Environment Canada Environnement Canada

2009 Annual Automated Water Quality Monitoring Report

St. Croix River at Milltown Dam

Figure 1: NB Power Facility on St. Croix River at Milltown

Program Description and Objective

The objective of the automated monitoring network is to collect and provide water quality information in a timely manner for selected streams and rivers. Important water quality trends can be identified and specific events can be highlighted with this type of data, which can help provide us with the overall health of our aquatic ecosystems. The information can be of benefit to the general public, community groups that have an interest in the environment, other government organizations, and the private sector. This project and report have been developed in partnership with the New Brunswick Department of Environment.

An automated monitoring instrument called a "sonde" is submerged in the river at the station and takes measurements for temperature, dissolved oxygen, specific conductance, pH and turbidity, every hour. This data gets recorded and transmitted by telemetry every three hours to a centralized national database. Stage height is also monitored at this site by the Water Survey of Canada.

Canada

Station Description

This station is located on the St. Croix River, at the NB Power Generation station in Milltown, New Brunswick. The river at this location forms the natural boundary between the United States and Canada. The monitoring location is in the headpond created by the dam that is located upstream of the turbines. The river elevation at this site is regulated by the NB Power facility to keep the flow of water within the range that the turbines can operate in. A fish ladder is located on the NB side of the dam, allowing the passage of migrating fish. Populations of alewives and smallmouth bass are closely monitored in the St. Croix River watershed for their respective importance within the river ecosystem and recreational fisheries.

Maintenance for this station is jointly fulfilled by the New Brunswick Department of Environment and the Water Quality Monitoring and Surveillance Division of Environment Canada. It consists of calibration visits at 4 to 6 week intervals, at which time grab samples for a range of parameters are collected for laboratory analysis. Grab sample results are available for this station at: http://map.ns.ec.gc.ca/envirodat/root/main/en/extraction_page_e.asp?stations=NB01AR0021

