INTERNATIONAL ST. CROIX RIVER WATERSHED BOARD

ANNUAL REPORT

2018

ST. CROIX RIVER MAINE AND NEW BRUNSWICK

2018 ANNUAL REPORT

OF THE

INTERNATIONAL ST. CROIX RIVER WATERSHED BOARD

Covering

The Orders of Approval with respect to the control of the discharge of the St. Croix River at Forest City, Vanceboro, and the water levels of East Grand Lake, Spednic Lake, Grand Falls Flowage and Milltown Dam Forebay

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The Water Quality and Aquatic Ecosystem Health of the St. Croix River Boundary Waters

SUBMITTED TO

THE INTERNATIONAL JOINT COMMISSION

BY

THE INTERNATIONAL ST. CROIX RIVER WATERSHED BOARD

Prepared March 2019

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1.0 GENERAL

1.1 Synopsis for 2018

During the year, reservoir levels and flows were operated within prescribed levels. The annual mean river flow of the St. Croix River, as measured at the Forest City Steam, Vanceboro, and Baring stations, was higher than the long term mean value. The most notable difference was at Vanceboro, where the annual mean flow was about 24% above the long term mean. The annual mean water levels measured at East Grand Lake and Spednic Lake were slightly higher than their respective long term mean values, while annual mean water level measured at East Grand Flowage was slightly lower than the long term mean.

Figure 1: St. Croix River, East Grand Lake, June 2018

In 2018, water quality in the system remained in good to excellent condition with respect to aquatic life. As in previous years, no parameters exceeded guidelines at the Environment and Climate Change Canada (ECCC) Forest City station in the upper watershed. However, some higher August water temperatures were observed at at the ECCC Milltown Dam station and the United States Geological Survey (USGS) Milltown station in the lower watershed. Observed dissolved oxygen concentrations remained above the IJC objective of 5.0 mg/l, reaching the lowest concentration of 5.7 mg/L on August 11-12.

During the year, the Board held several meetings in the watershed. The Board and IJC meet with Passamaquoddy/Peskotomuhkati leadership on Wednesday, June 18th, in St. Stephen, New Brunswick. The annual Board and Partners meeting was held on Tuesday, June 19th in Calais, Maine. The Board also held its annual public meeting on the evening of Tuesday, June 19th at the East Grand High School in Danforth, Maine.

In 2018, the Board continued its interest in supporting water resource and ecosystem restoration research in the St. Croix River watershed. The Board supported several projects through the IJC's International Watershed Initiative (IWI).

1.2 Board Membership

International St. Croix River Watershed Board - Membership	
Canadian Section	**U.S. Section**
Bill Appleby, Canadian Co-Chair Director, Prediction Services Operations East, Meteorological Service of Canada Environment & Climate Change Canada Dartmouth, Nova Scotia	Colonel William Conde, U.S. Co-Chair District Engineer U.S. Army Corps of Engineers New England District Concord, Massachusetts
Donald Fox, Ph.D. Provincial Water Quality Specialist New Brunswick Department of Environment & Local Government Fredericton, New Brunswick	Ralph Abele Chief Water Quality Branch EPA New England, Region 1 Boston, Massachusetts
Jessie Davies 4 O'Neill Farm Road St. Andrews, New Brunswick	Susanne Miller, J.D. Regional Director, Eastern Maine Office, Department of Environmental Protection Bangor, Maine
Geoff Mercer Regional Director General, Atlantic and Quebec Regions Environment & Climate Change Canada Dartmouth, Nova Scotia	Sean Ledwin Director, Division of Sea Run Fisheries & Habitat Maine Department of Marine Resources Bangor, Maine
Robert Stephenson, Ph.D. Principal Investigator, Canadian Capture Fisheries Research Network Visiting Research Professor, University of New Brunswick Research Scientist, Fisheries and Oceans Canada, St. Andrews, New Brunswick	Robert Lent, Ph.D. Maine District Chief United States Geology Survey Augusta, Maine
Board Secretaries	
Kathryn Parlee Regional Analysis & Relations, Atlantic Region Environment & Climate Change Canada Dartmouth, Nova Scotia	Barbara Blumeris U.S. Army Corps of Engineers New England District Concord, Massachusetts

The International St. Croix River Watershed Board (Board) was established to assist the International Joint Commission. The International Joint Commission (Commission) is a binational United States-Canada organization established under the Boundary Waters Treaty of 1909. The Board has ten members with an equal number of members from the United States and Canada. Board members are appointed by the Commission and they serve the Commission in their personal and professional capacity and not as representatives of their agencies. Current Board membership is provided above.

1.3 Meetings in the Basin

Each year, the St. Croix Board conducts several meetings in the watershed to engage with partners and the public. The Board uses these meetings to share information on its activities, seek input on issues affecting the St. Croix River watershed, and identify needs or opportunities to prevent or resolve potential disputes.

Annual Public Meeting: The Board held its annual public meeting on the evening of Tuesday, June 19th at the East Grand High School in Danforth, Maine. About 30 people attended the meeting to hear about the International Watersheds Initiative (IWI) supported project that modelled water levels on East Grand Lake and to discuss their concerns with the Board and IJC Commissioners regarding the Forest City Dam.

