Real-Time Water Quality Deployment Report

Voisey's Bay Network

July 17 to August 15, 2016

Newfoundland Labrador

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

Contents

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Real Time Water Quality Monitoring

Department of Municipal Affairs and Environment staff monitors the real-time web pages regularly.

This deployment report discusses water quality related events occurring at four stations in the Voisey's Bay Network; Reid Brook at Outlet to Reid Pond, Camp Pond Brook, Tributary to Lower Reid Brook, and Lower Reid Brook.

On July 17th, 2016, Vale Environment Staff redeployed real-time water quality monitoring instruments at the four real time stations in the Voisey's Bay network. The end of the deployment was August 15th, 2016. This was the second deployment for the 2016 season.

Quality Assurance and Quality Control

As part of the Quality Assurance and Quality Control protocol (QAQC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.

At deployment and removal, a QAQC Instrument is temporarily deployed alongside the Field Instrument. 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 Instrument and QAQC Instrument at deployment and at removal, a qualitative statement is made on the data quality (Table 1).

Table 1: Ranking classifications for deployment and removal

	Rank				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (oC)	<=+/-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 instrument 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 instrument the entire instrument 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 Voisey's Bay Network stations are summarized in Table 2.

Table 2: Comparison rankings for Voisey's Bay Network stations

Station Voisey's Bay	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Reid Brook at Outlet	July 17	Deployment	Excellent	Marginal	Excellent	Good	Excellent
	August 15	Removal	Excellent	Good	Excellent	Excellent	Excellent
Camp Pond Brook	July 17	Deployment	Excellent	Fair	Excellent	Excellent	Excellent
	August 15	Removal	Excellent	Excellent	Good	Excellent	Excellent
Reid Brook below Tributary	July 17	Deployment	Excellent	Fair	Excellent	Excellent	Excellent
	August 15	Removal	Excellent	Good	Excellent	Excellent	Poor
Tributary to Reid Brook	July 17	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	August 15	Removal	Excellent	Good	Good	Excellent	Excellent

During the deployment for **Reid Brook at Outlet of Reid Pond**, the temperature, conductivity, dissolved oxygen and turbidity all ranked as 'Excellent' and 'Good'. pH data ranked as 'Marginal' at deployment. The pH probe does require some time to acclimatize to the water environment thus it is likely that the readings for the pH were taken earlier than necessary. Upon removal of the instrument the water temperature, pH, conductivity, dissolved oxygen and turbidity all ranked as 'Excellent' and 'Good'.

At the station on **Camp Pond Brook below Camp Pond**, temperature, conductivity, dissolved oxygen and turbidity all ranked as 'Excellent'. At deployment the pH data ranked as 'Fair'. The pH probe does require some time to acclimatize to the water environment thus It is likely that the readings for the pH were taken earlier than necessary. During removal, temperature, pH, conductivity, dissolved oxygen, and turbidity all ranked as 'Good' or 'Excellent'. There were all acceptable rankings for water quality parameters for both deployment and removal comparisons against the QA instrument.

During deployment of the field instrument at **Reid Brook below Tributary**, water temperature, conductivity, dissolved oxygen and turbidity all ranked as 'Excellent', with pH data ranking as 'Fair'. During removal, water temperature, pH, specific conductivity, dissolved oxygen ranked as 'Excellent' and 'Good'. The turbidity data when compared ranked as 'Poor'. There was sand and debris blocking the turbidity sensor during removal of the instrument. This data was removed from the statistical analysis.

Tributary to Reid Brook water temperature, pH, conductivity, dissolved oxygen and turbidity all ranked as 'Excellent' and 'Good' during deployment. Upon removal, water temperature, pH, conductivity, dissolved oxygen and turbidity all ranked as 'Excellent' and 'Good'. There were all acceptable rankings for water quality parameters for both deployment and removal comparisons against the QA instrument.

Data Interpretation

The following graphs and discussion illustrate significant water quality-related events from July 17th to August 15th, 2016 in the Voisey's Bay Real Time Water Quality Monitoring Network.

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 QAQC protocol. Water Survey of Canada is responsible for QAQC of water quantity data. Corrected data can be obtained upon request.

Reid Brook below Tributary had turbidity data that indicated that there was debris blocking the sensor. Therefore the turbidity data from August 7th through to the end of deployment was removed from the analysis as it did not represent the brook.

Figure 1: Voisey's Bay Network Station Locations

Reid Brook at Outlet of Reid Pond

Water Temperature

Over the deployment period the water temperature ranged from 6.35 °C to 15.77 °C, with a median value of 12.18 °C (Figure 2).

The water temperature data at this station does not display the common diurnal pattern that water bodies often display. This is likely a result of the instrument being in a pond. This water body takes longer to acclimatize to changes in temperature as it is a larger surface area than the brooks. The water temperature has slower more exaggerated changes at this station.

There was a significant drop in water temperature and air temperature (Figure 3) on August 6th and August 7th, 2016. During this time frame, Nain Weather Station recorded rainfall (Figure 8) which was likely the influence for the cooler temperatures.

Please note the stage data, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC. Mean Air Temperature on Figure 3 was collected at the Nain Weather Station by Environment Canada.

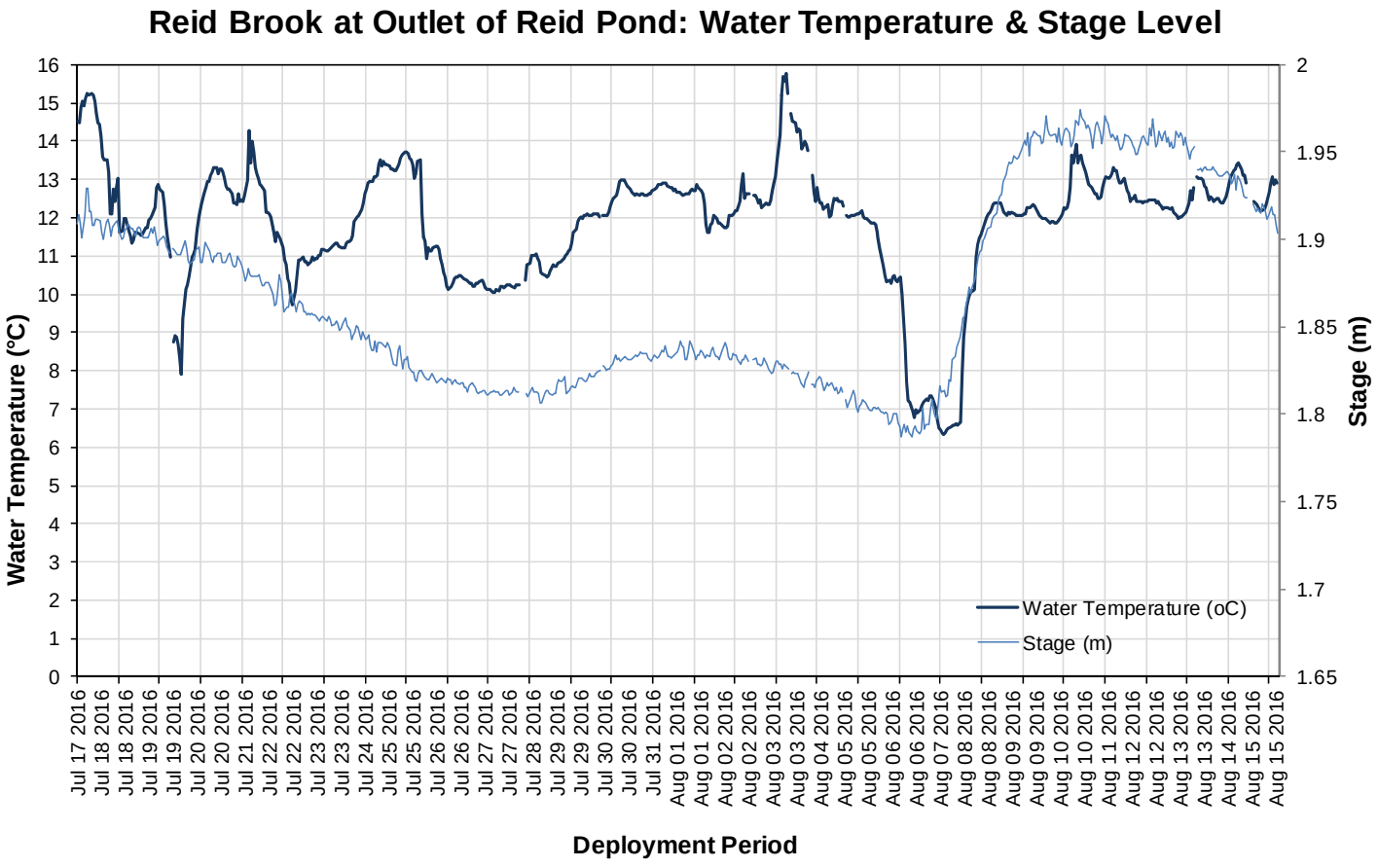

Figure 2: Water Temperature & Stage at Reid Brook at Outlet of Reid Pond

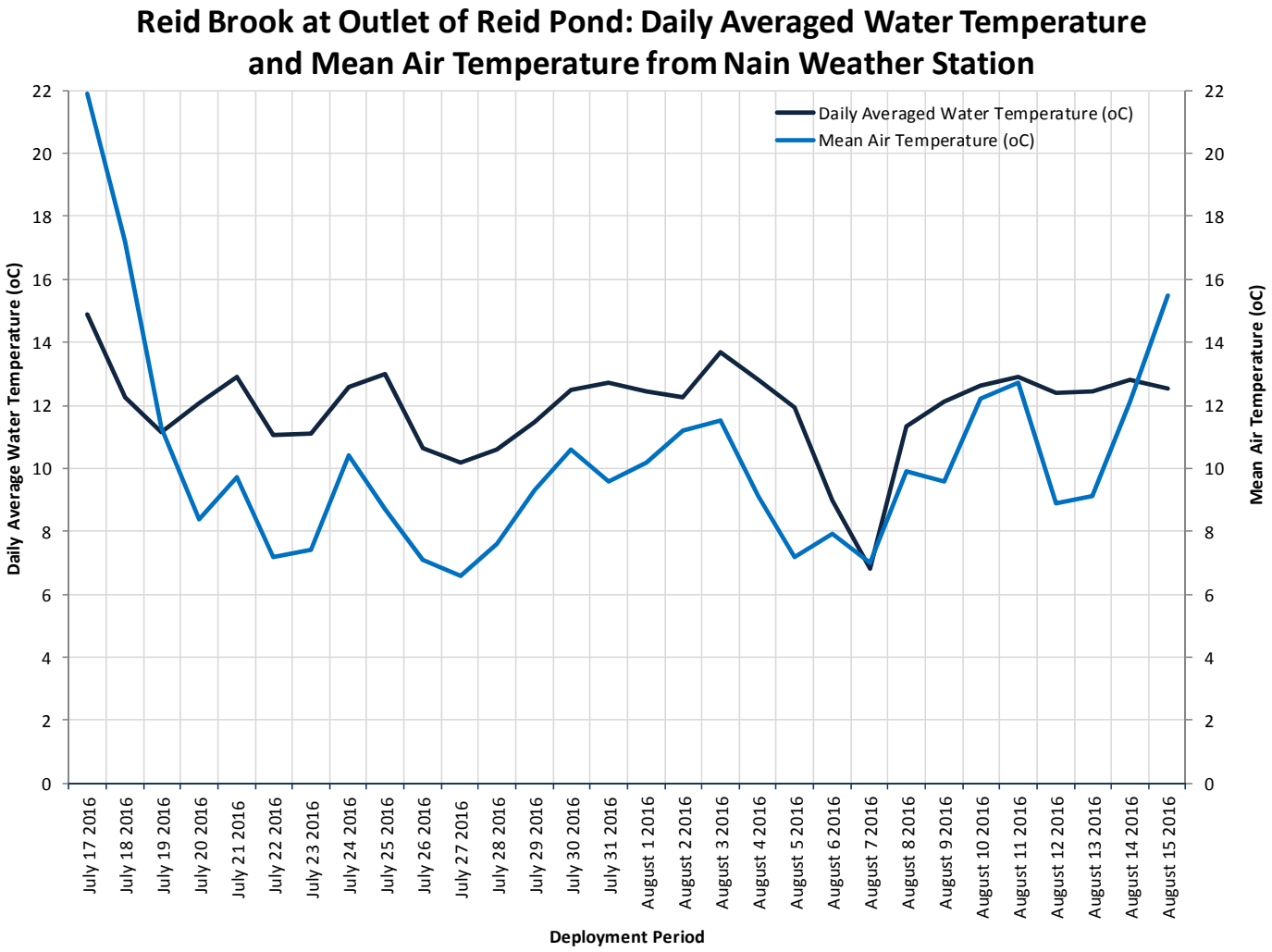

Figure 3: Daily Averaged Water Temperature at Reid Brook at Outlet of Reid Pond and Mean Air Temperatures from Nain Weather Station

pH

Throughout the deployment period, pH values ranged between 6.47 pH units and 7.42 pH units (Figure 4).

The pH levels are reasonably consistent during the deployment. The pH data decreases slowly over deployment, in July the pH dips below the minimum Guideline for Protection of Aquatic Life. The Canadian Council of Ministers of the Environment (CCME) guidelines are just a basis by which to compare any dramatic change in the pH data within a dataset. Every brook is different with its own natural baseline conditions.

Natural processes such as rainfall and runoff will alter the pH of a brook for a period of time. This is evident on Figure 4, during and after high stage levels the pH data decreases slightly for short period of time. This is a natural process.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

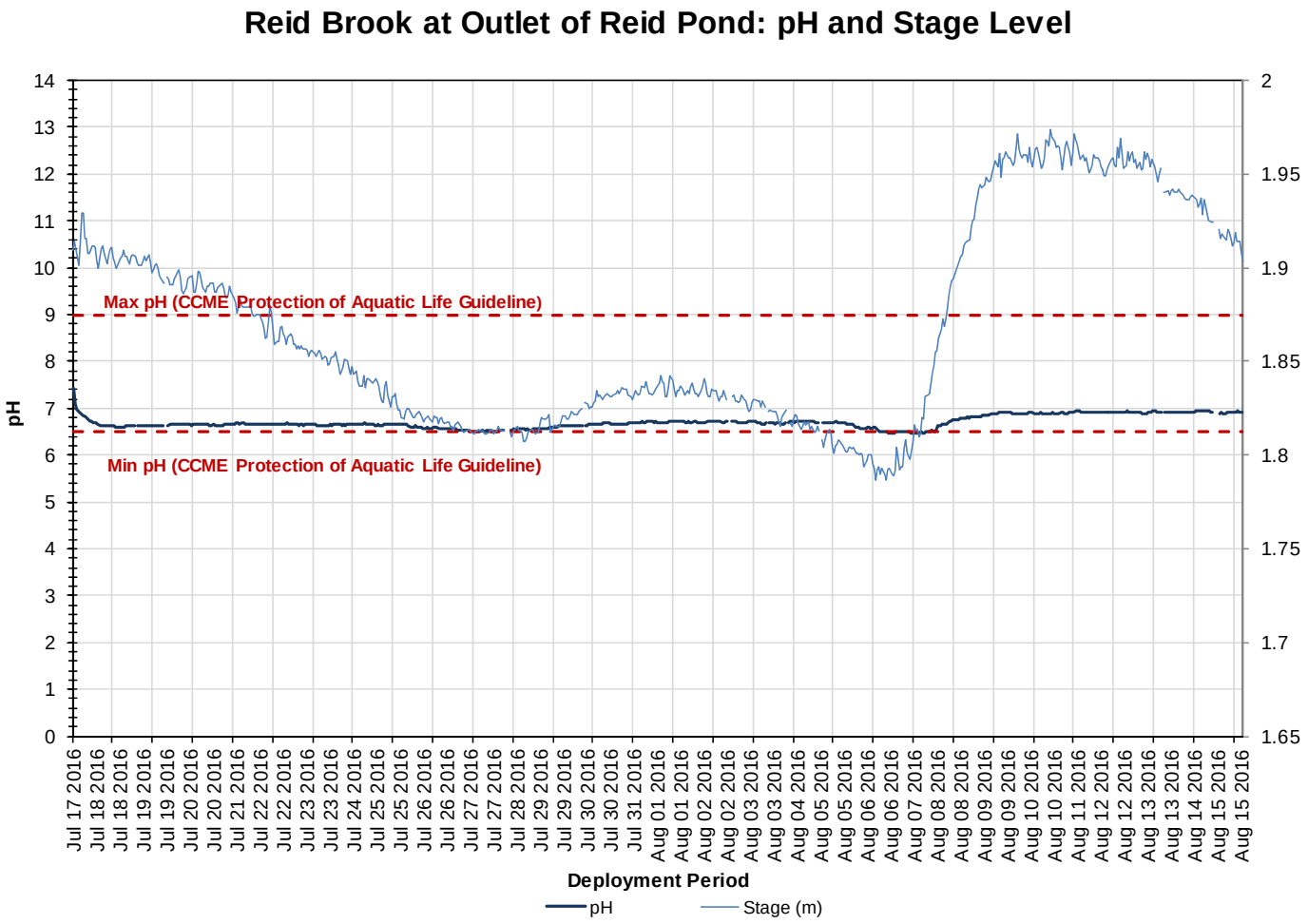

Figure 4: pH and Stage Level at Reid Brook at Outlet of Reid Pond

Specific Conductivity

The conductivity levels were within 9.1 µS/cm and 9.5 µS/cm during this deployment period. The conductivity at Reid Brook remains very stable. This is expected at this site as it is pristine in nature and a larger distance from any anthropogenic disturbances that could affect water parameters.

The common relationship between conductivity and stage level is generally inversed. However, due to this site being a pond environment and a significant distance from any anthropogenic influences, the conductivity at Reid Pond remains stable throughout this deployment (Figure 5).

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

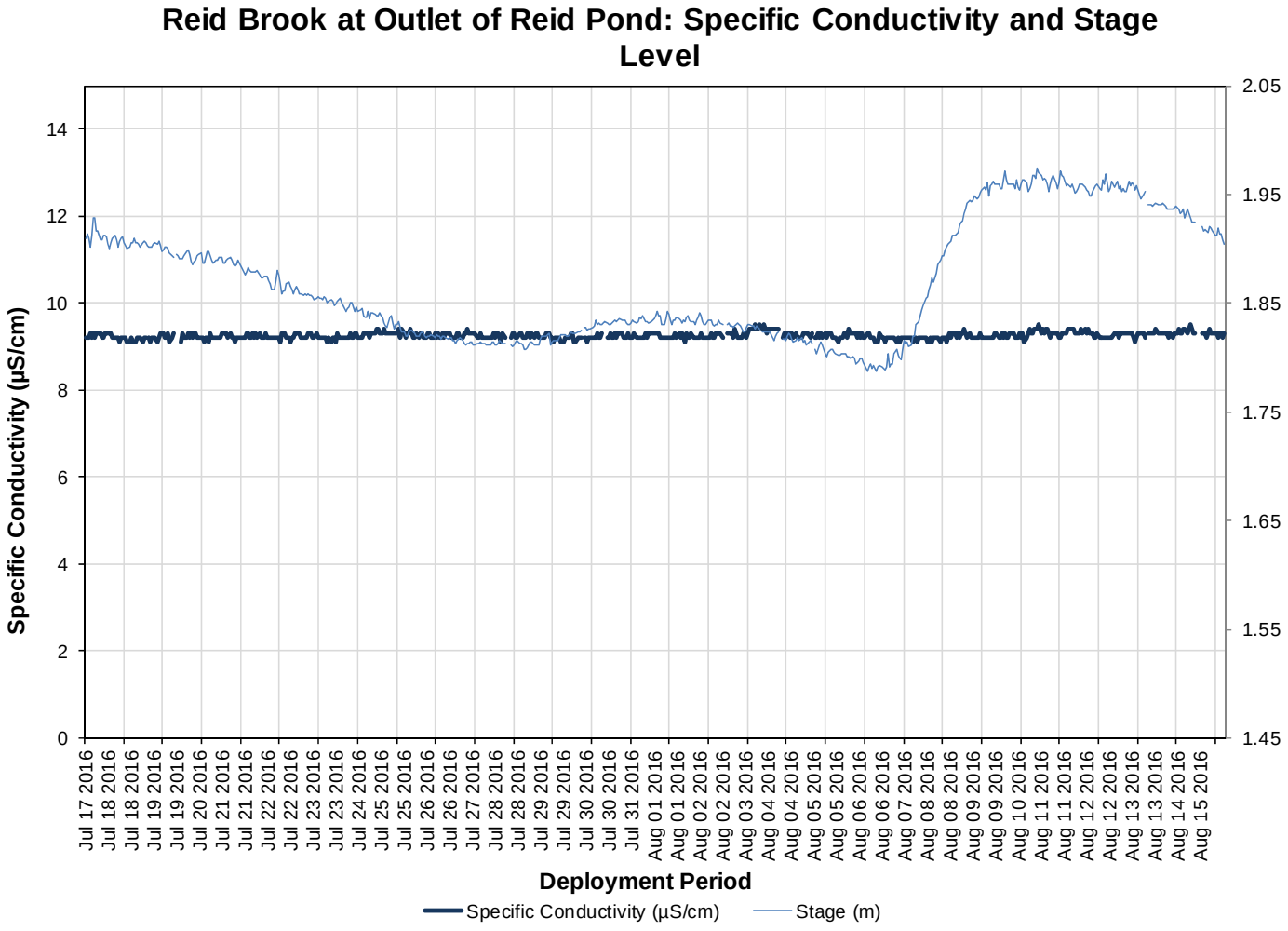

Figure 5: Specific Conductivity and Stage Level at Reid Brook at Outlet of Reid Pond

Dissolved Oxygen (mg/L & % Saturation)

The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe and then the instrument calculates percent saturation (% Sat) taking into account the water temperature.