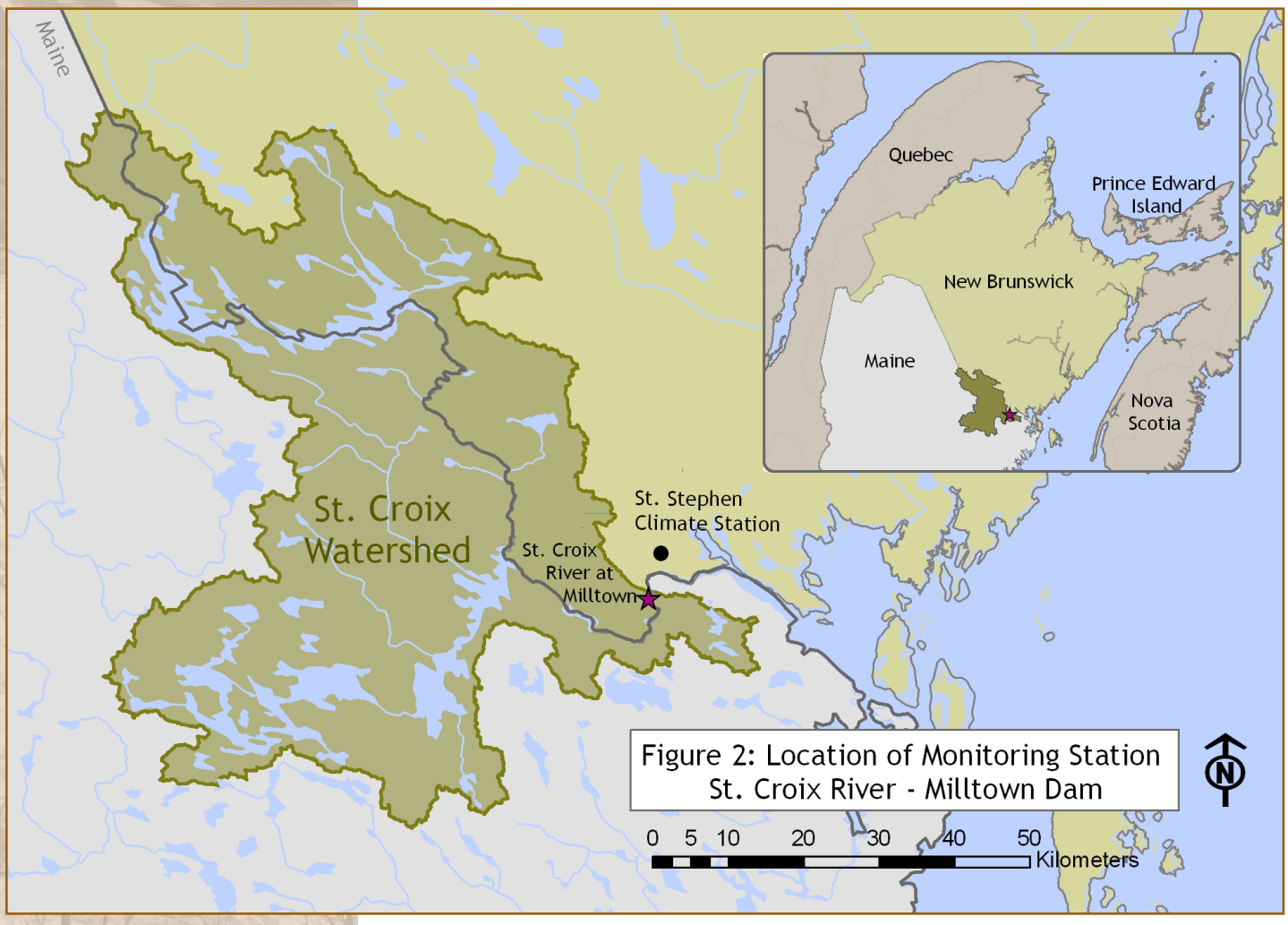


Figure 2: Location of Monitoring Station
St. Croix River - Milltown Dam

Daily Weather and Water Level Conditions

The nearest Environment Canada climate station is located at St. Stephen, New Brunswick, approximately 6.5 kilometres north of the Milltown station. Daily precipitation totals, snow depths and mean air temperature are presented in Figure 3. This information is useful to identify periods of surface water run-off, snowmelt, warming and cooling, and other conditions that may influence water quality parameters at the site. Daily mean water level in metres (m) is provided in Figure 4. Gaps in water level data are due to mechanical issues with measuring equipment primarily related to dam maintenance operations (e.g. abrupt changes in water level). By having this data available, it is possible to see how individual water quality parameters respond to individual weather events and water level changes.

Figure 3: Daily Weather Data

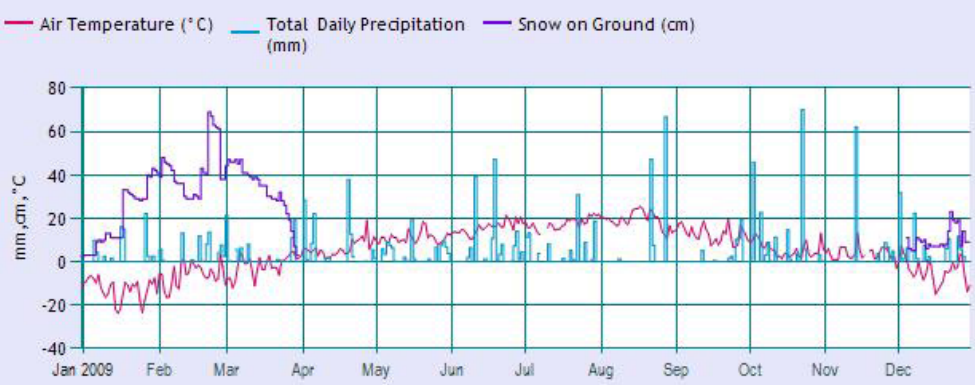
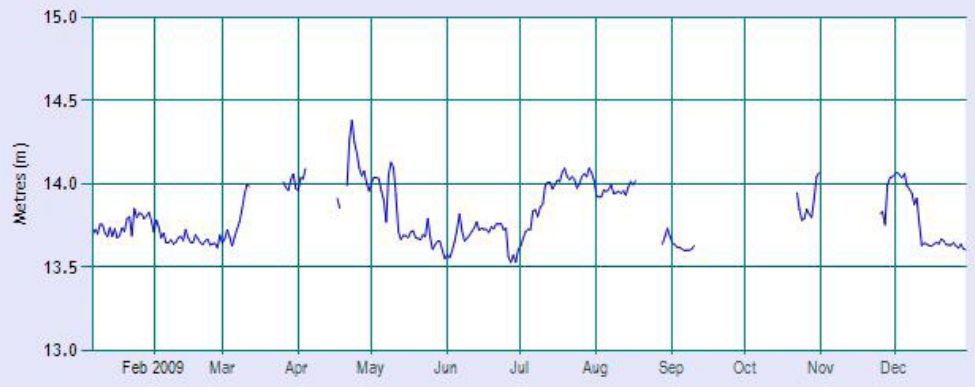


