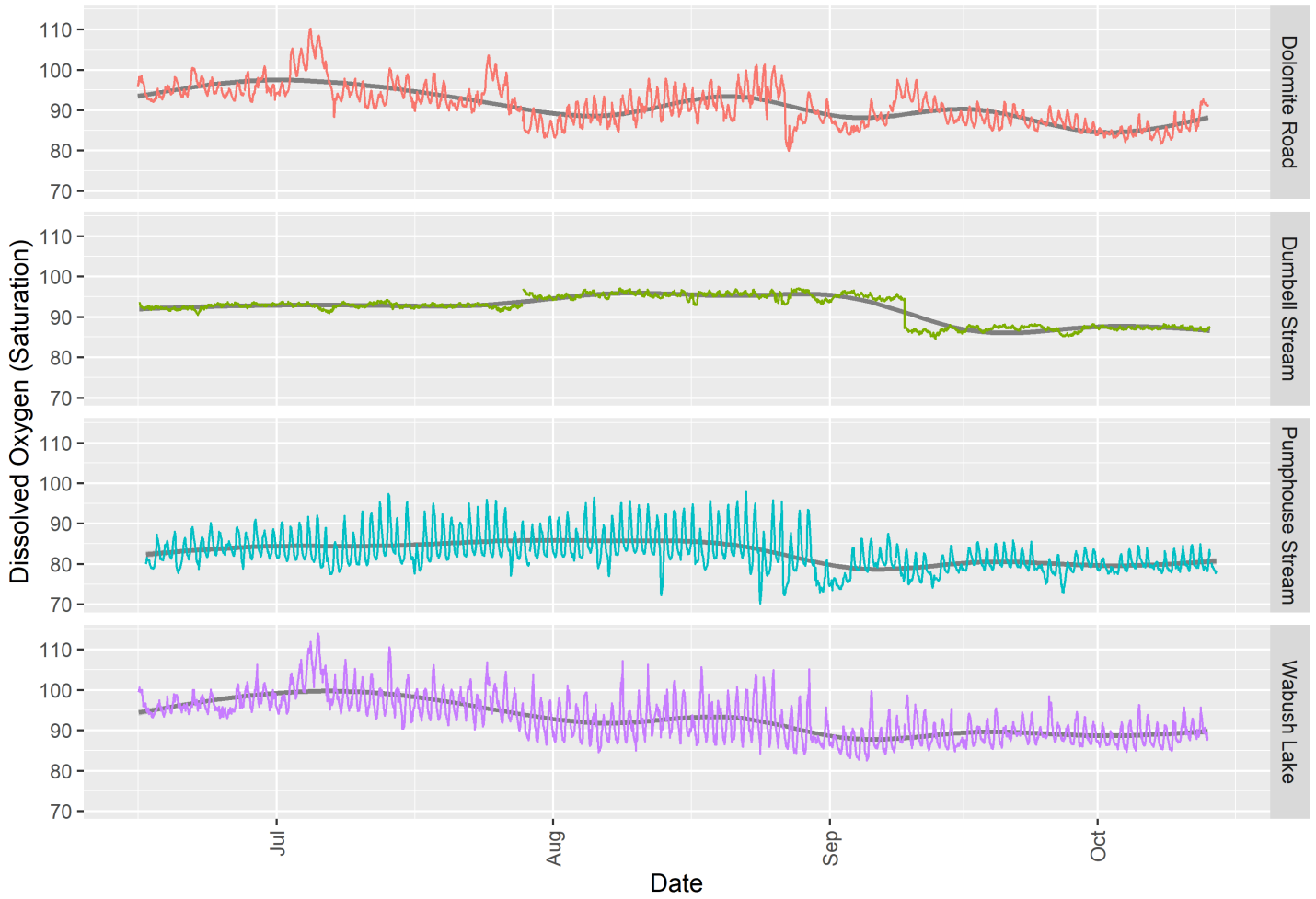
IOC Operations



Dissolved Oxygen (mg/l)				
	Dolomite Road	Dumbell Stream	Pumphouse Stream	Julienne Narrows (Wabush Lake)
Min	7.79	10.64	7.60	8.10
Max	10.68	12.88	11.09	11.69
Median	9.26	12.14	9.47	9.68

Dissolved Oxygen (Saturation)