During the deployment the dissolved oxygen concentration levels ranged within a minimum of 10.12 mg/L to a maximum of 11.75 mg/L. The percent saturation levels for dissolved oxygen ranged within 96.3% Saturation to 104.3% Saturation (Figure 6).

The dissolved oxygen concentration remained above the Guideline for the Protection of Early Life Stages (9.5mg/L). As the water temperatures rise over the summer there will be a natural decrease in dissolved oxygen present in the brook. On August 6th and 7th, there was a spike in dissolved oxygen, this event was likely a result of the drop in water temperature on the same dates.

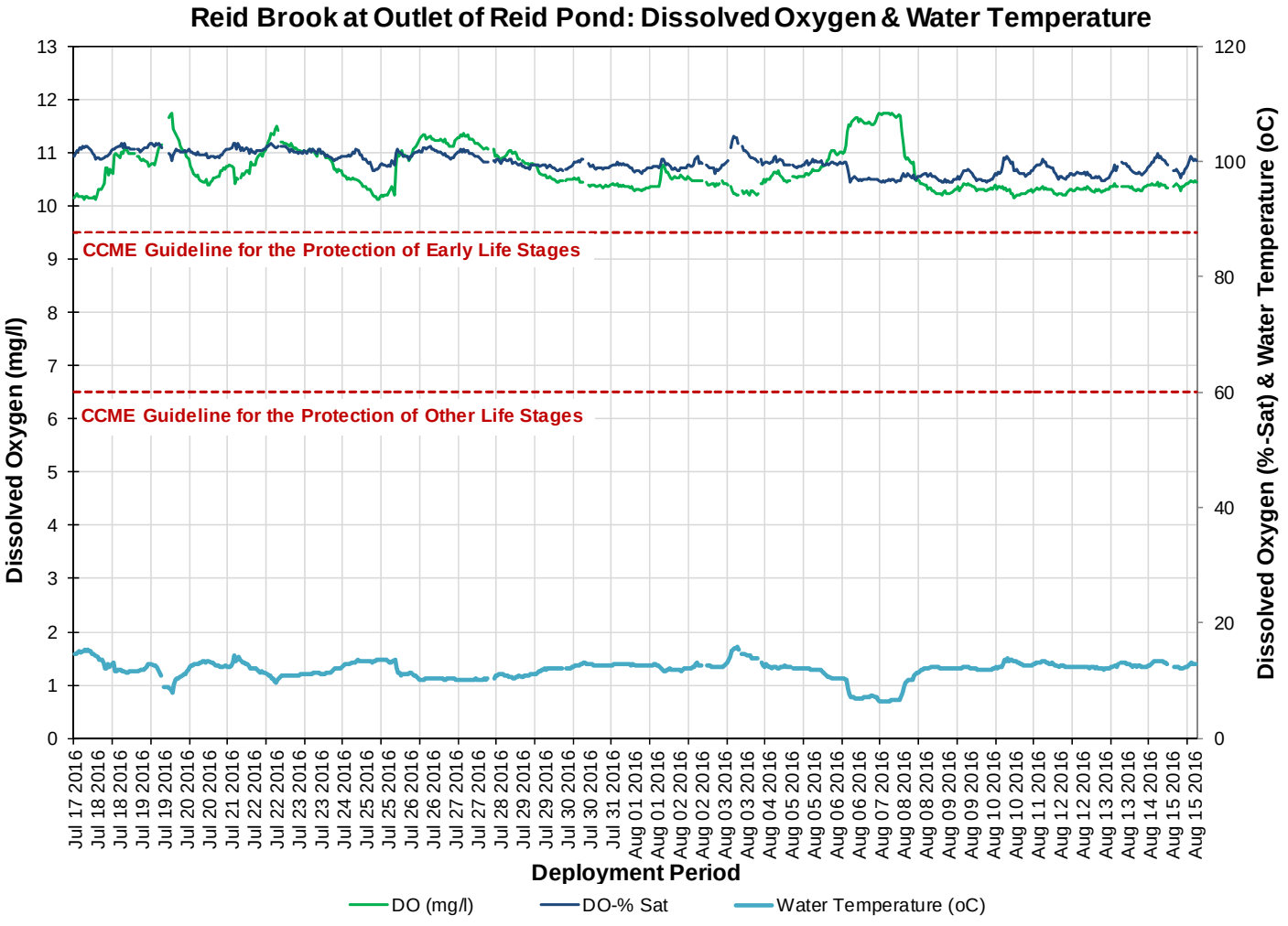

Figure 6: Dissolved Oxygen (mg/L & %Sat) at Reid Brook at Outlet of Reid Pond

Turbidity

Turbidity levels during the deployment ranged within 0.0 NTU and 1.4 NTU (Figure 7). The deployment data had a median of 0.0 NTU.

Waterbodies all have a level of turbidity to the water quality. A significant increase in turbidity is of concern when monitoring brooks.

During rainfall or runoff, higher turbidity readings would be expected. Generally the turbidity levels increase for a short period of time and then return to within the range of the baseline. At this station, the higher turbidity events throughout this deployment period correlate with increases in stage potentially from precipitation. Rainfall and subsequent runoff can increase the presence of suspended material in water.

Turbidity values can also increase if there is a decrease in water level and the natural material in the waterbody becomes concentrated.

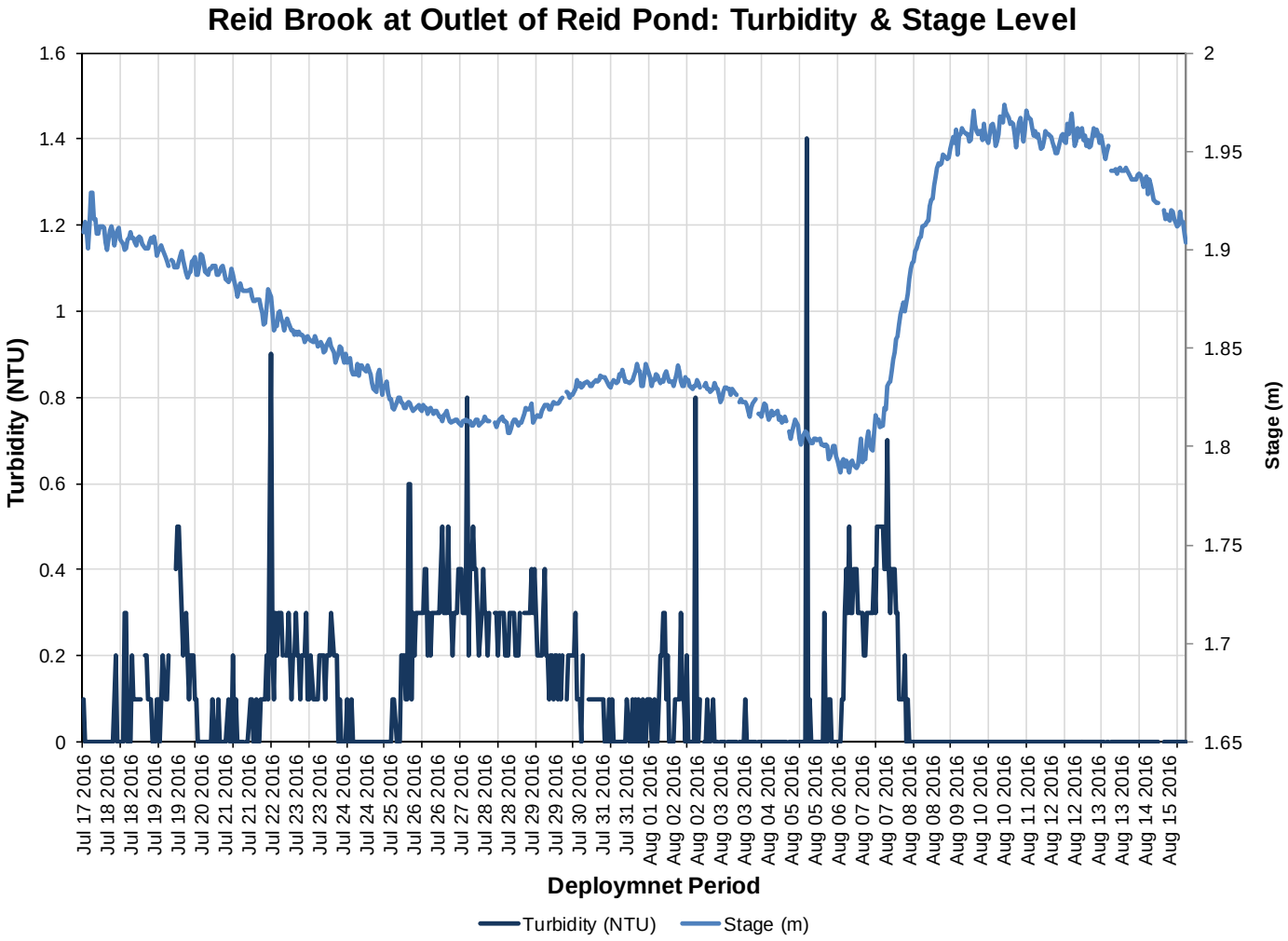

Figure 7: Turbidity & Stage at Reid Brook at Outlet of Reid Pond

Stage, Streamflow & Precipitation

Please note the stage data graphed below is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

Stage is important to display as it provides an estimation of water level at the station and can explain some of the events that are occurring with other parameters (i.e. Specific Conductivity, DO, turbidity). Stage will increase during rainfall events (Figure 8) and during any surrounding snow or ice melt as runoff will collect in the brooks. However, direct snowfall will not cause them to rise significantly.

During the deployment period, the stage values ranged from 1.79m to 1.97m. The larger peaks in stage do correspond with substantial rainfall events as noted on Figure 8. Precipitation data was obtained from Nain Weather Station. Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 15.5 mm on August 7th 2017.

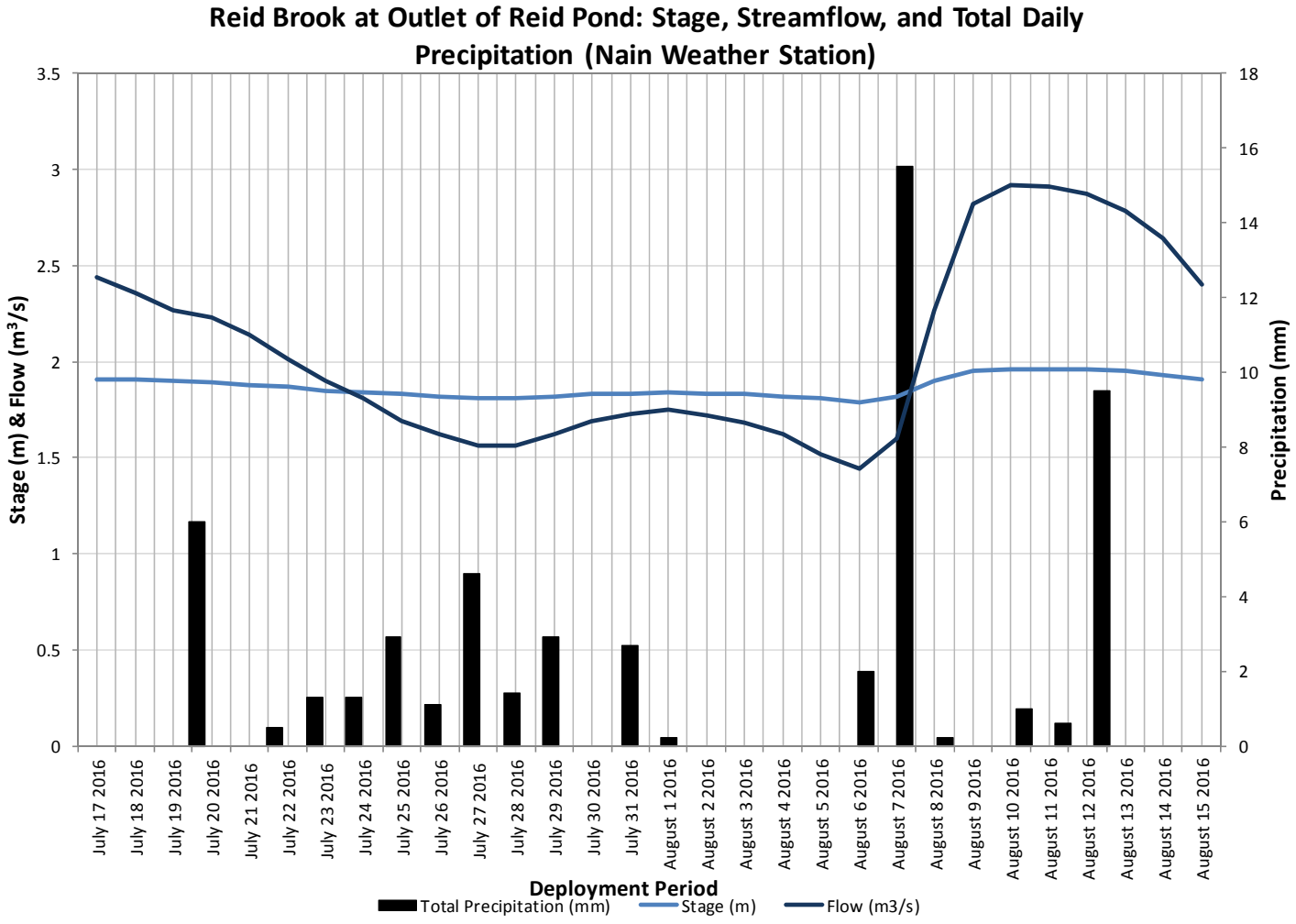

Figure 8: Daily Stage and Streamflow data from Reid Brook at Outlet of Reid Pond and Total Daily Precipitation from Nain, Labrador Weather Station

Camp Pond Brook below Camp Pond

Water Temperature

Water temperature ranged from 8.72°C to 22.02°C during this deployment period (Figure 9).

The water temperature at this station displays diurnal variations of the temperature. There is a peak in water temperature on August 3rd and 4th, 2016 this coincides with a dip in stage level likely a result of natural evaporation as the air temperatures increase. There was a significant drop in water temperature and air temperature (Figure 10) on August 6th and August 7th, 2016. During this time frame, Nain Weather Station recorded rainfall (Figure 15) which was likely the influence for the cooler temperatures.

As the climate changes into the summer the air temperatures will increase (Figure 10). This stream is sensitive to changes in the ambient air temperature and fluctuates considerably depending on the weather and time of day. This station typically has the highest water temperatures and greatest fluctuations when compared to the other stations in the network.

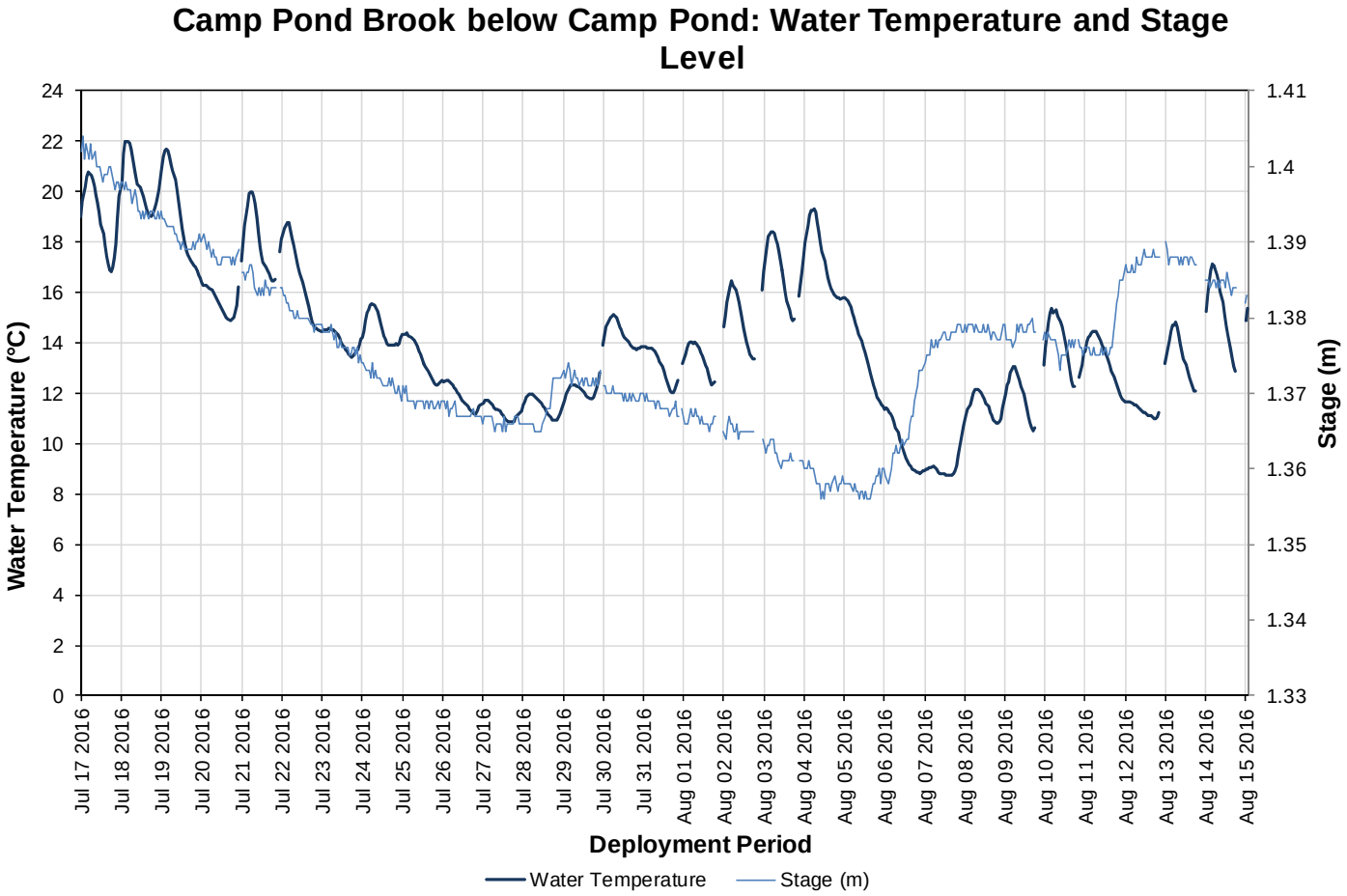

Figure 9: Water Temperature & Stage Level at Camp Pond Brook below Camp Pond

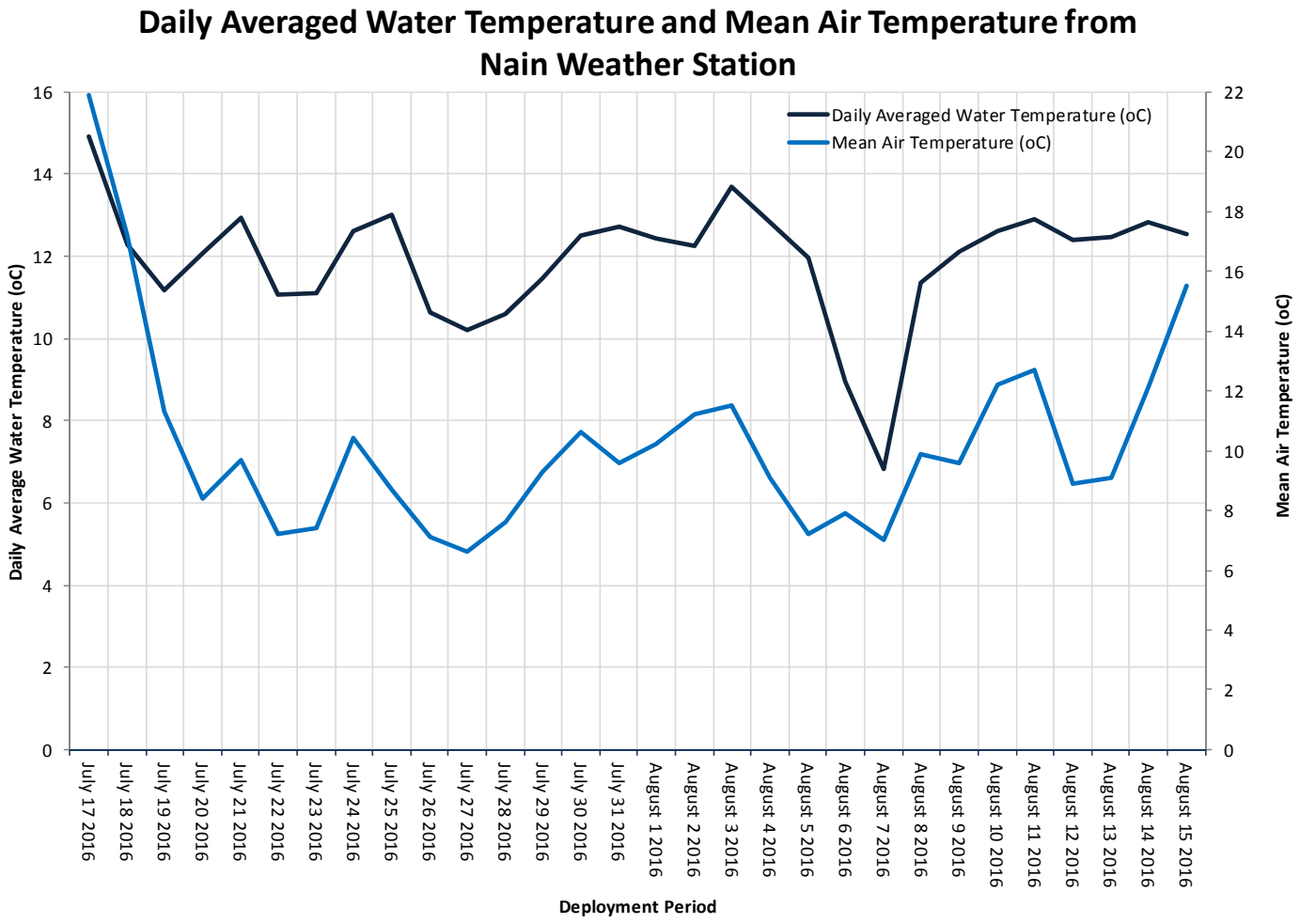

Figure 10: Daily Averaged Water Temperature at Camp Pond Brook below Camp Pond & Mean Air Temperature from Nain Weather Station.

pH

Throughout the deployment period, pH values ranged between 6.72 pH units and 7.00 pH units (Figure 11).