Figure 4: Water Level - Daily Mean for 2009



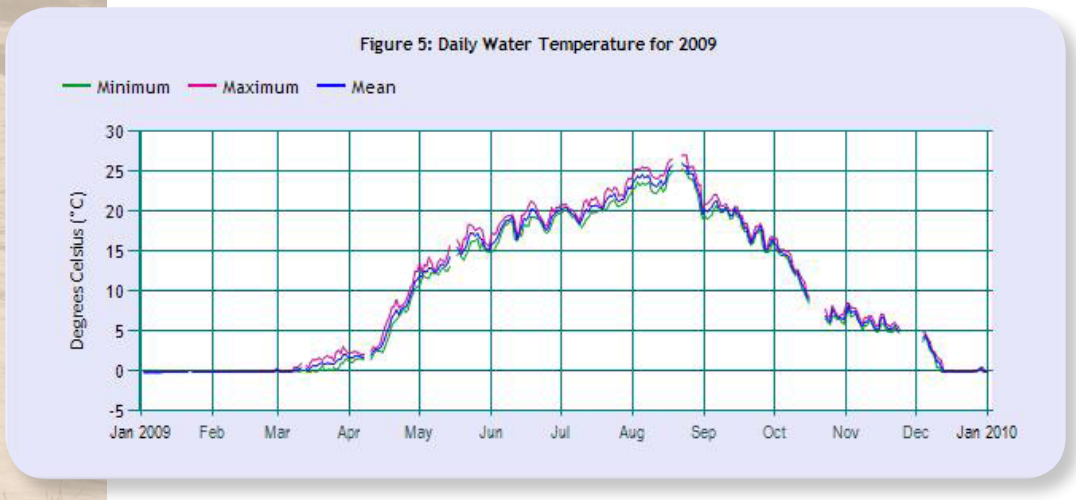
Measured Water Quality Parameters – Annual Summary

Summary graphs for the five water quality parameters collected at this site are presented in the following sections. Short term data gaps are due to the sonde being retrieved from the site for calibration purposes. The August 18th to 20th data gap resulted from the abnormally low water level during a dam maintenance operation, while the November 24th to December 2nd data gap was caused by a faulty cable. Parameters with guidelines are assessed against the Canadian Council of Ministers of the Environment (CCME) Freshwater Guidelines for the Protection of Aquatic Life (www.ccme.ca/assets/pdf/aql_summary_7.1_en.pdf).

Temperature

Daily mean temperatures, along with the daily minimum and maximum temperatures, measured at this station are presented in Figure 5. Temperatures in excess of 20 degrees Celsius were recorded on a total of 80 days during the months of June, July, August and September. At higher temperatures, the availability of dissolved oxygen is reduced thereby increasing the oxygen demand of fish. Also, aquatic species have both upper and lower temperature limits for optimal growth, spawning, egg incubation and migration.