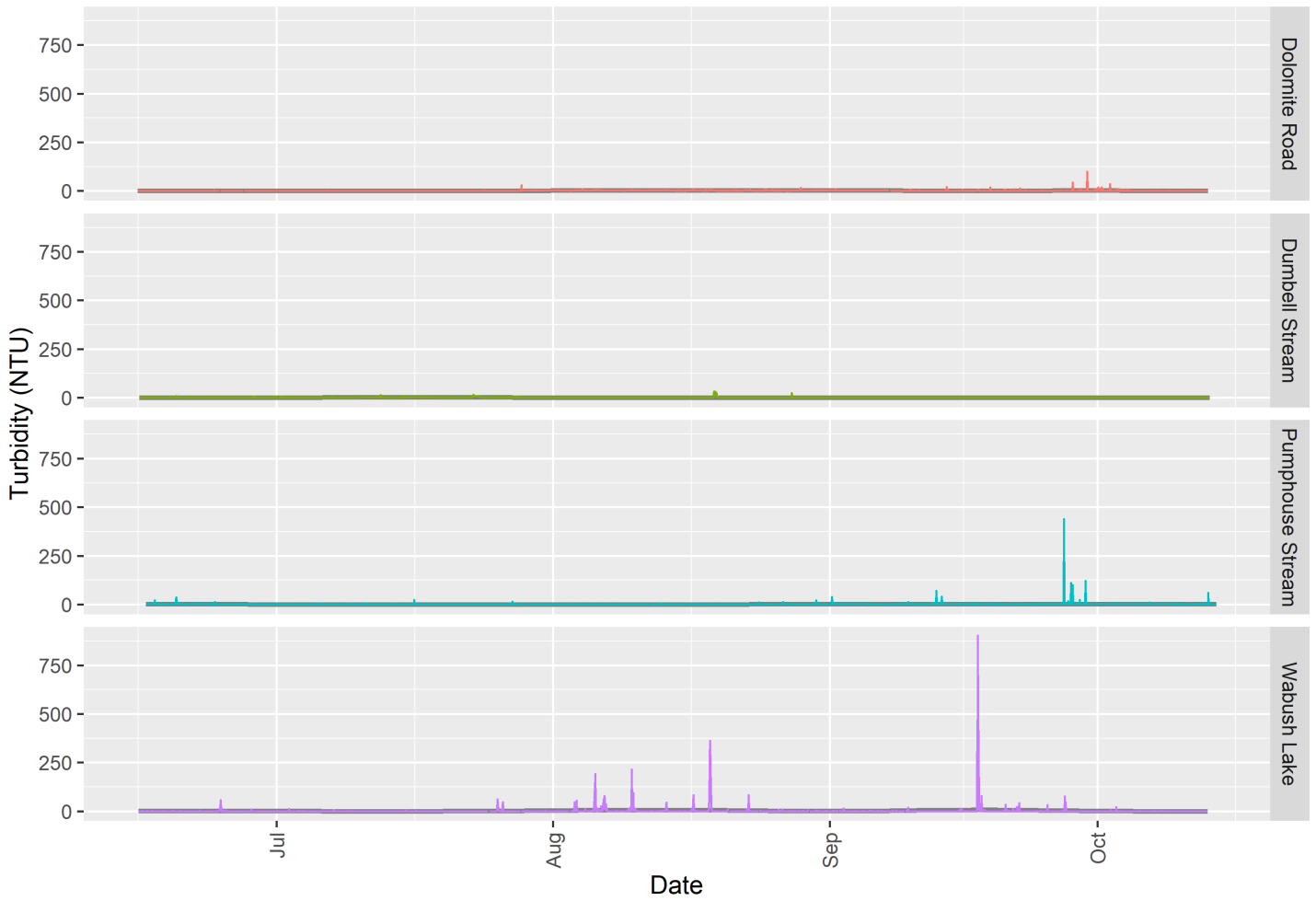
IOC Operations



Dissolved Oxygen (% Sat)				
	Dolomite Road	Dumbell Stream	Pumphouse Stream	Julienne Narrows (Wabush Lake)
Min	79.9	84.5	70.2	82.5
Max	110.2	97.1	97.8	113.9
Median	91.0	92.9	82.1	92.6

Turbidity (NTU)

IOC Operations



Turbidity (NTU)				
	Dolomite Road	Dumbell Stream	Pumphouse Stream	Julienne Narrows (Wabush Lake)
Min	0.0	0.0	0.0	0.0
Max	99.2	31.7	439.0	902.0
Median	0.5	0.0	0.0	0.0