The pH levels are consistent during the deployment. The pH data remains within the Guideline for Protection of Aquatic Life. The Canadian Council of Ministers of the Environment (CCME) guidelines are just a basis by which to compare any dramatic change in the pH data within a dataset. Every brook is different with its own natural baseline.

Natural events such as rainfall and snow melt will alter the pH of a brook for a period of time. The pH levels will decrease slightly for a short period of time during and after high stage levels. This is a natural process.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

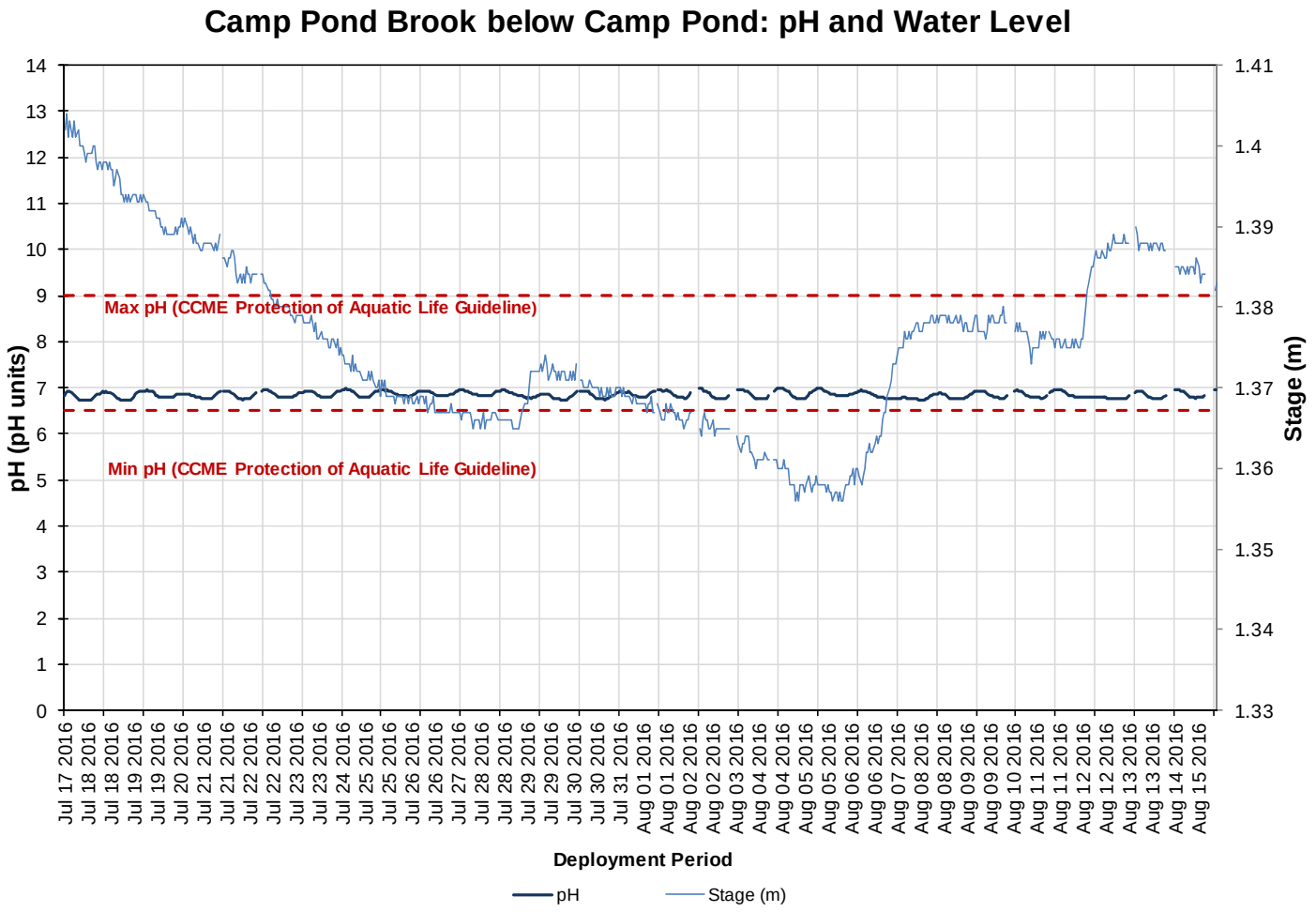

Figure 11: pH & Stage Level at Camp Pond Brook below Camp Pond

Specific Conductivity

Specific conductivity ranges from 34.2µS/cm to 45.8 µS/cm with a median of 36.9 µS/cm (Figure 12).

Typically, as stage level decreases, the specific conductivity of the water increases because of the increase in concentration of dissolved solids present in the water column. At this site the opposite is experienced in this trend (Figure 12).

At this location an increase in stage level will result in an increase in specific conductivity. The increase in specific conductivity is likely from runoff from the nearby roadways as substances are flushed into the brook. This relationship is evident on Figure 12, on July 29th, August 7th and August 12th, 2016 the stage and conductivity values both increase for a short period of time.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

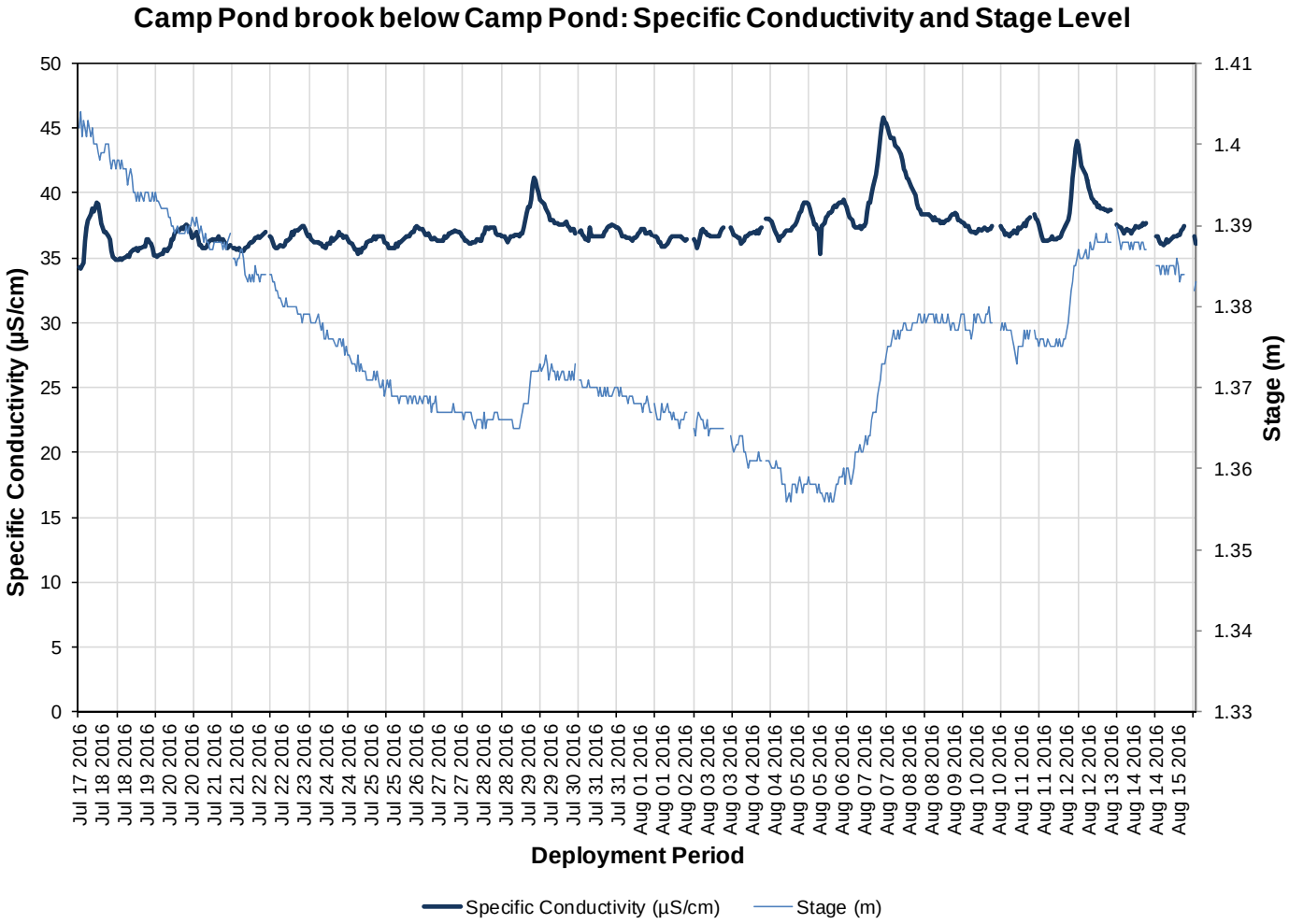

Figure 12: Specific Conductivity & Stage at Camp Pond Brook below Camp Pond

Dissolved Oxygen (mg/L & % Saturation)

Dissolved oxygen content ranges between 8.22mg/l and 10.77mg/l during the deployment period. The saturation of dissolved oxygen ranges from 90.0% to 100.5% (Figure 13).

The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe and then the instrument calculates percent saturation (% Sat) with water temperature.

Dissolved oxygen concentration dipped below the CCME guideline of 9.5mg/L during the deployment period. This occurrence corresponds with warmer water temperatures during the deployment period (Figure 13). This is expected as water temperature directly influences the level of dissolved oxygen present in the water column.

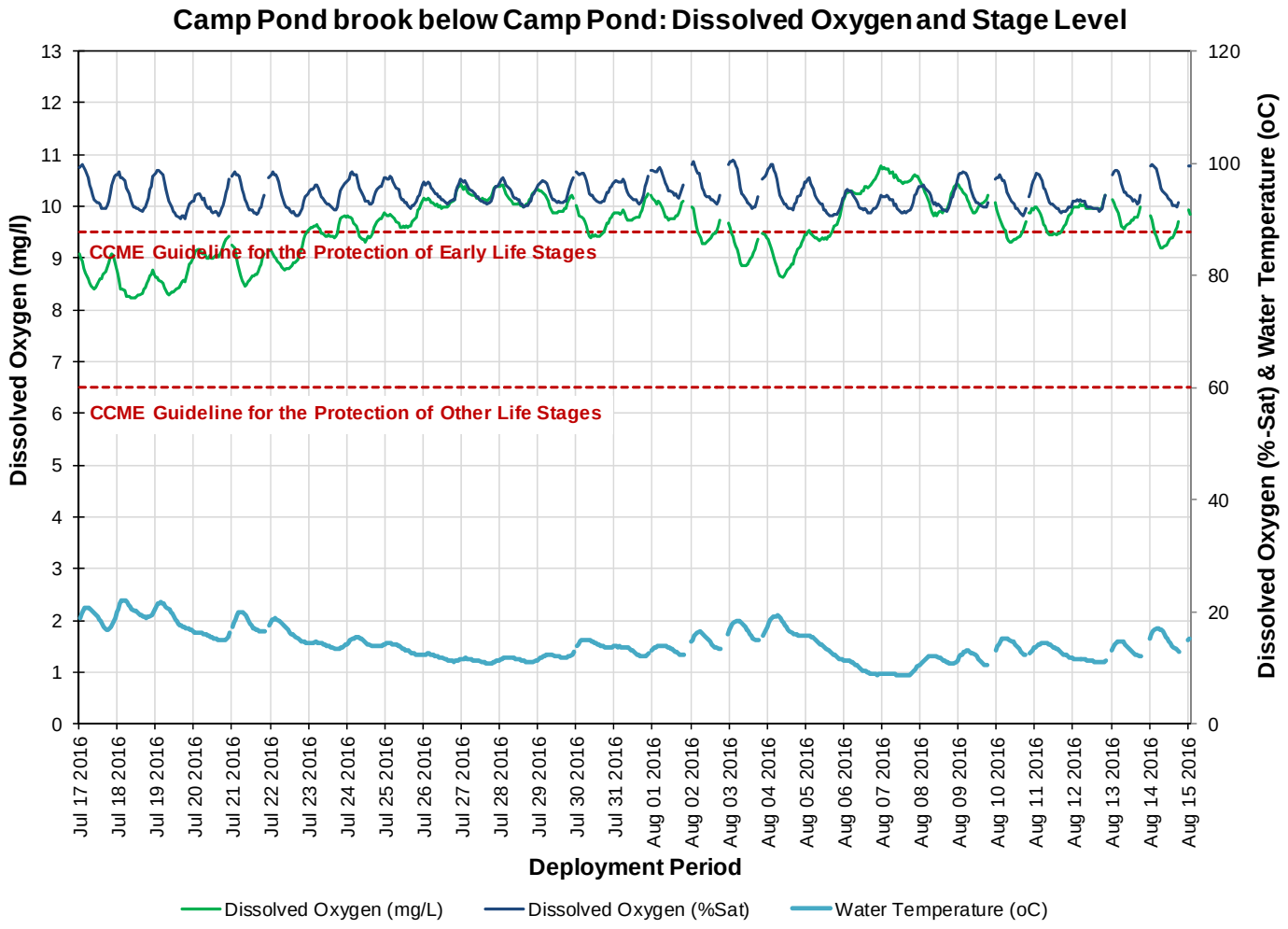

Figure 13: Dissolved Oxygen & Water Temperature at Camp Pond Brook below Camp Pond

Turbidity

Across the deployment period the turbidity ranges from 0.0NTU to 3.3NTU during the deployment period, with a median value of 0.0NTU (Figure 14). A median value of 0.0 NTU indicates there is very little natural background turbidity at this station during this deployment period.

The one turbidity spike during this deployment period is low. This event was likely a result of the rainfall that occurred on August 6th and August 7th, 2016. Rainfall can disturb particles in the water and flush material from the surrounding banks into the pond (Figure 14).

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

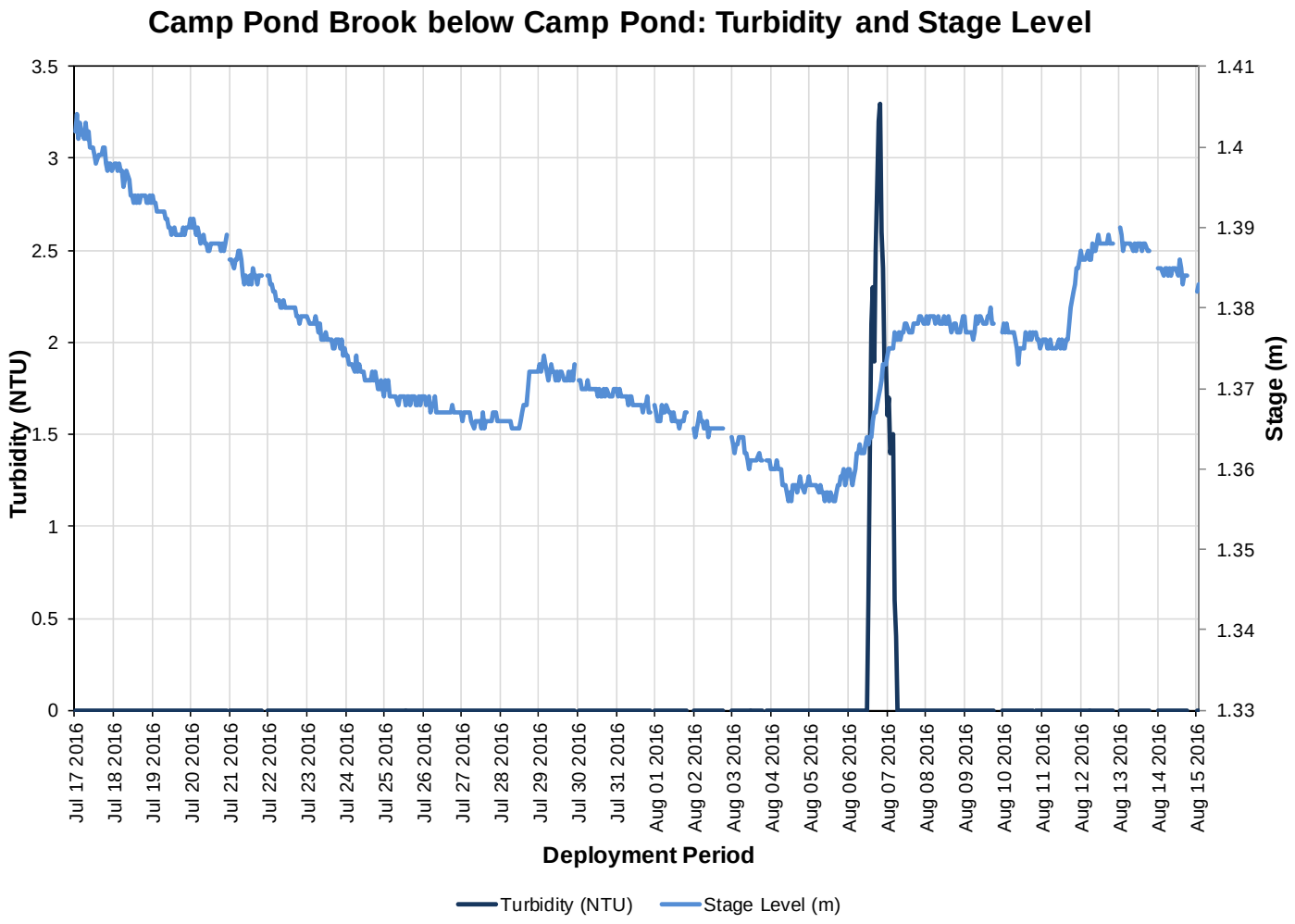

Figure 14: Turbidity & Stage Level at Camp Pond Brook below Camp Pond

Stage, Streamflow and Precipitation

WSC (Environment and Climate Change Canada) is responsible for QAQC of water quantity data (stage and flow). Corrected data can be obtained upon request.

Precipitation data was obtained from the Environment Canada weather station at Nain. The weather station is 30 km northeast of Voisey's Bay (Figure 15). Precipitation occurs on 17 days during the deployment period and amounts are small in magnitude, with the largest on August 7th accumulating 15.5 mm of precipitation.

During the deployment period, the stage values ranged from 1.36m to 1.40m. Streamflow had a minimum amount of 0.20m^3/s and a maximum flow of 0.33m^3/s.

Stage, streamflow and precipitation are graphed below to show the relationship between rainfall and water level (Figure 15).

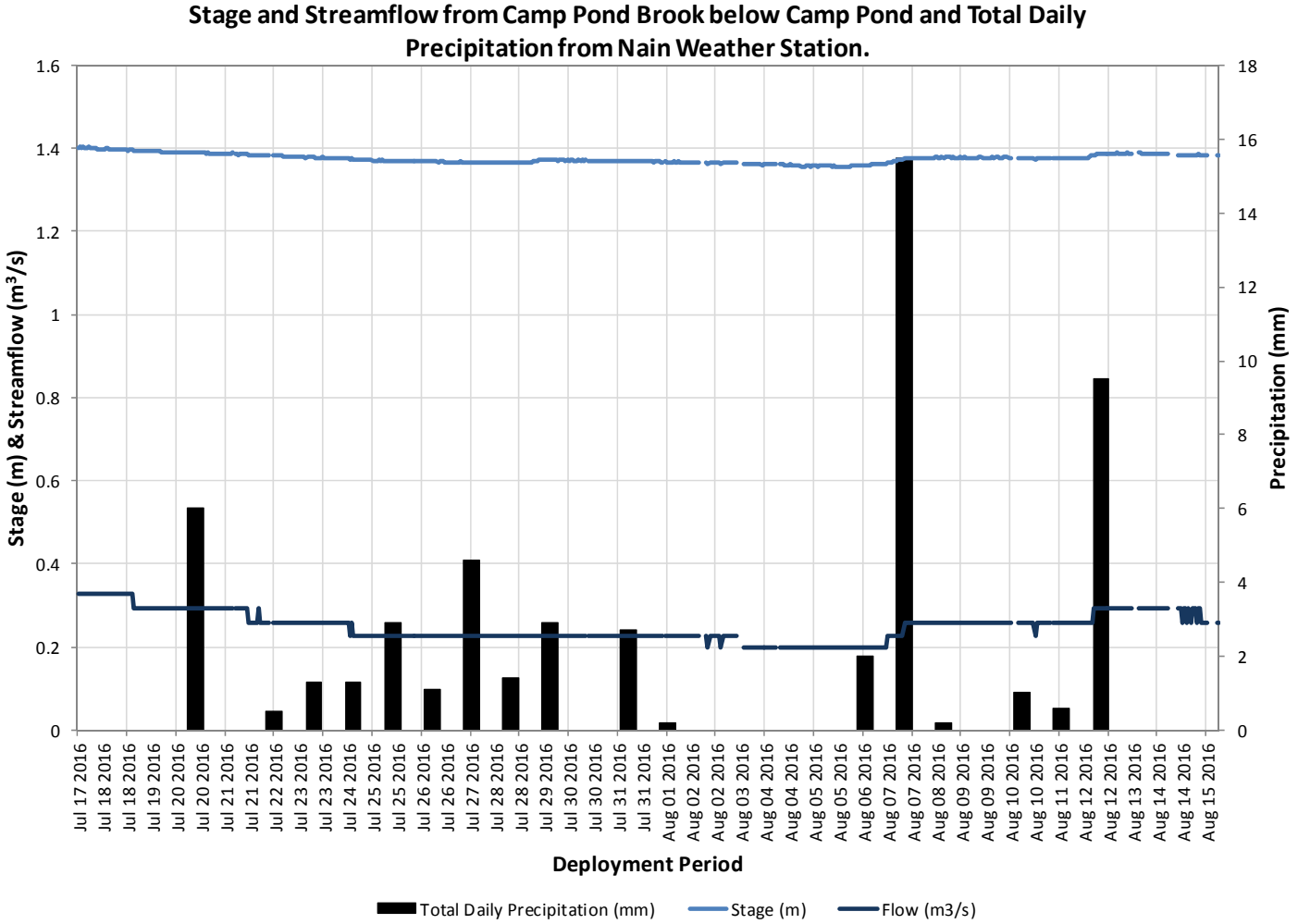

Figure 15: Stage, Streamflow, and Total Daily Precipitation (Nain, Labrador Weather Station) at Camp Pond Brook below Camp Pond

Reid Brook below Tributary

Water Temperature

Water temperature ranges from 8.05 °C to 17.34 °C, with a median value of 10.94 °C (Figure 16).