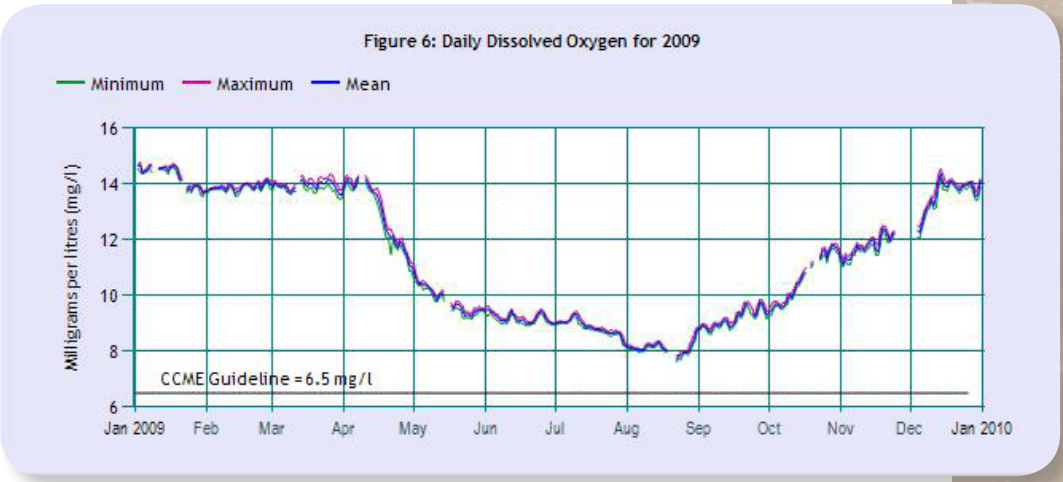
Water temperatures were consistent in January and February indicating ice conditions on the headpond and then began to increase in mid-March when significant decreases in snow depth occurred as a result of snow melt (Figure 3). Water temperatures peaked during the second half of August and began to decline as air temperatures decreased. Diurnal (daily) fluctuations in temperature were observed in the spring and summer months and are less pronounced in the fall and winter months.



Dissolved Oxygen (DO)

Daily mean DO concentrations, along with the daily minimum and maximum DO concentrations, measured at this station are presented in Figure 6. Dissolved oxygen, which is a measure of the concentration of oxygen dissolved in the water and therefore available to aquatic life, ranged from a maximum of 14.7 milligrams per litre (mg/L) on January 3, 2009, to a minimum of 7.6 mg/L on August 22, 2009. Concentrations below the CCME freshwater guideline for the protection of aquatic life (6.5 mg/L) were not observed at this location in 2009 for the period of record.

Dissolved oxygen concentrations were consistently between 13 and 15 mg/L during early 2009 indicating a good supply of oxygen at cooler temperatures when oxygen is more soluble in water. Concentrations began to decrease in mid-April corresponding to an increase in water temperatures. The lowest DO concentrations (<8 mg/L) were observed in late August when water temperatures were greater than 25 degrees Celsius. Daily fluctuations in DO are significantly greater in the second half of March, most likely the result of increased agitation in the water due to snowmelt run-off combined with daily variations in water temperature. The absence of greater diurnal DO fluctuation in the summer and fall is most likely reflective of a faster moving river section containing less aquatic plants (therefore less variation in DO concentrations due to photosynthesis and respiration) than more slow moving river sections (e.g. St. Croix River at Forest City Dam).



pH

Daily mean pH readings, along with the daily minimum and maximum pH readings, measured at this station are presented in Figure 7. pH is a measure of the hydrogen ion concentration of water with 7 being a neutral condition. Systems with a pH less than 7 are generally acidic and those with a pH greater than 7 are generally alkaline. During 2009, pH values ranged between a minimum of 6.4 on May 14, to a maximum of 7.6 on July 5. Measurements below the lower CCME guideline of 6.5 pH units were recorded on a total of 10 days. Small scale exceedances on such a short timeframe are unlikely to be harmful to fish; however, lower pH does affect the toxicity of various metals for some aquatic species.