The water temperature at this station displays diurnal variations of the temperature. There is a spike in water temperature on August 4th and 5th, 2016 which corresponds with a decrease in the stage level. The increase in water temperature was likely a result of evaporation at this time. This is to be expected as the air temperatures increase with the change into summer (Figure 17).

This graph displays the relationship between stage decrease and water temperature increase. Temperature is influenced by the lower stage level and increases slightly for a short period of time.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

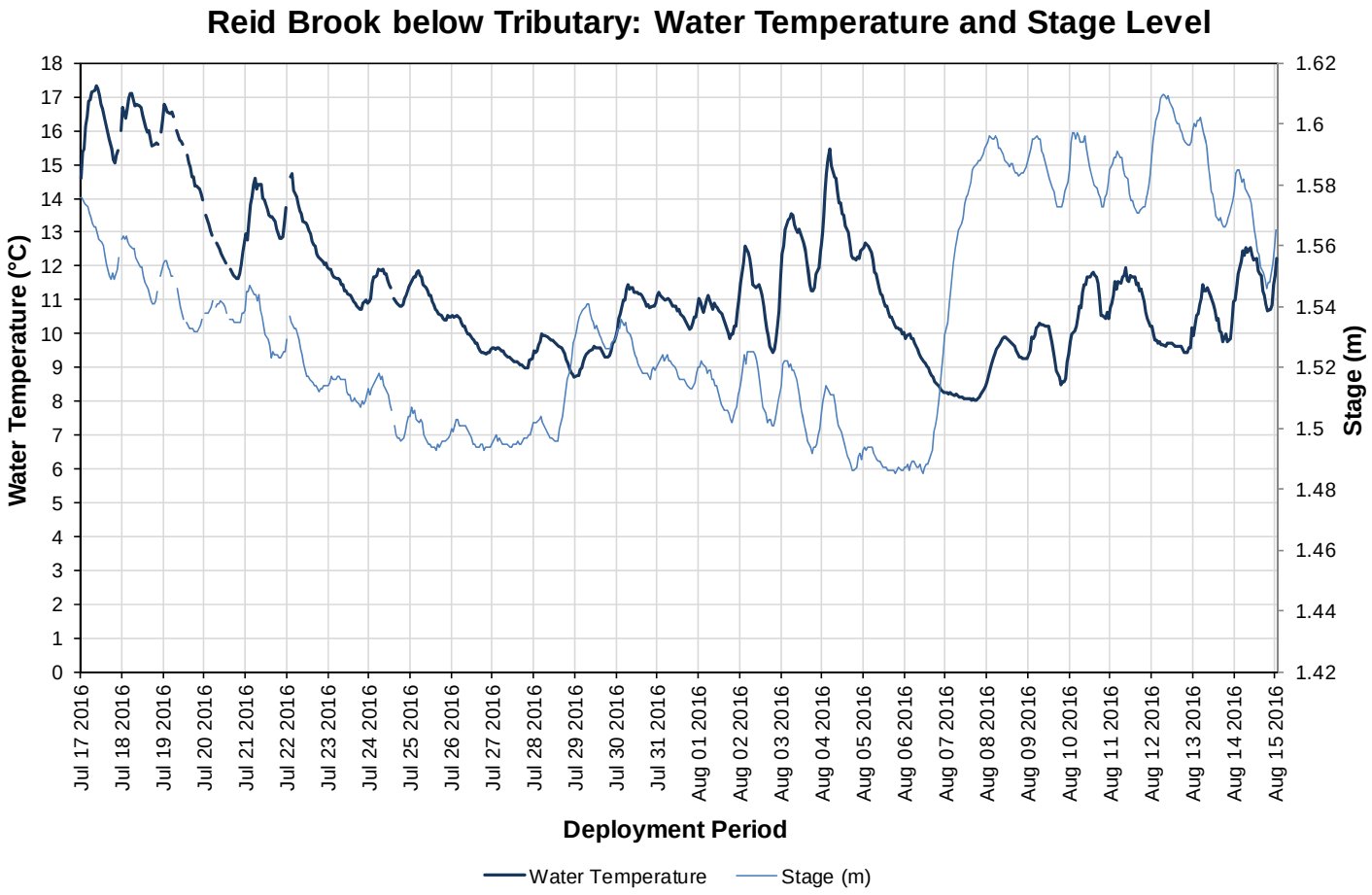

Figure 16: Water Temperature & Stage Level at Reid Brook below Tributary

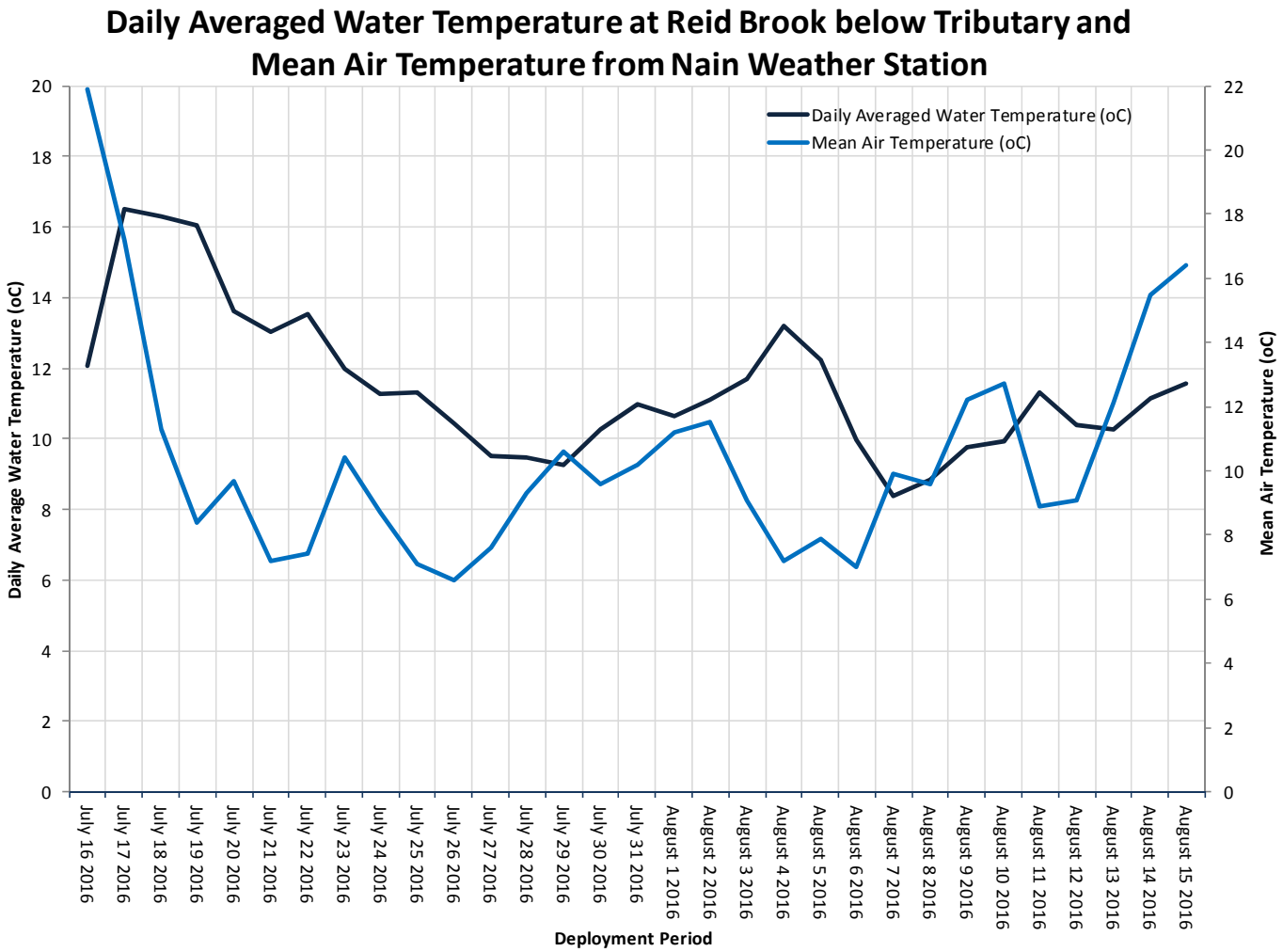

Figure 17: Daily Averaged Water Temperature at Reid Brook below Tributary and Mean Air Temperature from Nain Weather Station

pH

During this deployment this station had a pH range from 6.31 to 6.83 pH units, with a median value of 6.63 (Figure 18).

The pH data dips below the minimum CCME guidelines on a few occasions and these dips correspond with increases in stage. The stage increases are likely a result of precipitation, the addition of rain water causes the water to become slightly more acidic therefore the pH drops. Overall the pH levels at this station are reasonably consistent.

The Canadian Council of Ministers of the Environment (CCME) guidelines are just a basis by which to compare any dramatic change in the pH data within a dataset. Every brook is different with its own natural baseline.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

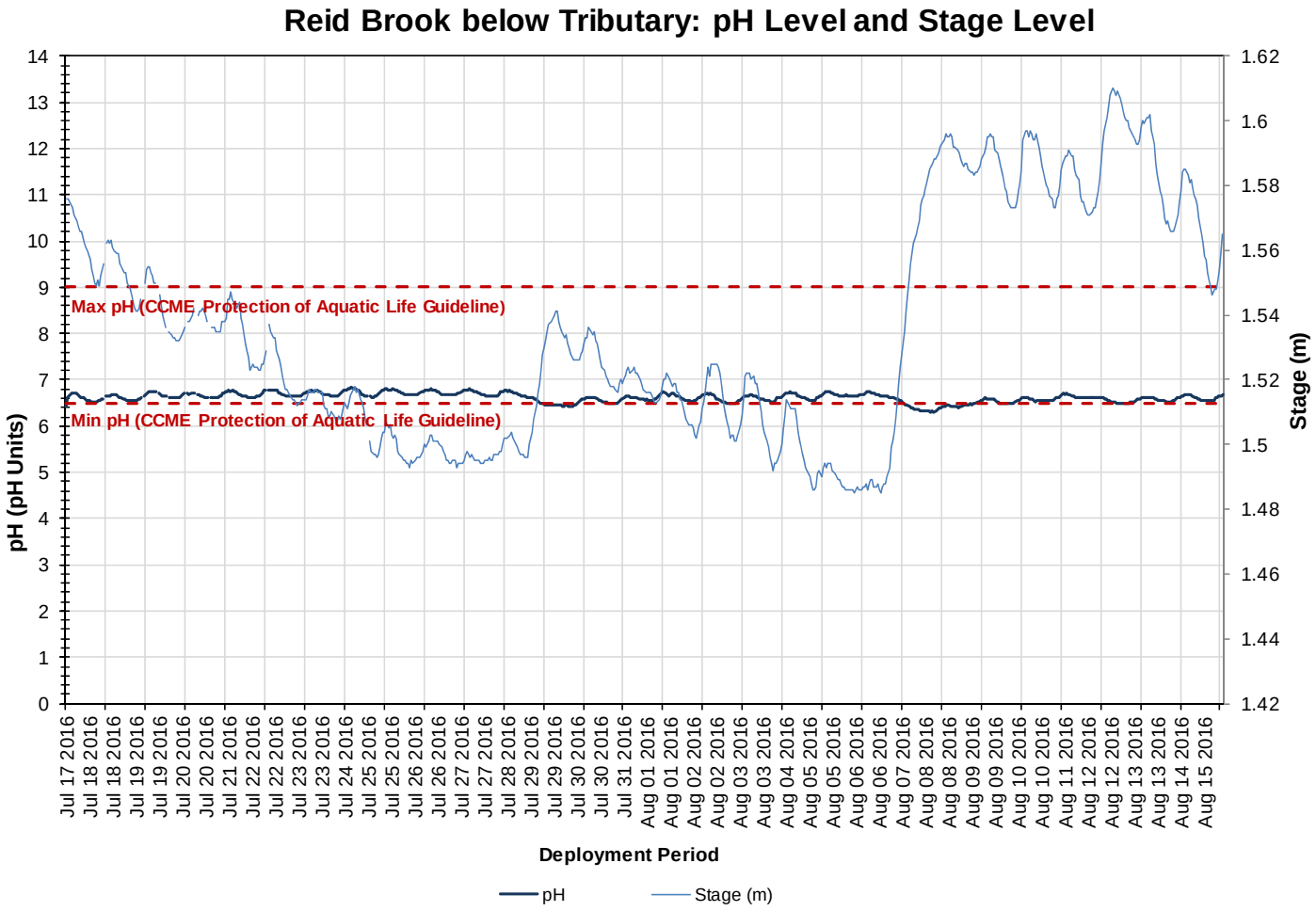

Figure 18: pH & Stage at Reid Brook below Tributary

Specific Conductivity

Specific conductivity ranges from 26.5µS/cm to 33.5µS/cm with a median of 30.3µS/cm. (Figure 19).

As stage level increases, the specific conductivity of the water decreases likely a result of the higher volume of water flushing the dissolved solids through the brook. The relationship is evident on Figure 19, on July 29th and August 7th 2016 whereby the stage and conductivity values show an inverse relationship.

Over the deployment period the conductivity levels are gradually increasing. This is to be expected as the water level drops slightly due to a result of warmer air temperatures and less precipitation occurring at this time of year. This trend is typically experienced at this site (Figure 19).

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

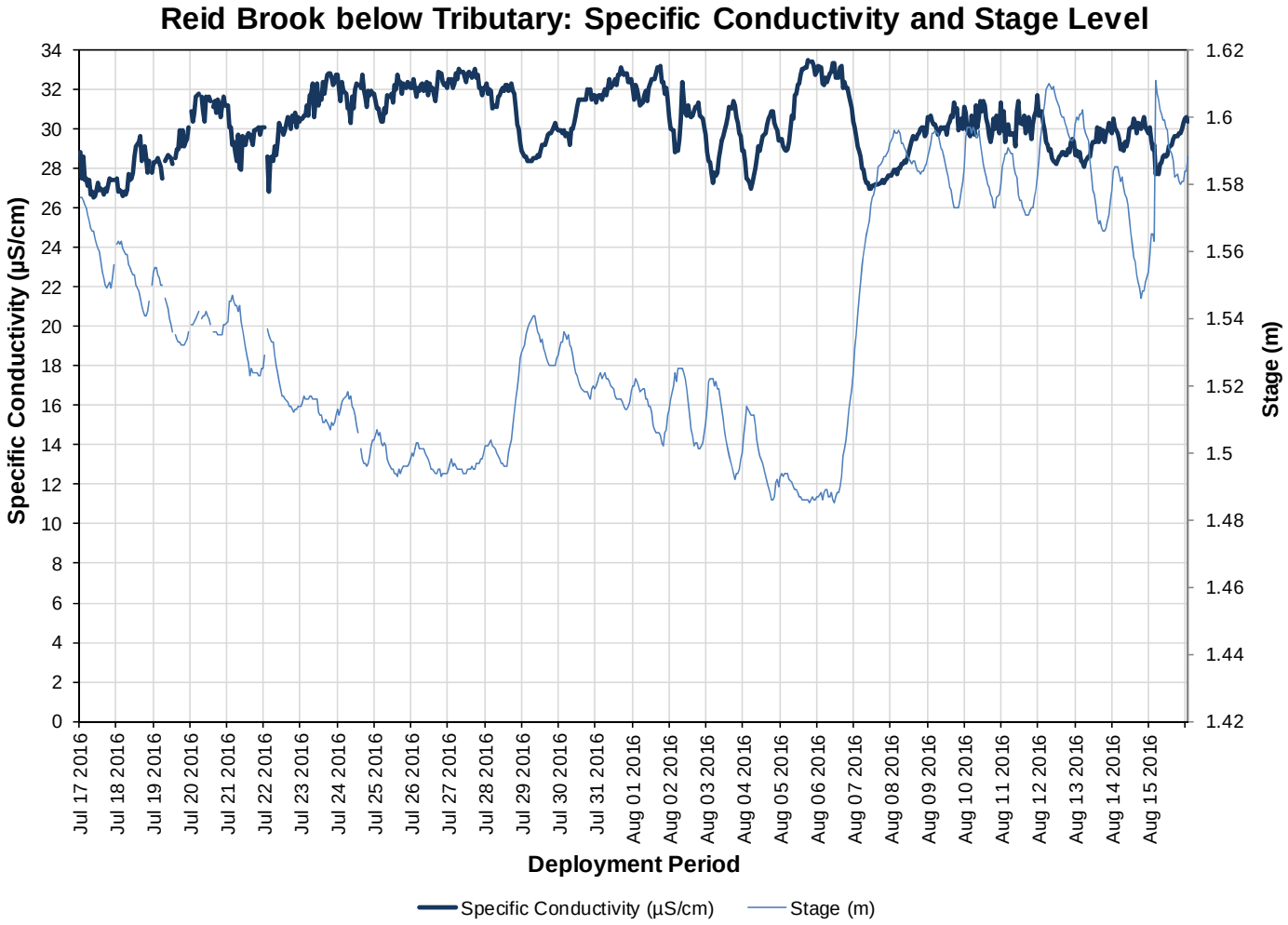

Figure 19: Specific Conductivity & Stage at Reid Brook below Tributary

Dissolved Oxygen

Dissolved oxygen content ranges between 9.10mg/l and 11.20mg/l during the deployment period. The saturation of dissolved oxygen ranges from 93.4% to 103.4% (Figure 20). The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe and then the instrument calculates percent saturation (% Sat) with water temperature (Figure 20).

At the beginning of the deployment the dissolved oxygen is slightly below CCME guideline of 9.5mg/L, however it increases above the guideline for the remainder of the deployment. The dissolved oxygen levels were reasonably consistent, there were small changes in dissolved oxygen that correspond with changes in water temperature at the same time.

On August 6th and 7th, 2016 the dissolved oxygen level in the brook flattened out with less of diurnal pattern occurring. The DO was likely reacting to the lower water temperature and rainfall event at that same time frame.

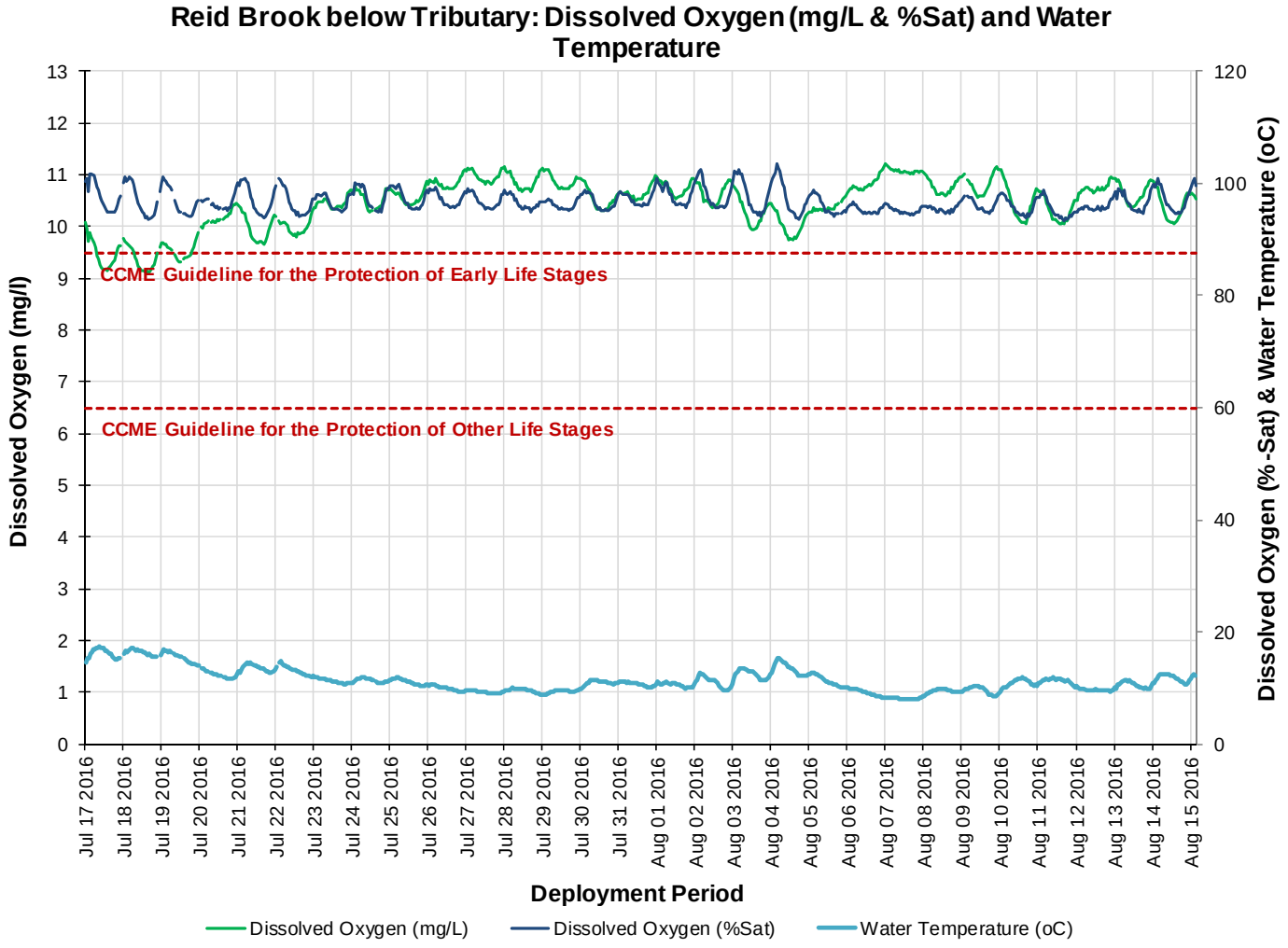

Figure 20: Dissolved Oxygen and Water Temperature at Reid Brook below Tributary

Turbidity

Turbidity ranges from 0.0 NTU to 20.7 NTU during the deployment period, with a median value of 0.0NTU (Figure 21).

A median value of 0.0 NTU indicates there is very little natural background turbidity. There were a few low - medium turbidity events at this station throughout the deployment. The turbidity spikes correlate with an increase in stage level and likely a result of precipitation causing the mixing of solids in the water column (Figure 21).

At removal it was determined that the turbidity probe was blocked by debris. Therefore the data from August 7th, 2016 towards to the end of the deployment was not representing the brook; the data was removed and not used in this report.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

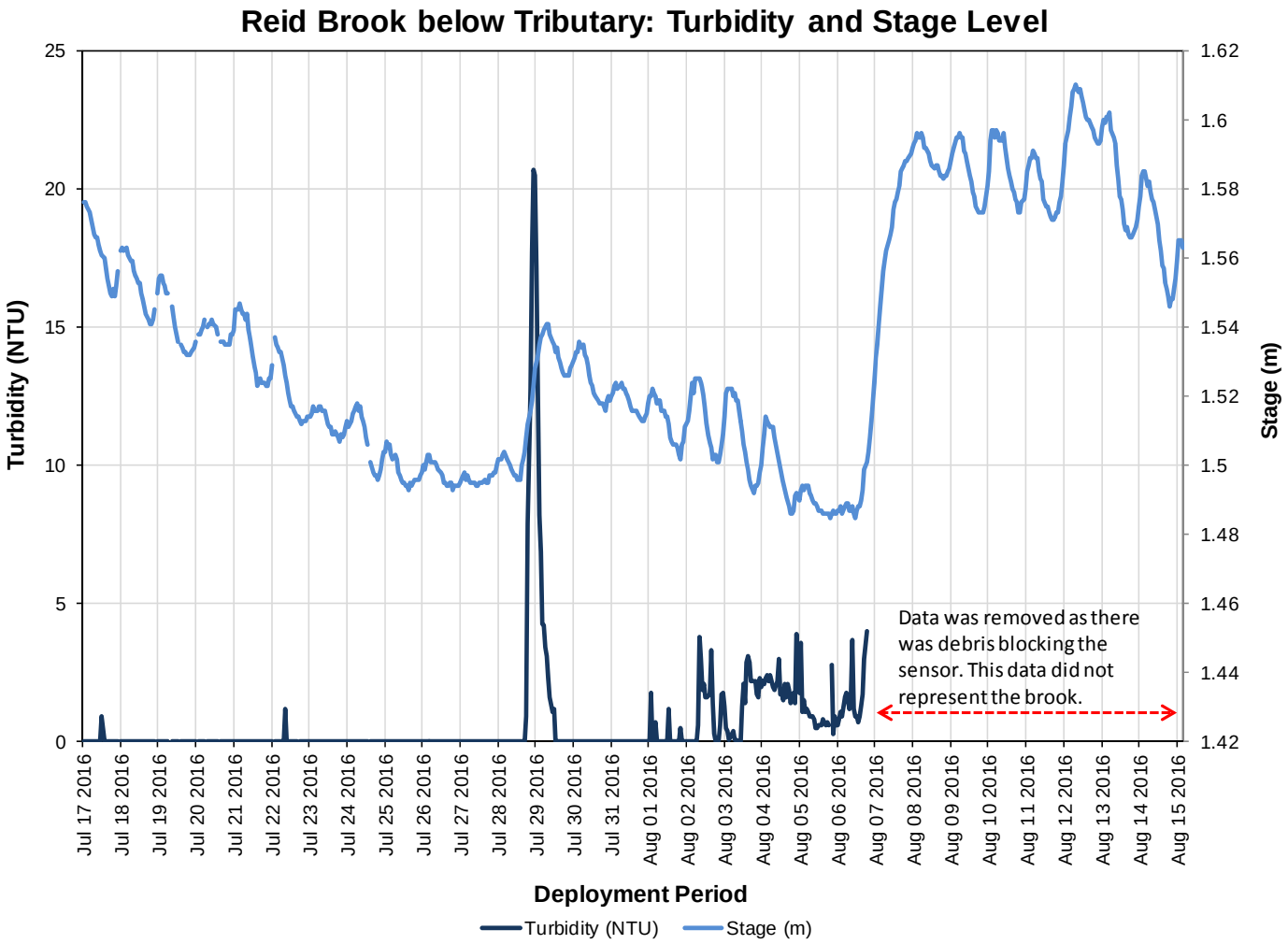

Figure 21: Turbidity and Stage Level at Reid Brook below Tributary

Stage, Streamflow and Precipitation

Stage, Streamflow and precipitation are graphed below to show the relationship between rainfall and water level (Figure 22). It is evident that the peaks in stage (m) and streamflow (m^3/s) data are a result of precipitation.

Precipitation data was obtained from the Environment Canada weather station at Nain. The weather station is 30 km northeast of Voisey's Bay. Precipitation occurs on 17 days during the deployment period and amounts are small in magnitude, with the exception of the largest on August 7th, 2016 with 15.5mm of rain.

During the deployment period, the stage values ranged from 1.49m to 1.61m. Streamflow had a minimum amount of 2.13m^3/s and a maximum flow of 4.80m^3/s.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

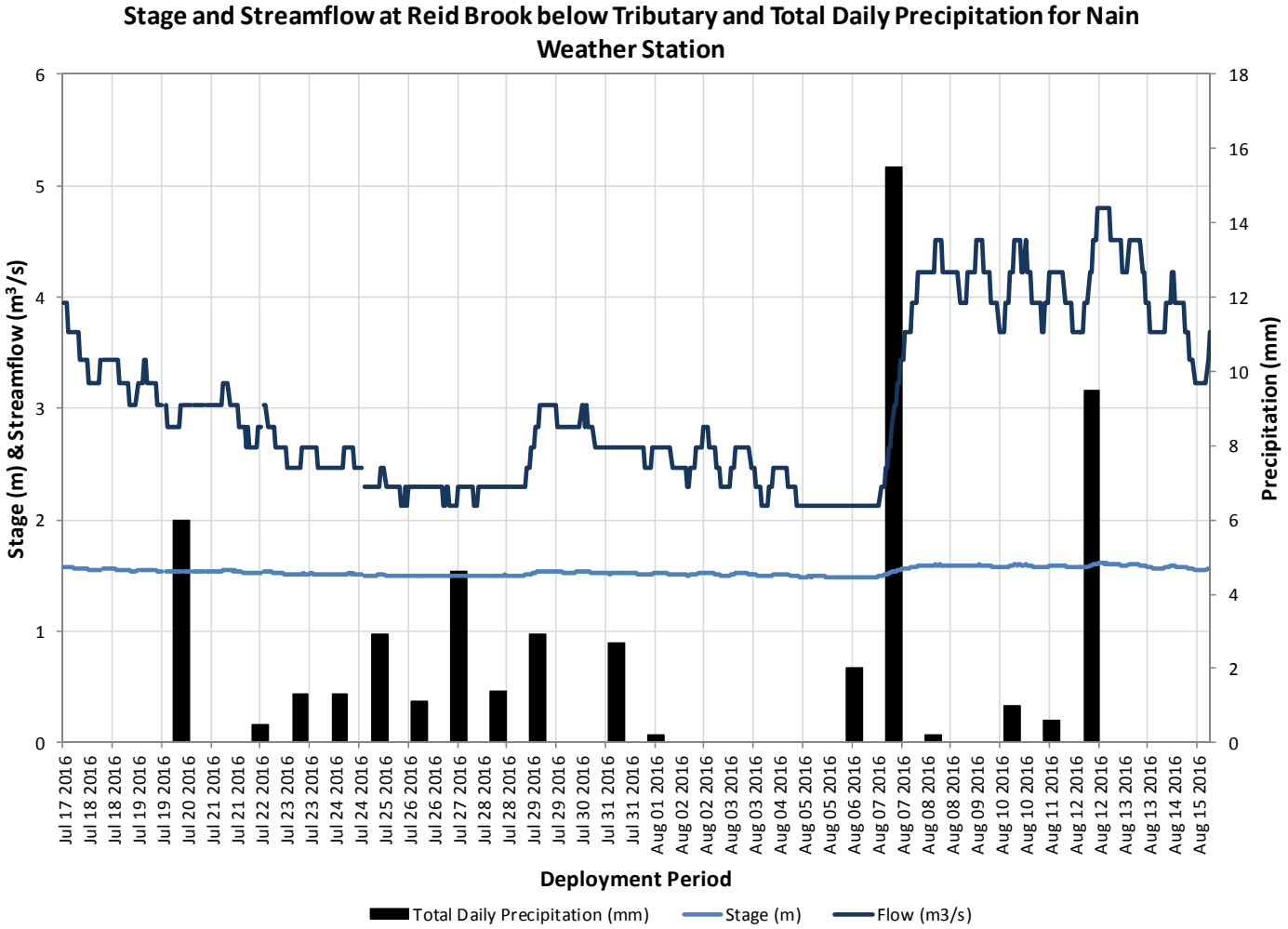

Figure 22: Stage, Streamflow, and Total Daily Precipitation (Nain, Labrador Weather Station) at Reid Brook below Tributary

Tributary to Reid Brook

Water Temperature

Water temperature ranges from 7.80 °C to 15.70 °C, with a median value of 10.40°C (Figure 23).

Streams and brooks are sensitive to changes in the ambient air temperature, thus water temperature will fluctuate considerably depending on the weather and the time of day (Figure 24). This is evident at this station with the low dips in water temperature during the higher stage increases. It is likely that there was a rainfall event at this time.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

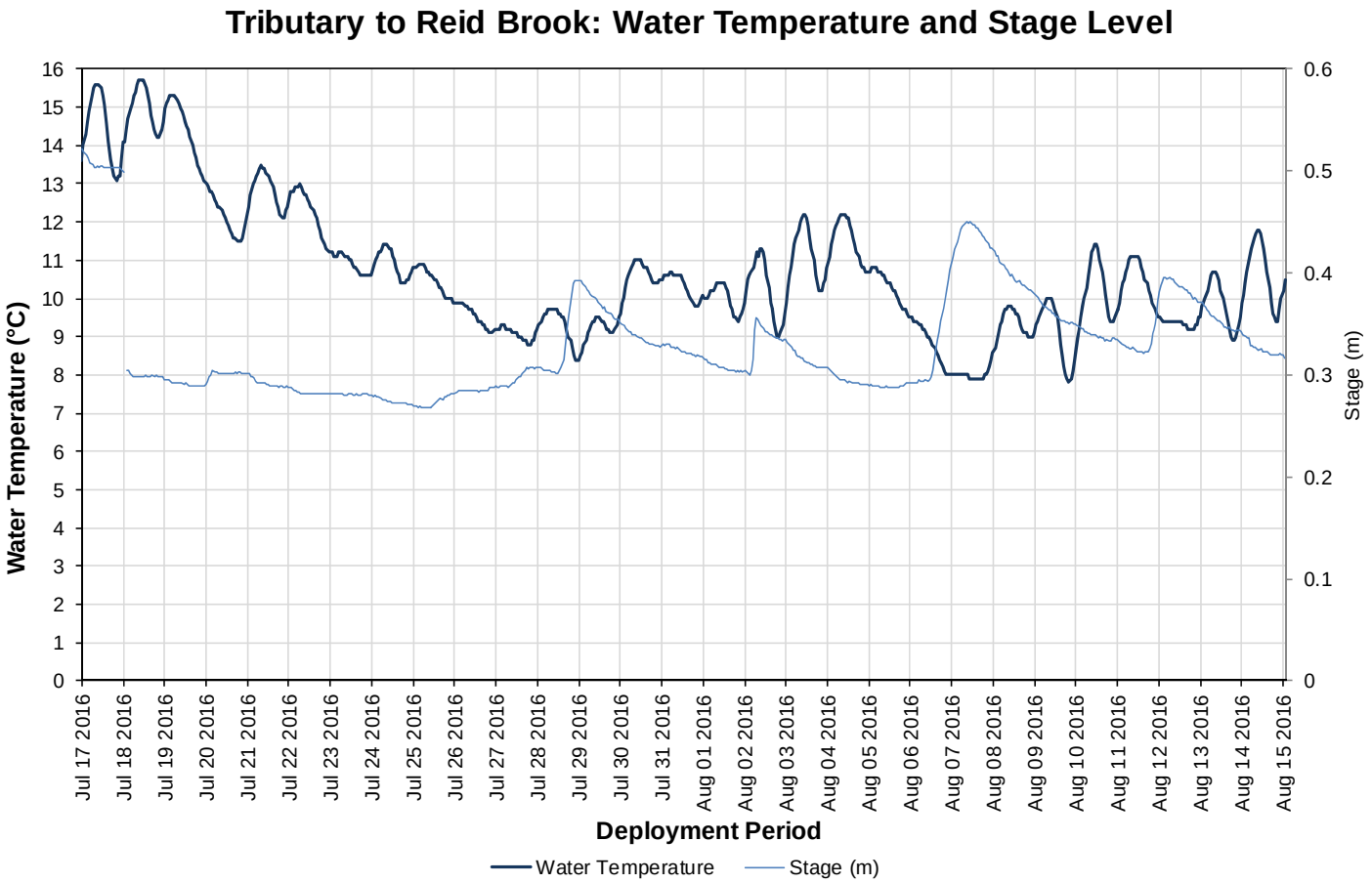

Figure 23: Water Temperature and Stage at Tributary to Reid Brook

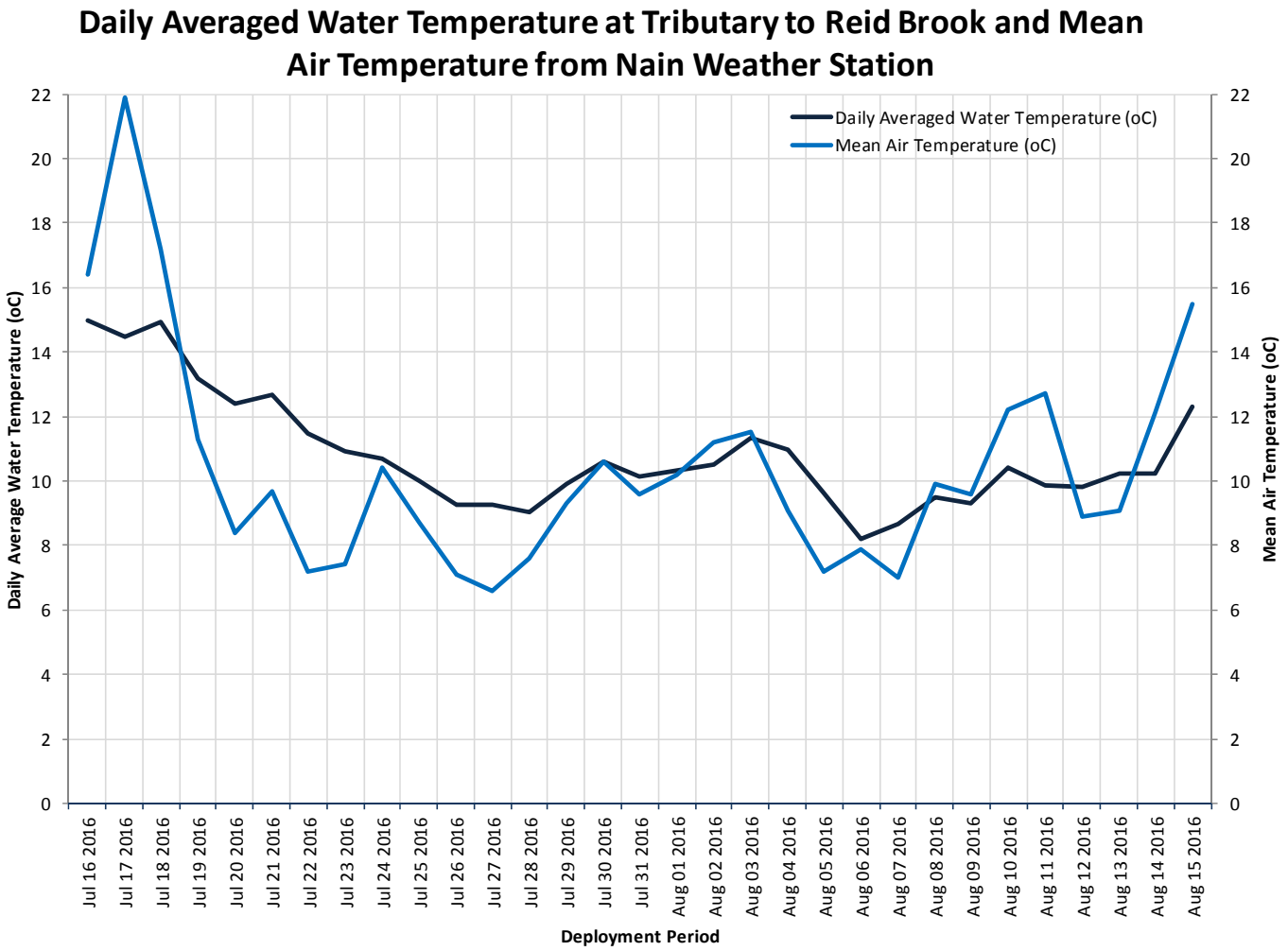

Figure 24: Daily Average Water Temperature at Tributary to Reid Brook and Mean Air Temperature from Nain Weather Station.

pH

Over the deployment period the pH values ranged from 6.71 to 7.22 pH units, with a median value of 7.07 (Figure 25).

The pH values stayed within the CCME guidelines over the deployment period. There were slight dips in pH values during high stage events. Stage increases can indicate a rainfall event, and rainfall will influence the pH values to decrease for a short period of time. This is evident on Figure 25 on the dates, July 29th, August 7th and August 12th, 2016.

The CCME guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams are different and have natural baseline conditions.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

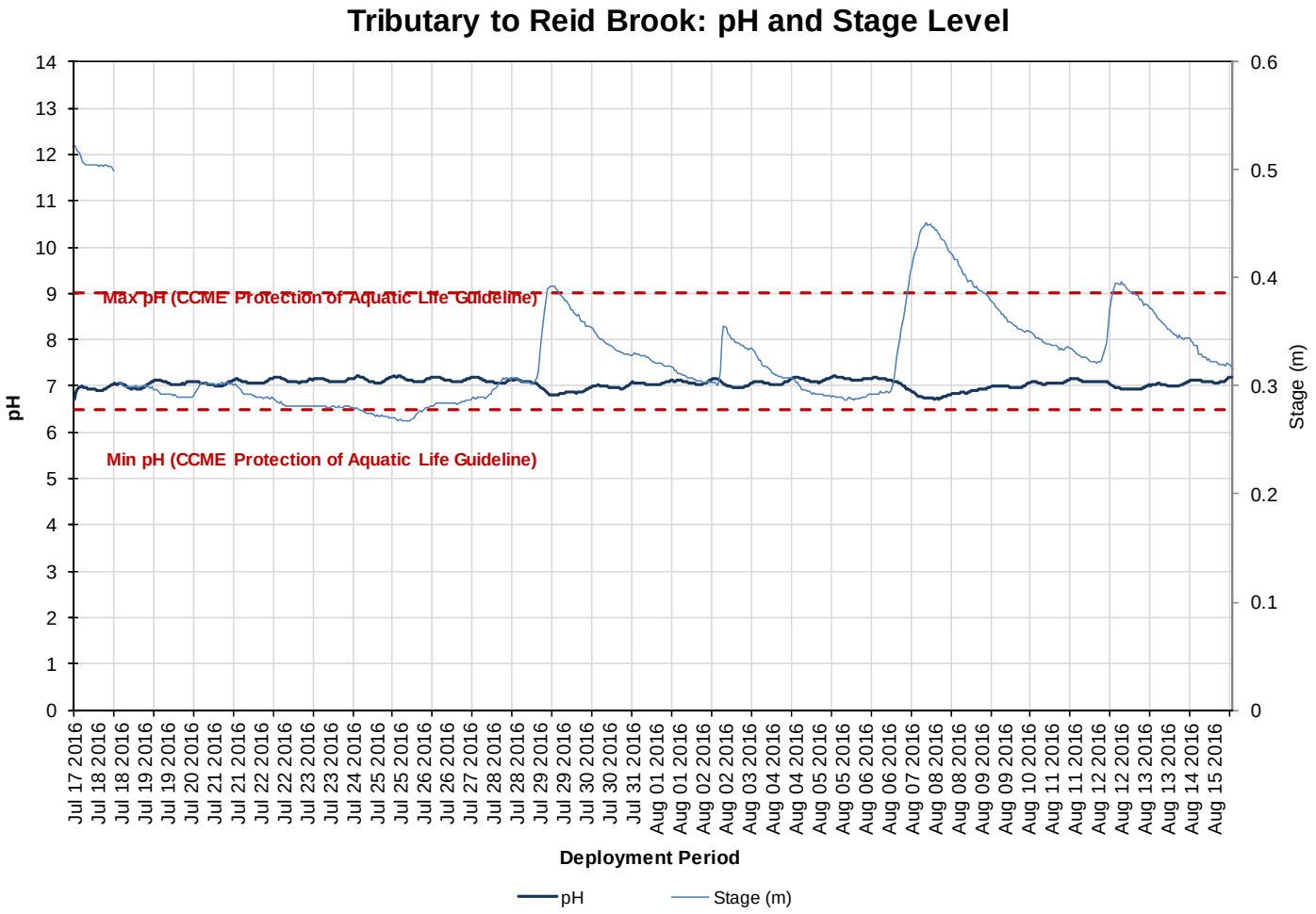

Figure 25: pH & Stage Level at Tributary to Reid Brook

Specific Conductivity

Specific conductivity ranges from 27.5µS/cm to 36.4µS/cm with a median of 34.0µS/cm. (Figure 26).