Recorded pH at this site shows some variations in response to weather events. For example, the pH increase during freezing conditions in January, February and December is likely due to diminished precipitation and surface runoff input into the river and greater influence from groundwater inputs that typically have a higher pH. The drop in pH just after rain events in mid-June, end of August, end of October and mid-November, indicates influence from acidic precipitation. The gap in data at the end of June is due to the pH sensor malfunctioning during this period of time.

Specific Conductance

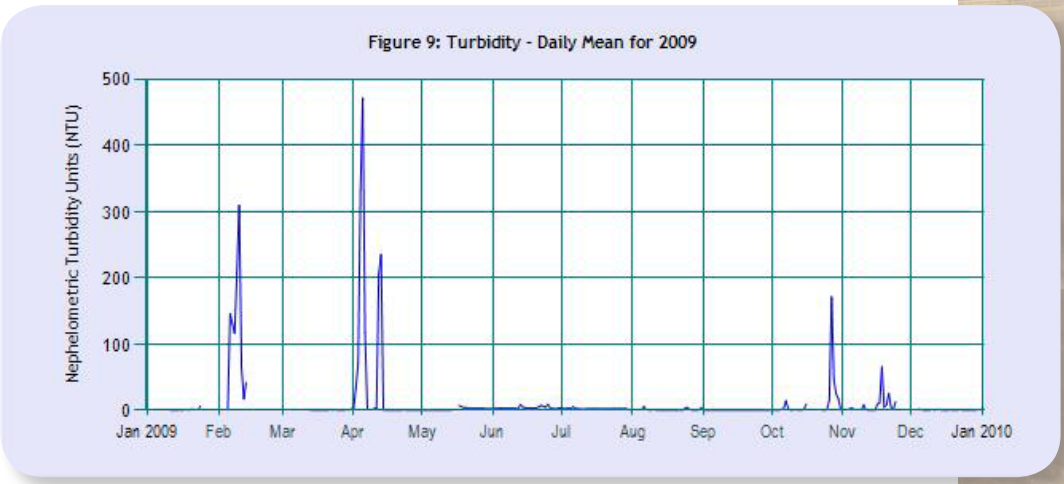
Daily mean specific conductance measurements at this station are presented in Figure 8. Specific conductance is a measure of water's ability to conduct a current and is a good indicator of the total concentration of dissolved solids (i.e. the more dissolved solids, the higher the specific conductance). Monitoring this parameter provides information about changes in water chemistry in the river system in response to events such as snowmelt, precipitation, or influences from human activity. The daily mean specific conductance at this site ranged from 20.2 to 103.1 microSiemens per centimetre (µS/cm) in 2009.

Specific conductance measurements only appear to fluctuate slightly with water level (usually during large precipitation events), most likely because the water level is controlled at the downstream dam and therefore does not vary as much with naturally occurring events like a free flowing river would. However, specific conductance usually varies with precipitation events: the sudden decreases (e.g. start of April, second half of June, start of September and October and at mid-November) all closely follow heavier rain events, indicating a dilution of the water from precipitation. Specific conductance increases during drier periods (e.g. first half of July, of August, September as a whole and end of October–first half of November) are likely due to the greater influence of groundwater inputs, that are typically more concentrated with dissolved solids and therefore have a higher conductivity.

Turbidity

Daily mean turbidity measurements for this station are presented in Figure 9. Turbidity is a measurement of the clarity of the water and is a good indicator of suspended solids in a river. Water quality guidelines exist for turbidity but are related to background levels in periods of low and high flow. The background levels have not been determined yet since river flow data is not available at this site.

Increased turbidity was observed in February (corresponding to a snowmelt period) at the start of April (right after the spring freshet) and also after the largest precipitation event of the year on October 23, 2009. These increased turbidity events indicate the introduction of suspended sediment into the river from surface run-off. Turbidity events were typically short-lived (estimated to 3 to 5 days) and quickly returned to normal levels. Additional gaps in the data are due to fouling of the sensor.



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