The relationship between specific conductance and stage is inversed. When stage level rises, the specific conductance level drops in response as the increased amount of water in the river system dilutes the solids that are present (Figure 26).

The conductivity data graphed below displays the inverse relationship. As the stage levels peak there is a corresponding dip in specific conductivity for a short period of time.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

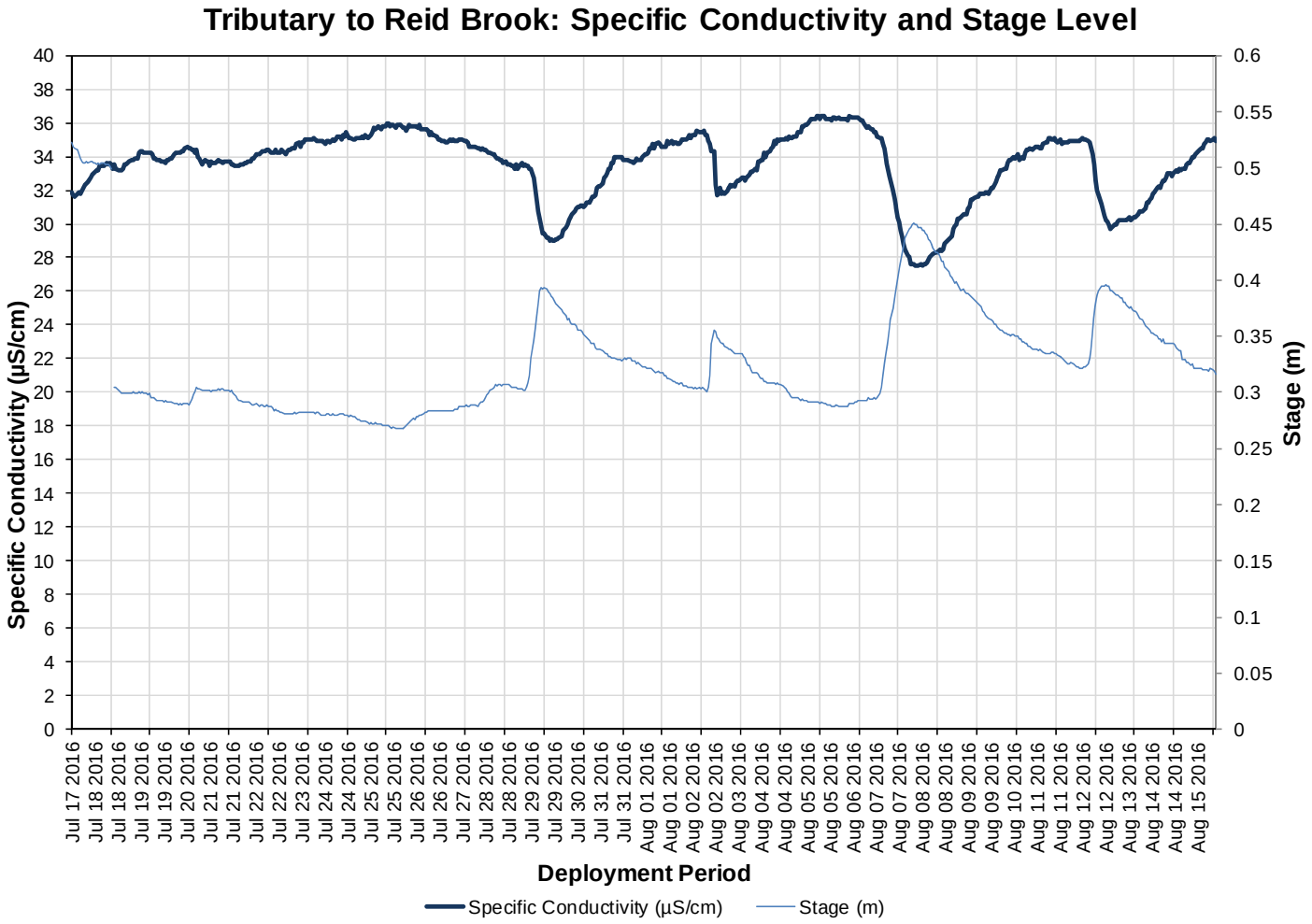

Figure 26: Specific Conductivity & Stage at Tributary to Reid Brook

Dissolved Oxygen

Dissolved oxygen content ranges between 9.29mg/l and 11.37mg/l during the deployment period. The saturation of dissolved oxygen ranges from 94.4% to 100.2% (Figure 27). The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe and then the instrument calculates percent saturation (% Sat) with water temperature.

At the beginning of this deployment the dissolved oxygen concentration was just below the CCME guideline for Early Life Stages. These dips correspond with high water temperatures at the same time. For the remainder of the deployment the dissolved oxygen mg/L levels remained above the CCME guidelines for the protection of early/other life stages (Figure 27).

Dissolved oxygen data also displays a diurnal pattern as the data is displayed. During nightfall the dissolved oxygen levels are higher, the cooler temperatures allow for more DO to be stored in the water column. During the day time the water temperatures are higher so there is less DO in the water column. During the day time aquatic organisms will also be using the dissolved oxygen present.

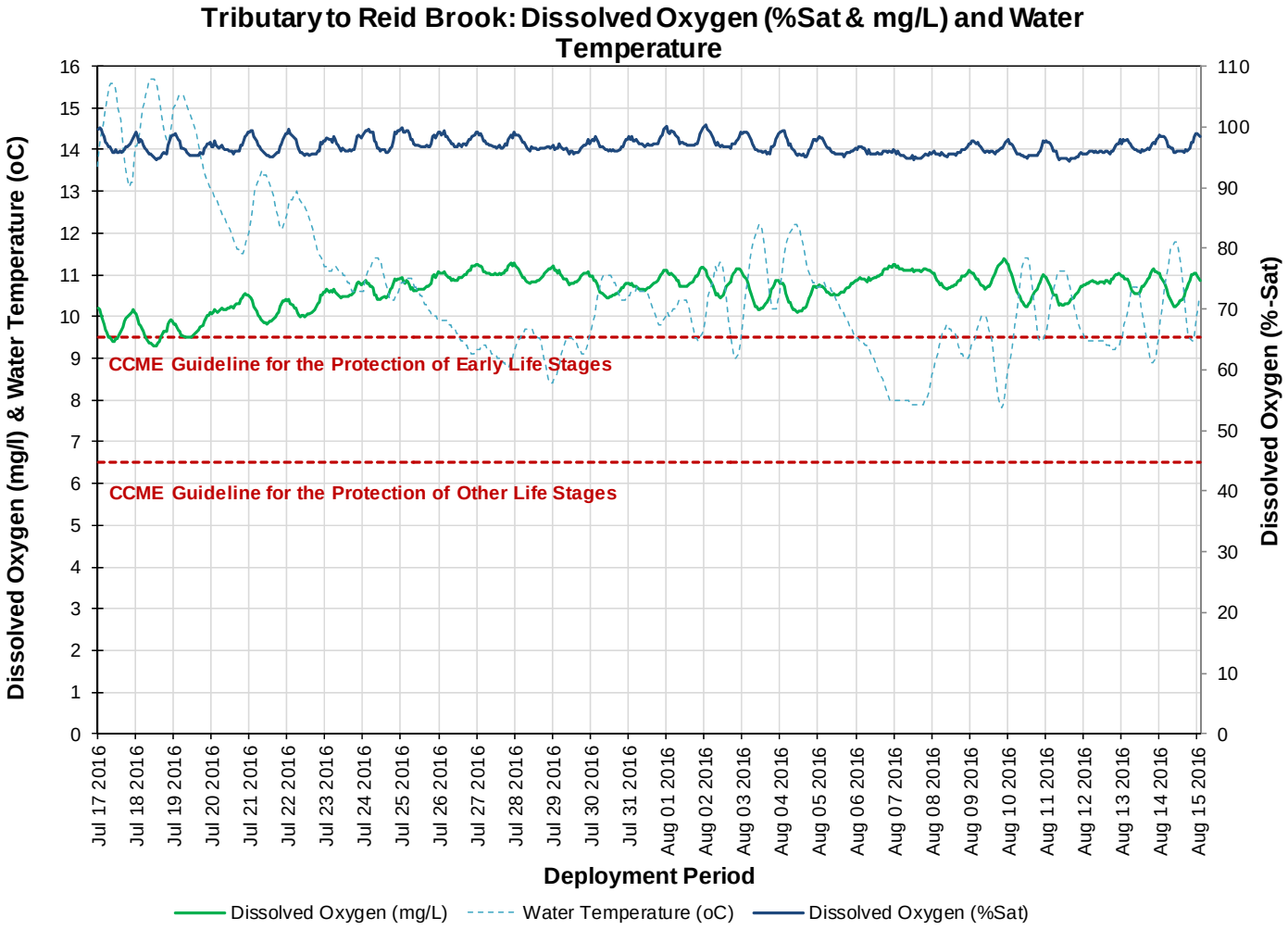

Figure 27: Dissolved Oxygen & Water Temperature at Tributary to Reid Brook

Turbidity

Turbidity ranges from 0.0 NTU to 30.8 NTU during the deployment period, with a median value of 0.0NTU (Figure 28). A median value of 0.0 NTU indicates there is very little natural background turbidity at this station during this deployment period.

There are a number of low and medium turbidity events at this station throughout the deployment. The larger turbidity events correlate with an increase in stage level, likely a result of rainfall. The increase in water volume can stir up solids and materials in the water column (Figure 28).

This particular site has sandy-clay like bottom to the brook. This material is easily disturbed during rainfall events or large increases in stage.

Please note the stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

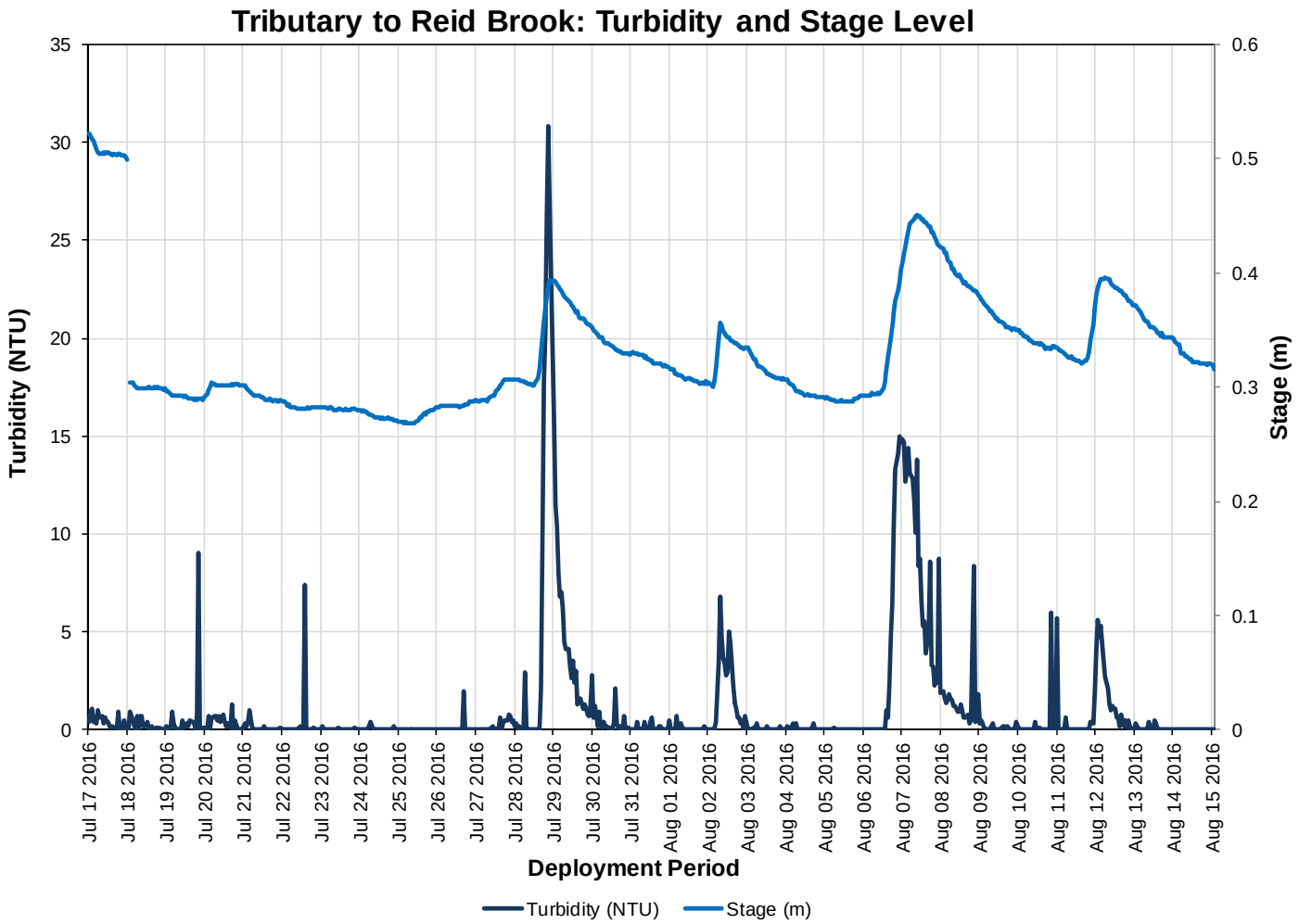

Figure 28: Turbidity & Stage at Tributary to Reid Brook

Stage, Streamflow, and Precipitation

Please note the stage and streamflow data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data and corrected data can be obtained upon request to WSC. Precipitation data was obtained from the Environment Canada weather station at Nain. The weather station is 30 km northeast of Voisey's Bay (Figure 29).

Precipitation occurs on 17 days during the deployment period and amounts are relatively small in magnitude, the largest rainfall occurs on August 7th, 2017 with a total of 15.5mm

Daily averaged Stage, Streamflow and total precipitation are graphed below to show the relationship between rainfall and water level (Figure 29). It is evident that the peaks in stage (m) and streamflow data are a result of precipitation. During the deployment period, the stage values ranged from 0.27m to 0.52m. Streamflow had a minimum amount of 0.19m^3/s and a maximum flow of 0.23m^3/s.

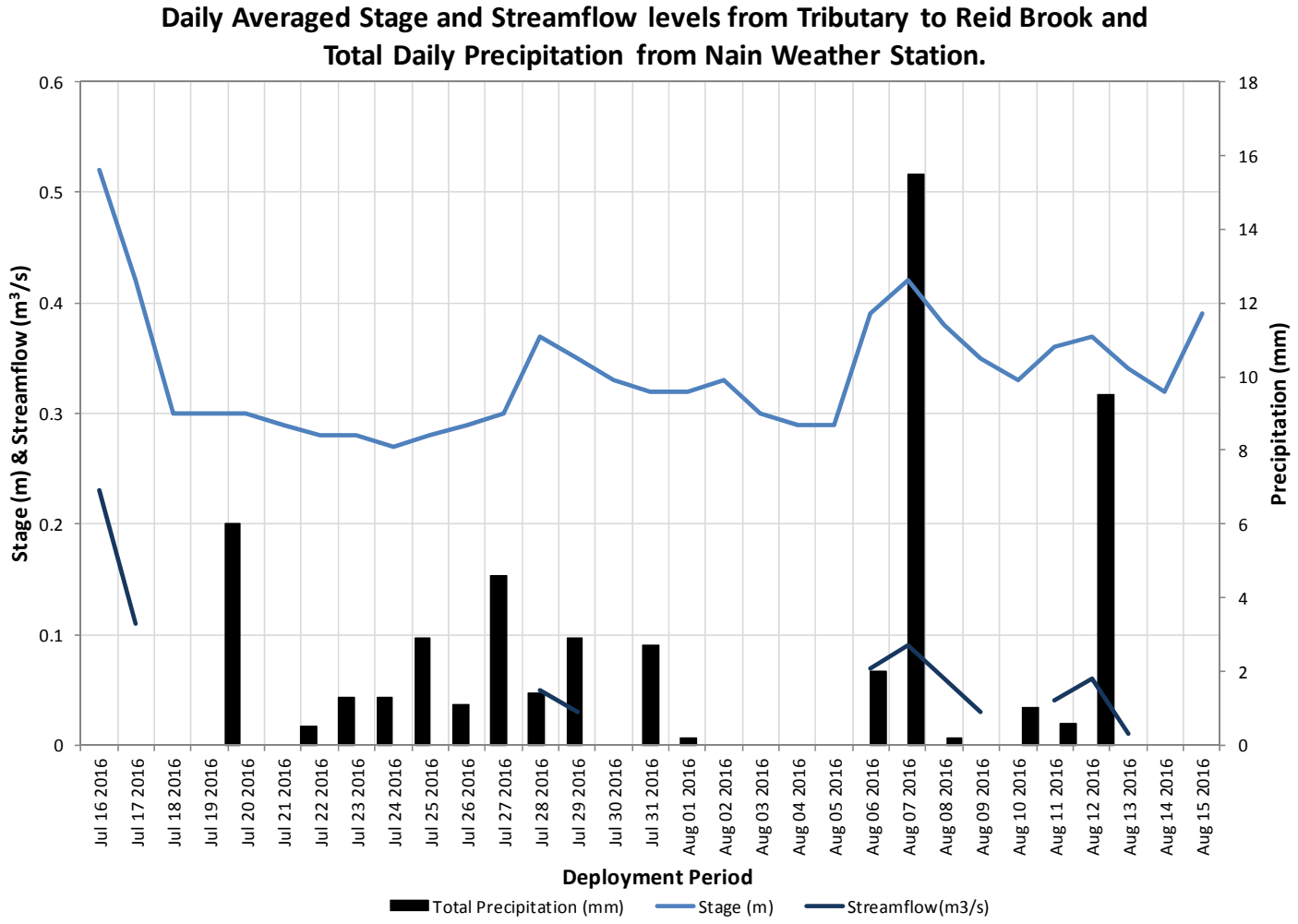

Figure 29: Daily Averaged Stage and Streamflow at Tributary to Reid Brook and Total Daily Precipitation (Nain, Labrador Weather Station)

Conclusions

The overall water temperatures across all stations were within a minimum of 6.35°C found at Reid Brook at Outlet of Reid Pond and a maximum of 22.02°C recorded at Camp Pond Brook below Camp Pond. These two stations also had the lowest water temperature minimum and highest water temperature maximum from the previous deployment season. Overall the water temperature was increasing across the network of stations. The stations on Camp Pond Brook, Tributary to Lower Reid Brook and Lower Reid Brook are more sensitive to changes in the ambient air temperatures as these sites are brooks with continuously moving water. Reid Brook at Outlet of Reid Pond is a pond that has a larger surface area and is deeper. Ponds and lakes take a longer time to adjust to the ambient air temperature. This is likely the reason why Reid Brook at Outlet of Reid Pond maintains the lowest minimum water temperature.

The pH values for this deployment ranged between a minimum of 6.31 pH units at Reid Brook below Tributary and maximum of 7.42 pH units at Reid Brook at Outlet of Reid Pond site. Throughout this season the pH at all of the stations was reasonably consistent. When there were changes in the pH values it was during high stage events, indicating rainfall, which is a natural occurrence.

The overall specific conductivity across all stations were within a minimum of 9.1 µS/cm at Reid Brook at Outlet of Reid Pond and a maximum value of 45.8 µS/cm at Camp Pond Brook below Camp Pond. These two stations also had the lowest conductivity minimum and highest conductivity maximum from the June to July 2016 deployment. Conductivity values at Reid Brook at Outlet of Reid Pond were the lowest across deployment when compared to the other stations. Camp Pond Brook below Camp Pond maintains the highest median at 36.9µS/cm, however this is to be expected with Camp Pond Brook being closer to the mine site and has an increased potential for roadway runoff and other anthropogenic influences.

Dissolved oxygen levels for the deployment period ranged between a minimum of 8.22 mg/l at Camp Pond Brook below Camp Pond and a maximum of 11.75 mg/l found at Reid Brook at Outlet to Reid Pond. These two stations also had the lowest DO mg/L minimum and highest DO mg/L maximum from the June to July 2016 deployment season. Dissolved oxygen is lower at this time of year and varies diurnally as water temperature is greatly affected by ambient air temperature.

Turbidity levels for the four real-time stations ranged within a minimum of 0.0 NTU from all stations and a maximum of 30.8 NTU at Tributary to Reid Brook. Tributary to Reid Brook site has sandy-clay like bottom to the brook. This material is easily disturbed during rainfall events or large increases in stage. It is likely the cause of why this brook has the highest maximum turbidity data for this deployment.

Overall the changes in the water quality for this deployment can be explained by natural events. Camp Pond Brook below Camp Pond does have the potential for anthropogenic influences as the site is the closest to the inhabited area. It is important to note that during a change (a decrease or increase) in the water quality the change only occurs for a short period of time and the water quality parameters do return to the original state.

APPENDIX A: Comparison Graphs

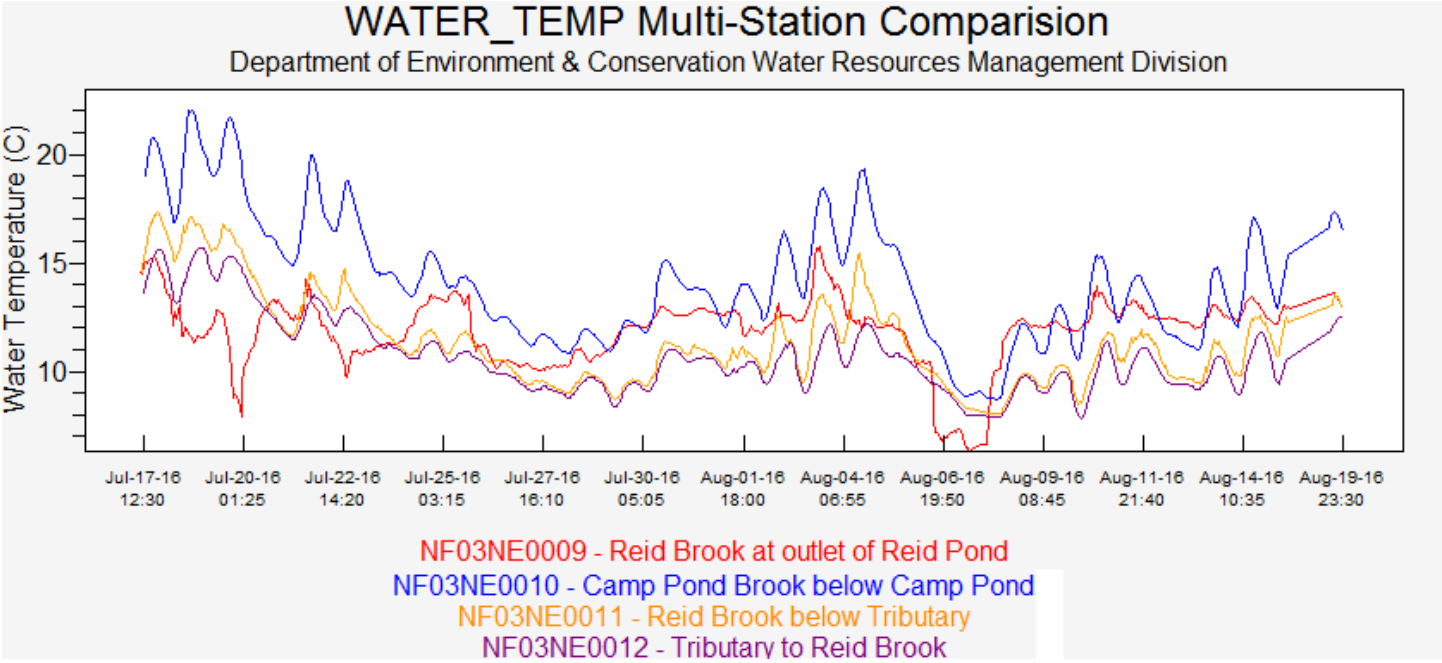

Figure A1: Comparison of Water Temperature at the Real-Time Stations in Voisey's Bay

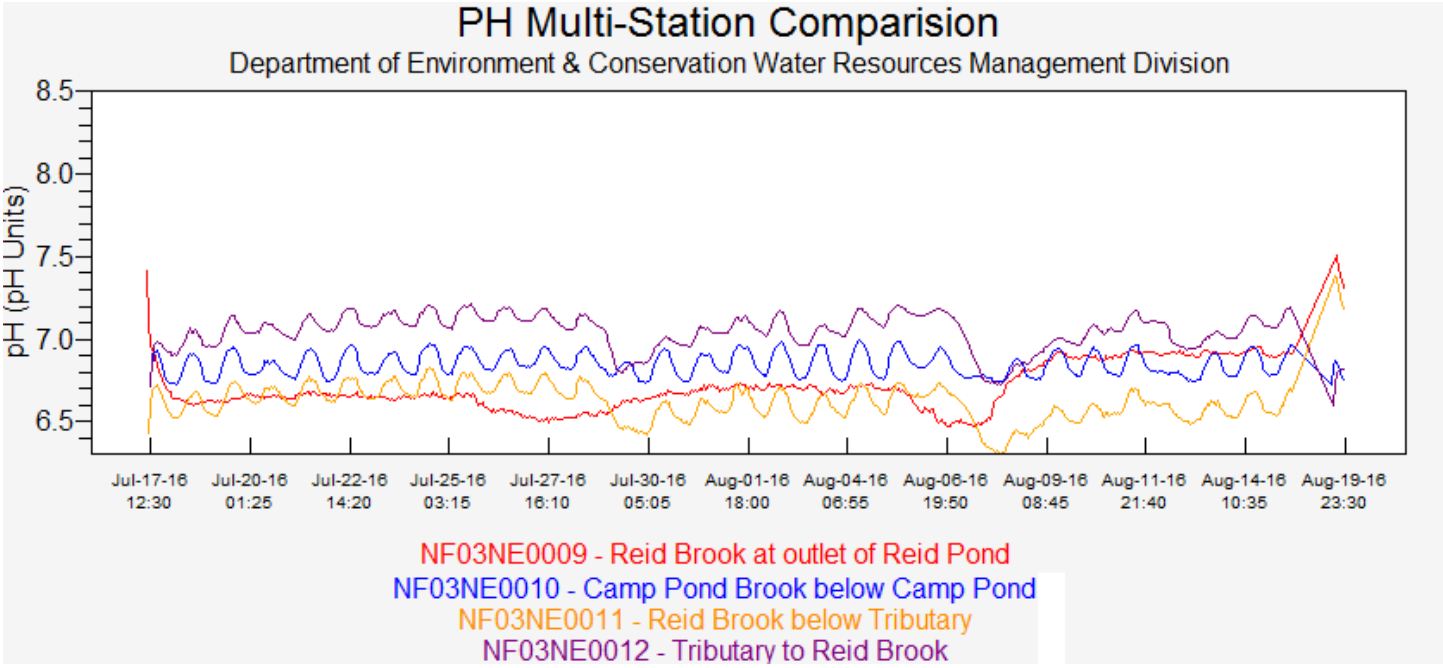

Figure A2: Comparison of pH at the Real-Time Stations in Voisey's Bay

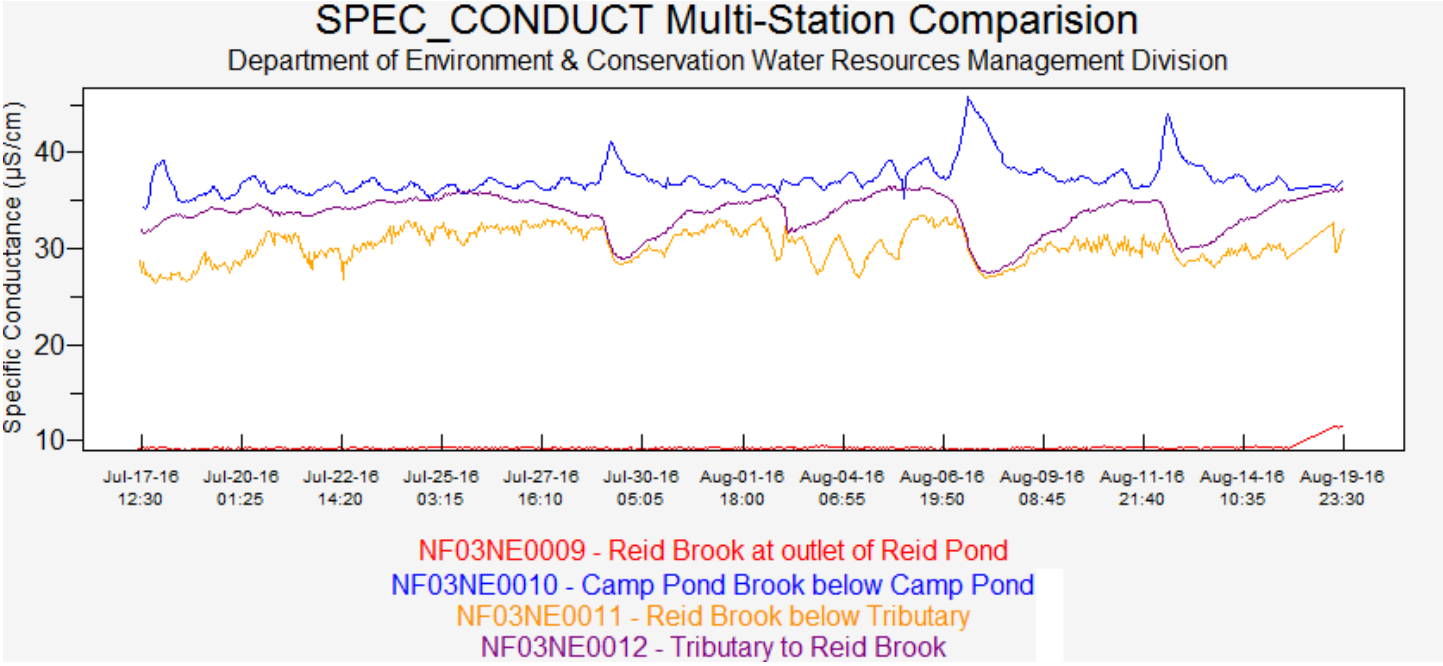

Figure A3: Comparison of Conductivity at the Real-Time Stations in Voisey's Bay

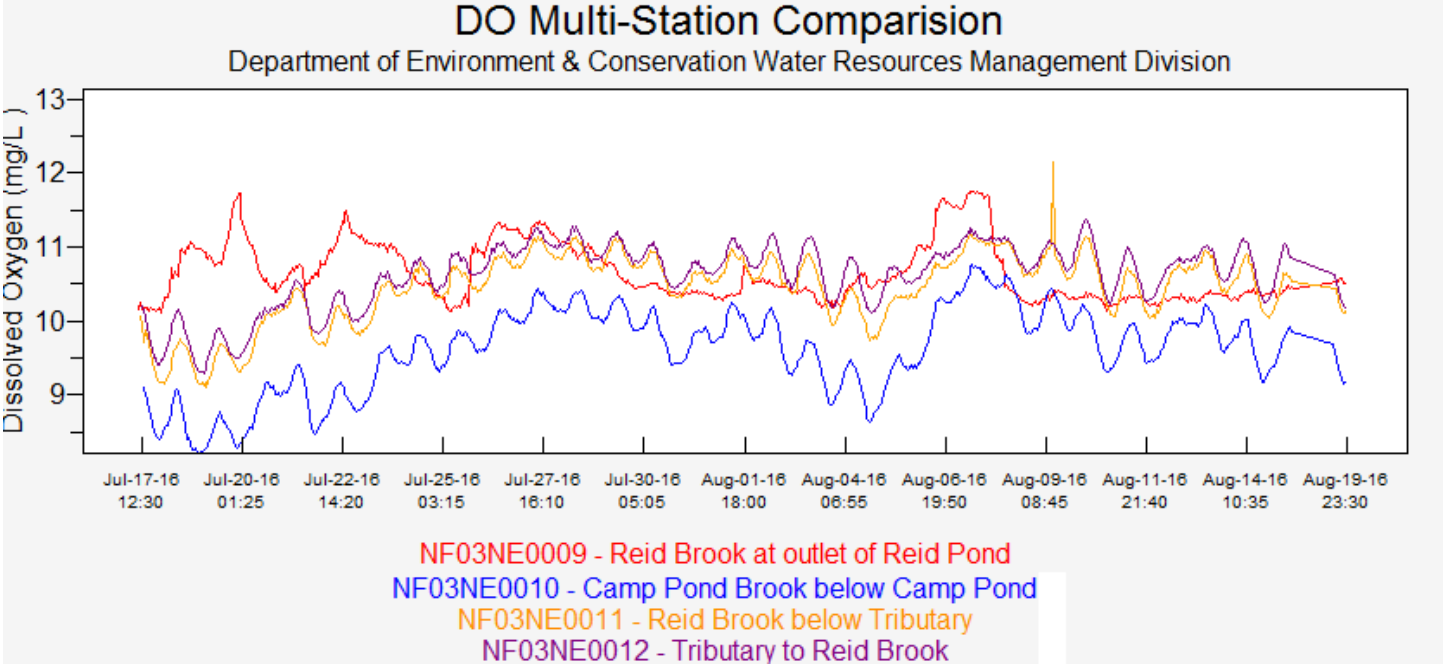

Figure A4: Comparison of Dissolved Oxygen (mg/L) at the Real-Time Stations in Voisey's Bay

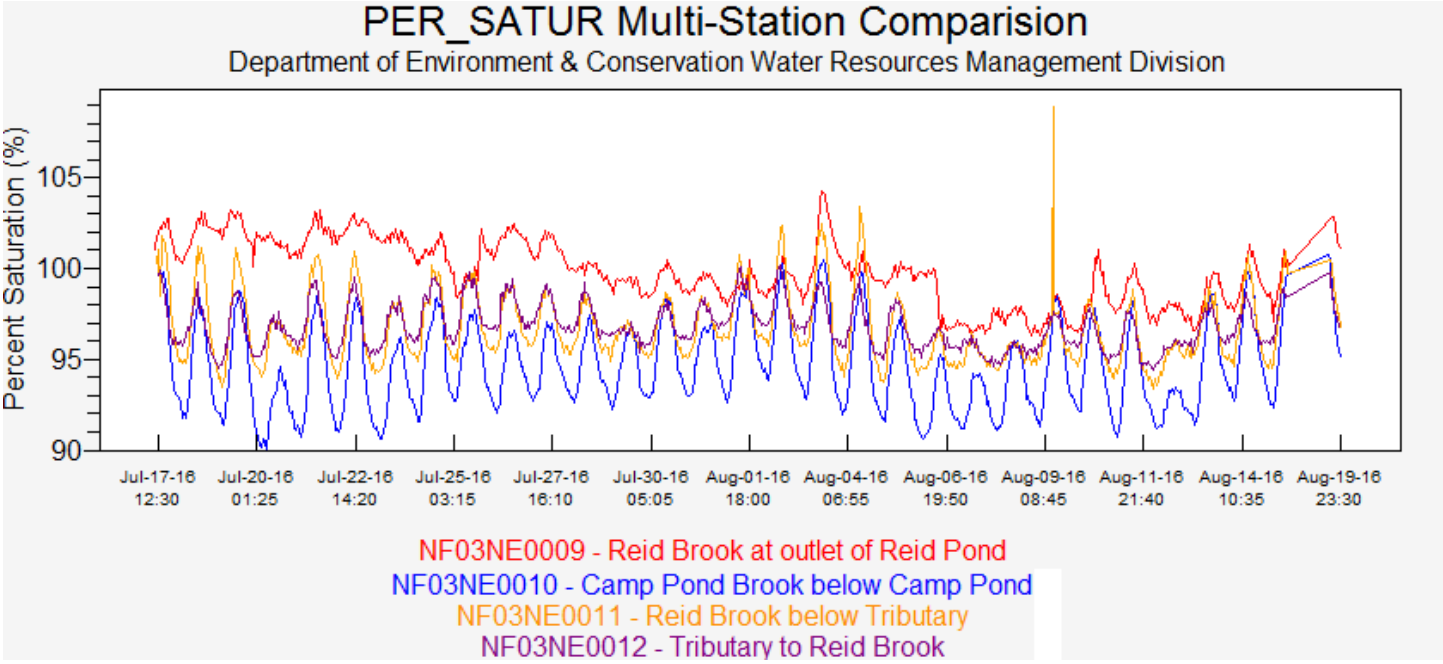

Figure A5: Comparison of Dissolved Oxygen (%Sat) at the Real-Time Stations in Voisey's Bay

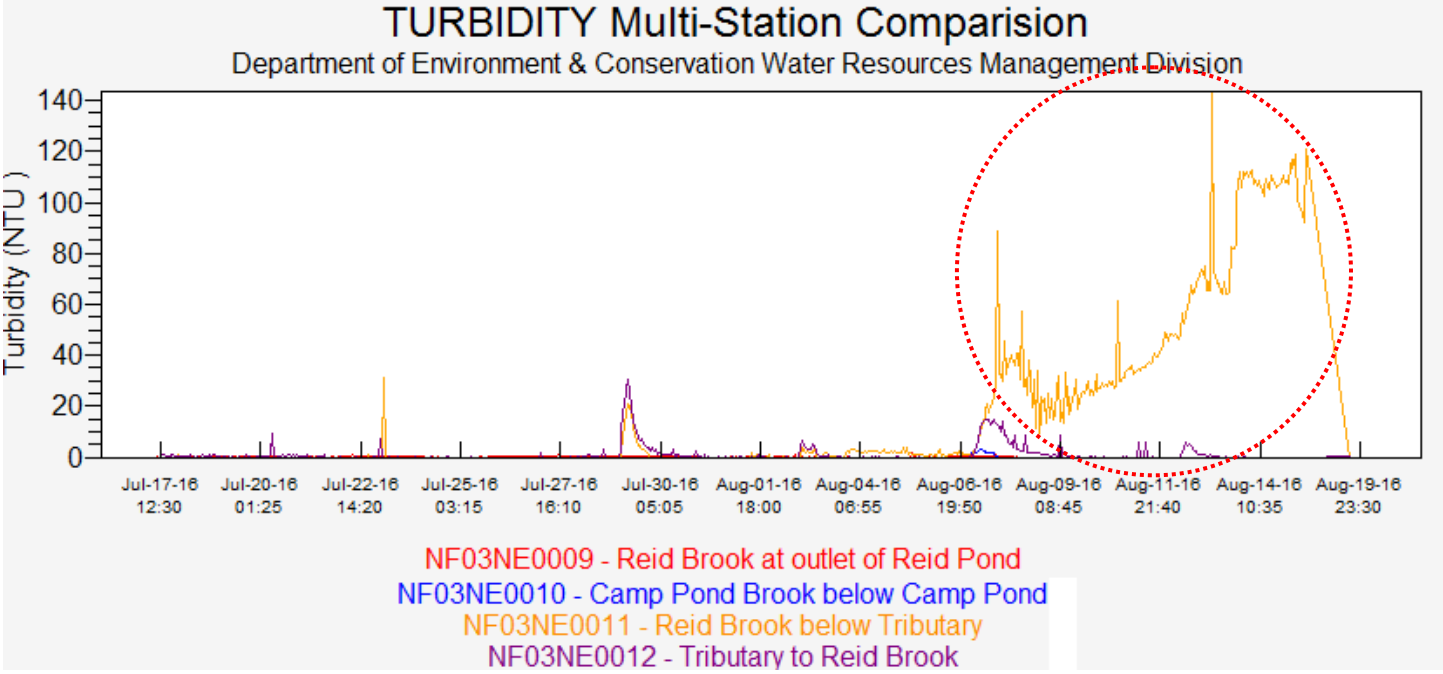

Figure A6: Comparison of Turbidity at the Real-Time Stations in Voisey's Bay. (The circled Reid Brook below Tributary turbidity data was removed for the report).

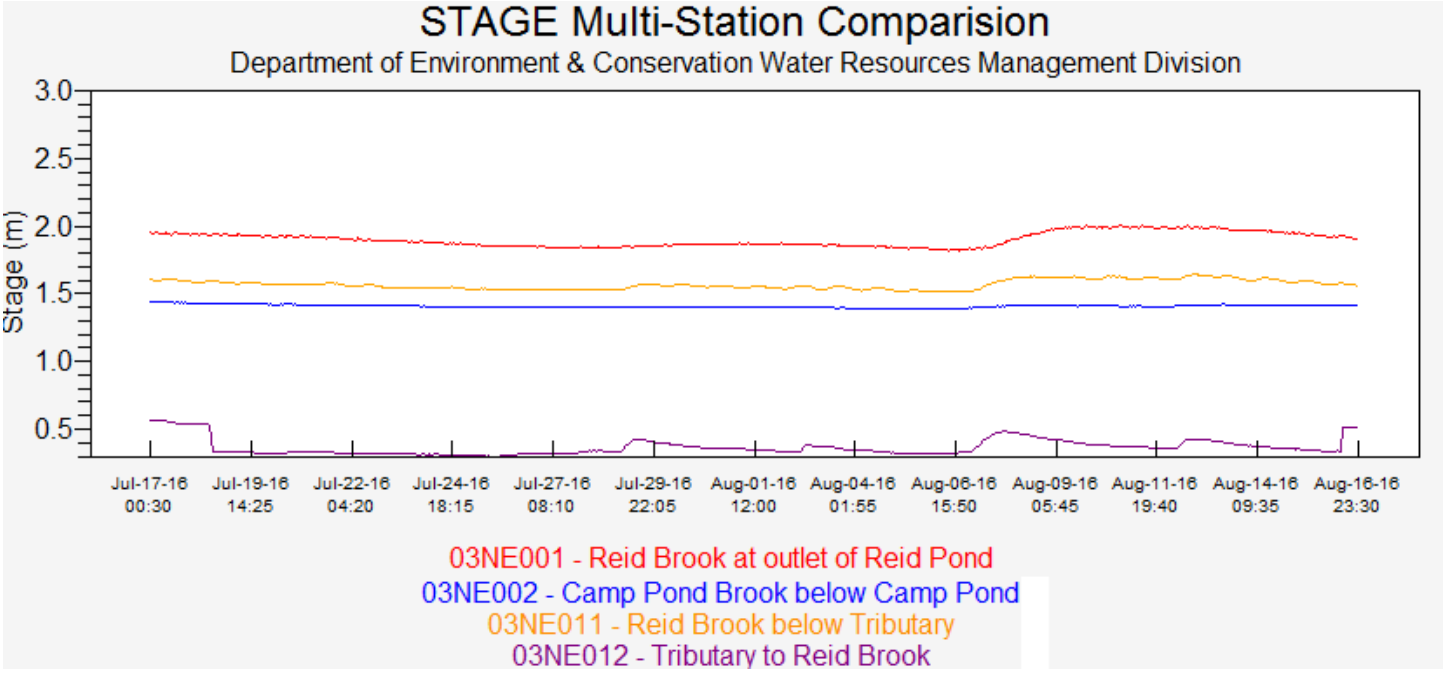

Figure A7: Comparison of Stage (m) at the Real-Time Stations in Voisey's Bay. Please note the stage and streamflow data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data.

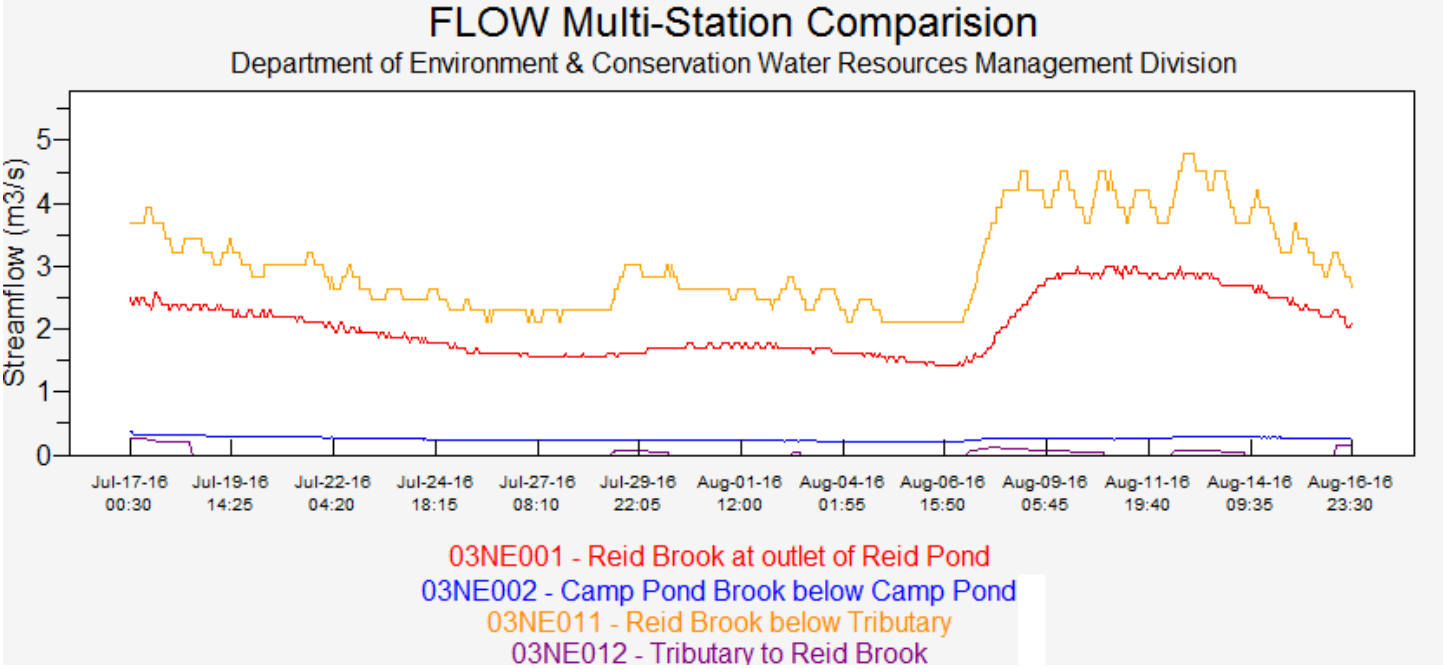

Figure A8: Comparison Flow (m^3/s) at the Real-Time Stations in Voisey's Bay. Please note the stage and streamflow data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data.

APPENDIX B: Water Parameter Description

Dissolved Oxygen: The amount of Dissolved Oxygen (DO) (mg/l or % saturation) in the water is vital to aquatic organisms for their survival. The concentration of DO is affected by such things as water temperature, water depth and flow (e.g., aeration by rapids, riffles etc.), consumption by aerobic organisms, consumption by inorganic chemical reactions, consumption by plants during darkness, and production by plants during the daylight (CCME 2014).

Flow: Flow (m3/s) is a measure of how quickly a volume of water is displaced in streams, rivers, and other channels.

pH: pH is the measure of hydrogen ion activity and affects: (i) the availability of nutrients to aquatic life; (ii) the concentration of biochemical substances dissolved in water; (iii) the efficiency of hemoglobin in the blood of vertebrates; and (iv) the toxicity of pollutants. Changes in pH can be attributed to industrial effluence, saline inflows or aquatic organisms involved in the photosynthetic cycling of CO_2 (CCME 2014).

Specific conductivity: Specific conductivity (µS/cm) is a measure of water's ability to conduct electricity, with values normalized to a water temperature of 25°C. Specific conductance indicates the concentration of dissolved solids (such as salts) in the water, which can affect the growth and reproduction of aquatic life. Specific conductivity is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (Swanson and Baldwin 1965).

Stage: Stage (m) is the elevation of the water surface and is often used as a surrogate for the more difficult to measure flow.

Temperature: Essential to the measurement of most water quality parameters, temperature (°C) controls most processes and dynamics of limnology. Water temperature is influenced by such things as ambient air temperature, solar radiation, meteorological events, industrial effluence, wastewater, inflowing tributaries, as well as water body size and depth (OTT Hydromet 2017).

Total Dissolved Solids: Total Dissolved Solids (TDS) (g/l) is a measure of alkaline salts dissolved in water or in fine suspension and can affect the growth and reproduction of aquatic life. It is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (CCME 2014; Swanson and Baldwin 1965).

Turbidity: Turbidity (NTU) is a measure of the translucence of water and indicates the amount of suspended material in the water. Turbidity is caused by any substance that makes water cloudy (e.g., soil erosion, micro-organisms, vegetation, chemicals, etc.) and can correspond to precipitation events, high stage, and floating debris near the sensor (Sadar, 2017).

APPENDIX C: Grab Sample Results

Maxxam Job #: B6F2238
Report Date: 2016/07/29

Department of Environment & Conservation
Site Location: VOISEY'S BAY, NL
Your P.O. #: 215062145-2

Sample Details/Parameters	Result	RDL	UNITS	MU	Extracted	Analyzed	By	Batch
CSZ922 Reid Brook at Outlet to Reid Pond								
Sampling Date 2016/07/17 10:24								
Matrix W								
Sample # 2016-6404-00-SI-SP								
Registration # WS-S-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Calculated TDS	5.0	1.0	mg/L	N/A	2016/07/29	2016/07/29		4588215
Hardness (CaCO3)	4.5	1.0	mg/L	N/A	2016/07/26	2016/07/26		4588089
Nitrate (N)	0.066	0.050	mg/L	N/A	2016/07/29	2016/07/29		4588212
Inorganics								
Conductivity	13	1.0	uS/cm	N/A	2016/07/25	2016/07/25	JMV	4592004
Bromide (Br-)	<1.0	1.0	mg/L	N/A	2016/07/26	2016/07/26	FD	4591718
Total Alkalinity (Total as CaCO3)	<5.0	5.0	mg/L	N/A	2016/07/27	2016/07/27	MCN	4594500
Dissolved Chloride (Cl)	<1.0	1.0	mg/L	N/A	2016/07/28	2016/07/28	MCN	4594515
Colour	11	5.0	TCU	N/A	2016/07/29	2016/07/29	MCN	4594522
Dissolved Fluoride (F-)	<0.10	0.10	mg/L	N/A	2016/07/25	2016/07/25	JMV	4592005
Total Kjeldahl Nitrogen (TKN)	0.12	0.10	mg/L	+/- <RDL	2016/07/26	2016/07/26	RTY	4593688
Nitrite (N)	<0.010	0.010	mg/L	N/A	2016/07/29	2016/07/29	MCN	4594525
Nitrogen (Ammonia Nitrogen)	<0.050	0.050	mg/L	N/A	2016/07/27	2016/07/27	MCN	4594425
Dissolved Organic Carbon (C)	1.5	0.50	mg/L	N/A	2016/07/26	2016/07/26	SMT	4594112
Total Organic Carbon (C)	1.6	0.50	mg/L	N/A	2016/07/27	2016/07/27	SMT	4595468
pH	6.71	N/A	pH	N/A	2016/07/25	2016/07/25	JMV	4592003
Total Phosphorus	<0.004	0.004	mg/L	N/A	2016/07/26	2016/07/26	SNR	4594494
Dissolved Sulphate (SO4)	<2.0	2.0	mg/L	N/A	2016/07/28	2016/07/28	MCN	4594519
Turbidity	0.37	0.10	NTU	N/A	2016/07/25	2016/07/25	JMV	4592045
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	<0.000013	0.000013	mg/L	N/A	2016/07/22	2016/07/25	ARS	4589905
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	0.055	0.0050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Antimony (Sb)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Arsenic (As)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Barium (Ba)	0.0024	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Boron (B)	<0.050	0.050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Cadmium (Cd)	<0.000010	0.000010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Calcium (Ca)	1.4	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Chromium (Cr)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Copper (Cu)	<0.0020	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Iron (Fe)	<0.050	0.050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Lead (Pb)	<0.00050	0.00050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Magnesium (Mg)	0.27	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Manganese (Mn)	<0.0020	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Nickel (Ni)	<0.0020	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Potassium (K)	0.15	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Selenium (Se)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Sodium (Na)	0.79	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Strontium (Sr)	0.0049	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Uranium (U)	<0.00010	0.00010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Zinc (Zn)	<0.0050	0.0050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334

Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.maxxamanalytics.com

Maxxam Job #: B6F2238
Report Date: 2016/07/29

Department of Environment & Conservation
Site Location: VOISEY'S BAY, NL
Your P.O. #: 215062145-2

Sample Details/Parameters	Result	RDL	UNITS	MU	Extracted	Analyzed	By	Batch
CSZ923 Camp Pond Brook								
Sampling Date 2016/07/17 12:55								
Matrix W								
Sample # 2016-6405-00-SI-SP								
Registration # WS-S-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Calculated TDS	21	1.0	mg/L	N/A	2016/07/29	2016/07/29		4588215
Hardness (CaCO3)	12	1.0	mg/L	N/A	2016/07/26	2016/07/26		4588089
Nitrate (N)	0.053	0.050	mg/L	N/A	2016/07/29	2016/07/29		4588212
Inorganics								
Conductivity	34	1.0	uS/cm	N/A	2016/07/25	2016/07/25	JMV	4592004
Bromide (Br-)	<1.0	1.0	mg/L	N/A	2016/07/26	2016/07/26	FD	4591718
Total Alkalinity (Total as CaCO3)	8.6	5.0	mg/L	N/A	2016/07/27	2016/07/27	MCN	4594500
Dissolved Chloride (Cl)	1.8	1.0	mg/L	N/A	2016/07/28	2016/07/28	MCN	4594515
Colour	22	5.0	TCU	N/A	2016/07/29	2016/07/29	MCN	4594522
Dissolved Fluoride (F-)	<0.10	0.10	mg/L	N/A	2016/07/25	2016/07/25	JMV	4592005
Total Kjeldahl Nitrogen (TKN)	0.17	0.10	mg/L	+/- <RDL	2016/07/26	2016/07/26	RTY	4593688
Nitrite (N)	<0.010	0.010	mg/L	N/A	2016/07/29	2016/07/29	MCN	4594525
Nitrogen (Ammonia Nitrogen)	<0.050	0.050	mg/L	N/A	2016/07/27	2016/07/27	MCN	4594425
Dissolved Organic Carbon (C)	3.0	0.50	mg/L	N/A	2016/07/26	2016/07/26	SMT	4594112
Total Organic Carbon (C)	2.9	0.50	mg/L	N/A	2016/07/27	2016/07/27	SMT	4595468
pH	7.09	N/A	pH	N/A	2016/07/25	2016/07/25	JMV	4592003
Total Phosphorus	0.004	0.004	mg/L	N/A	2016/07/26	2016/07/26	SNR	4594494
Dissolved Sulphate (SO4)	4.5	2.0	mg/L	N/A	2016/07/28	2016/07/28	MCN	4594519
Turbidity	0.78	0.10	NTU	N/A	2016/07/25	2016/07/25	JMV	4592043
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	<0.000013	0.000013	mg/L	N/A	2016/07/22	2016/07/25	ARS	4589905
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	0.078	0.0050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Antimony (Sb)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Arsenic (As)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Barium (Ba)	0.0055	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Boron (B)	<0.050	0.050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Cadmium (Cd)	<0.000010	0.000010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Calcium (Ca)	3.1	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Chromium (Cr)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Copper (Cu)	0.0031	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Iron (Fe)	0.14	0.050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Lead (Pb)	<0.00050	0.00050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Magnesium (Mg)	0.96	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Manganese (Mn)	0.0063	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Nickel (Ni)	0.022	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Potassium (K)	0.65	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Selenium (Se)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Sodium (Na)	2.0	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Strontium (Sr)	0.019	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Uranium (U)	<0.00010	0.00010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Zinc (Zn)	<0.0050	0.0050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334

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Maxxam Job #: B6F2238
Report Date: 2016/07/29

Department of Environment & Conservation
Site Location: VOISEY'S BAY, NL
Your P.O. #: 215062145-2

Sample Details/Parameters	Result	RDL	UNITS	MU	Extracted	Analyzed	By	Batch
CSZ925 Lower Reid Brook								
Sampling Date 2016/07/17 11:28								
Matrix W								
Sample # 2016-6407-00-SI-SP								
Registration # WS-S-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Calculated TDS	22	1.0	mg/L	N/A	2016/07/29	2016/07/29		4588215
Hardness (CaCO3)	10	1.0	mg/L	N/A	2016/07/26	2016/07/26		4588089
Nitrate (N)	0.054	0.050	mg/L	N/A	2016/07/29	2016/07/29		4588212
Inorganics								
Conductivity	30	1.0	uS/cm	N/A	2016/07/25	2016/07/25	JMV	4592004
Bromide (Br-)	<1.0	1.0	mg/L	N/A	2016/07/26	2016/07/26	FD	4591718
Total Alkalinity (Total as CaCO3)	9.5	5.0	mg/L	N/A	2016/07/27	2016/07/27	MCN	4594500
Dissolved Chloride (Cl)	1.5	1.0	mg/L	N/A	2016/07/28	2016/07/28	MCN	4594515
Colour	41	5.0	TCU	N/A	2016/07/29	2016/07/29	MCN	4594522
Dissolved Fluoride (F-)	<0.10	0.10	mg/L	N/A	2016/07/25	2016/07/25	JMV	4592005
Total Kjeldahl Nitrogen (TKN)	0.17	0.10	mg/L	+/- <RDL	2016/07/26	2016/07/26	RTY	4593688
Nitrite (N)	<0.010	0.010	mg/L	N/A	2016/07/29	2016/07/29	MCN	4594525
Nitrogen (Ammonia Nitrogen)	<0.050	0.050	mg/L	N/A	2016/07/27	2016/07/27	MCN	4594425
Dissolved Organic Carbon (C)	3.6	0.50	mg/L	N/A	2016/07/26	2016/07/26	SMT	4594112
Total Organic Carbon (C)	3.8	0.50	mg/L	N/A	2016/07/27	2016/07/27	SMT	4595468
pH	6.94	N/A	pH	N/A	2016/07/25	2016/07/25	JMV	4592003
Total Phosphorus	0.004	0.004	mg/L	N/A	2016/07/26	2016/07/26	SNR	4594494
Dissolved Sulphate (SO4)	2.6	2.0	mg/L	N/A	2016/07/28	2016/07/28	MCN	4594519
Turbidity	1.7	0.10	NTU	N/A	2016/07/25	2016/07/25	JMV	4592045
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	<0.000013	0.000013	mg/L	N/A	2016/07/22	2016/07/25	ARS	4589905
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	0.12	0.0050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Antimony (Sb)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Arsenic (As)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Barium (Ba)	0.0047	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Boron (B)	<0.050	0.050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Cadmium (Cd)	<0.000010	0.000010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Calcium (Ca)	2.7	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Chromium (Cr)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Copper (Cu)	<0.0020	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Iron (Fe)	0.34	0.050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Lead (Pb)	<0.00050	0.00050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Magnesium (Mg)	0.85	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Manganese (Mn)	0.0055	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Nickel (Ni)	0.0054	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Potassium (K)	0.41	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Selenium (Se)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Sodium (Na)	2.1	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Strontium (Sr)	0.015	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Uranium (U)	<0.00010	0.00010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Zinc (Zn)	<0.0050	0.0050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334

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Maxxam Job #: B6F2238
Report Date: 2016/07/29

Department of Environment & Conservation
Site Location: VOISEY'S BAY, NL
Your P.O. #: 215062145-2

Sample Details/Parameters	Result	RDL	UNITS	MU	Extracted	Analyzed	By	Batch
CSZ924 Tributary to Lower Reid								
Sampling Date 2016/07/17 11:55								
Matrix W								
Sample # 2016-6406-00-SI-SP								
Registration # WS-S-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Calculated TDS	24	1.0	mg/L	N/A	2016/07/29	2016/07/29		4588215
Hardness (CaCO3)	11	1.0	mg/L	N/A	2016/07/26	2016/07/26		4588089
Nitrate (N)	0.051	0.050	mg/L	N/A	2016/07/29	2016/07/29		4588212
Inorganics								
Conductivity	32	1.0	uS/cm	N/A	2016/07/25	2016/07/25	JMV	4592004
Bromide (Br-)	<1.0	1.0	mg/L	N/A	2016/07/26	2016/07/26	FD	4591718
Total Alkalinity (Total as CaCO3)	10	5.0	mg/L	N/A	2016/07/27	2016/07/27	MCN	4594500
Dissolved Chloride (Cl)	1.5	1.0	mg/L	N/A	2016/07/28	2016/07/28	MCN	4594515
Colour	44	5.0	TCU	N/A	2016/07/29	2016/07/29	MCN	4594522
Dissolved Fluoride (F-)	<0.10	0.10	mg/L	N/A	2016/07/25	2016/07/25	JMV	4592005
Total Kjeldahl Nitrogen (TKN)	0.17	0.10	mg/L	+/- <RDL	2016/07/26	2016/07/26	RTY	4593688
Nitrite (N)	<0.010	0.010	mg/L	N/A	2016/07/29	2016/07/29	MCN	4594525
Nitrogen (Ammonia Nitrogen)	<0.050	0.050	mg/L	N/A	2016/07/27	2016/07/27	MCN	4594425
Dissolved Organic Carbon (C)	4.0	0.50	mg/L	N/A	2016/07/26	2016/07/26	SMT	4594112
Total Organic Carbon (C)	4.5	0.50	mg/L	N/A	2016/07/27	2016/07/27	SMT	4595468
pH	7.15	N/A	pH	N/A	2016/07/25	2016/07/25	JMV	4592003
Total Phosphorus	0.006	0.004	mg/L	+/- 0.004	2016/07/26	2016/07/26	SNR	4594494
Dissolved Sulphate (SO4)	2.8	2.0	mg/L	N/A	2016/07/28	2016/07/28	MCN	4594519
Turbidity	1.3	0.10	NTU	N/A	2016/07/25	2016/07/25	JMV	4592045
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	<0.000013	0.000013	mg/L	N/A	2016/07/22	2016/07/25	ARS	4589905
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	0.12	0.0050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Antimony (Sb)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Arsenic (As)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Barium (Ba)	0.0050	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Boron (B)	<0.050	0.050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Cadmium (Cd)	<0.000010	0.000010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Calcium (Ca)	2.7	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Chromium (Cr)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Copper (Cu)	<0.0020	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Iron (Fe)	0.38	0.050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Lead (Pb)	<0.00050	0.00050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Magnesium (Mg)	0.91	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Manganese (Mn)	0.0054	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Nickel (Ni)	0.0060	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Potassium (K)	0.40	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Selenium (Se)	<0.0010	0.0010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Sodium (Na)	2.3	0.10	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Strontium (Sr)	0.016	0.0020	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Uranium (U)	<0.00010	0.00010	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334
Total Zinc (Zn)	<0.0050	0.0050	mg/L	N/A	2016/07/25	2016/07/26	BAN	4592334

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