Figure 2: Annual Public Meeting

Partners Meeting: A Board & Partners meeting was held on Tuesday, June 19th in Calais, Maine. About 30 people attended the meeting including representatives from the IJC, Passamaquoddy Nation/Tribe, Fisheries and Oceans Canada, Woodland Pulp, New Brunswick Power, US Fish and Wildlife Service, and local NGOs. Presentations were provided by attendees on alewife restoration, water quality, and current lake levels and flows. A Board and Partners meeting was also held on Thursday, November 29th in Saint Andrews, New Brunswick. About 20 people attended the meeting including representatives from the IJC, Global Affairs Canada, Passamaquoddy Nation/Tribe, Fisheries and Oceans Canada, US Geological Survey, and local NGOs. Updates were provided on projects and activities underway in the St. Croix, and the Board discussed a

number of administrative items including the new IJC Diversity Policy, revisions to the IJC and St. Croix Board website, and potential projects and activities for 2019.

Passamaquoddy/ Peskotomuhkati Meeting: In 2018, the Board and IJC held a meeting with Passamaquoddy/ Peskotomuhkati leadership. The meeting was held on Wednesday, June 18th at the Garcelon Centre in St. Stephen, New Brunswick. The purpose of the meeting was to help build stronger relationships and look for partnership opportunities between the Board and the Tribe. The Board has met with the Passamaquoddy/ Peskotomuhkati in the past on a periodic basis, however, going forward the Board plans to incorporate this as an annual event.

1.4 Annual Site Visit of Facilities in the Basin

In June 2018, Board members conducted their annual site visit of facilities under IJC Orders on the St. Croix River. Board members met with New Brunswick Power Corporation officials on the morning of June 19 to tour the Milltown Dam in St. Stephen, New Brunswick. On June 20, Board members met with Woodland Pulp, LLC officials at the Woodland Mill at Baileyville, Maine and then toured the Grand Falls, Forest City, and Vanceboro Dams (See Appendix 2 for additional information).

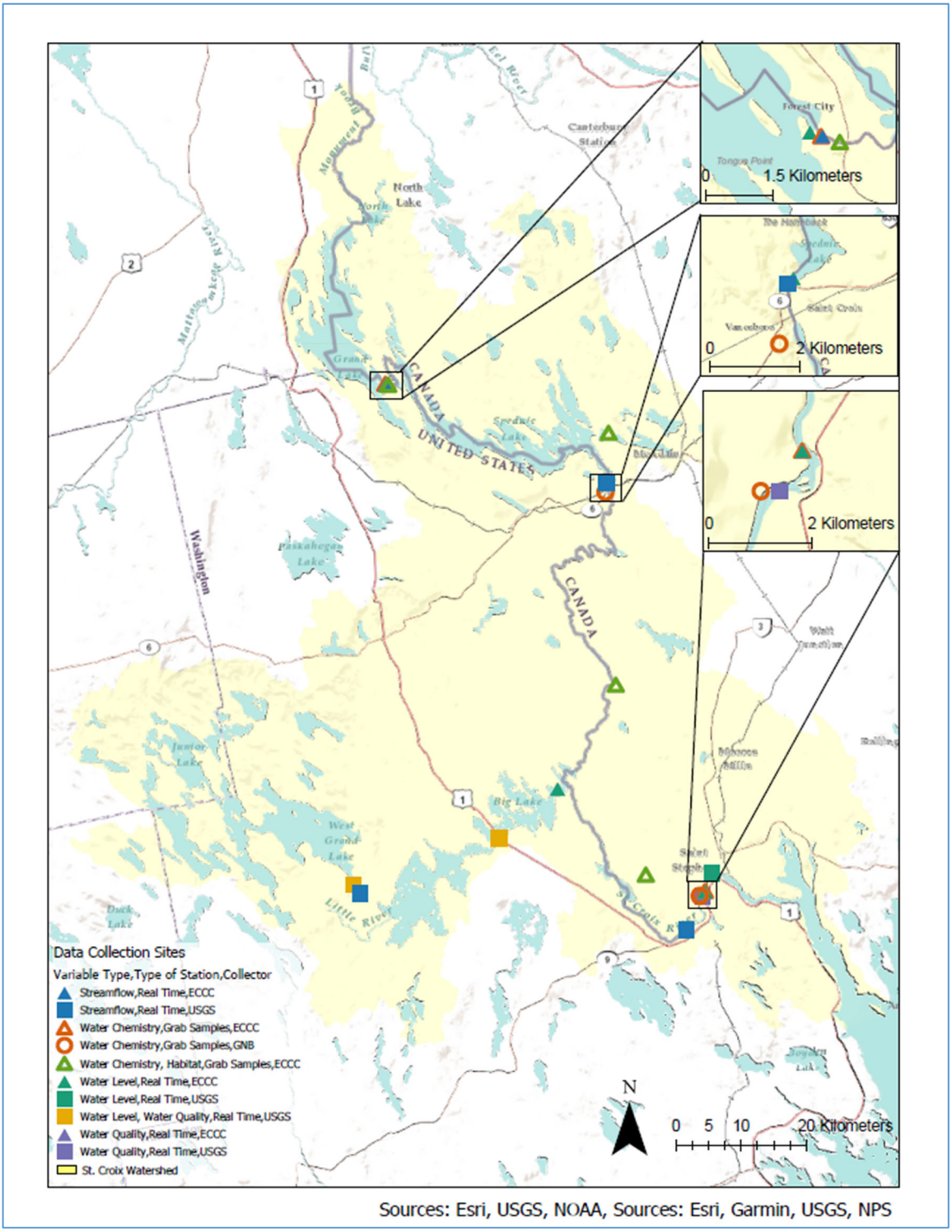
It is the responsibility of the dam owners, operators, and appropriate jurisdictional agencies to conduct the necessary dam inspections and maintenance to ensure the safety and security of the dams.

1.5 Policy of the Board Regarding Dam Regulation

In accordance with its mandate from the IJC, the Board leaves the control of operation of the dams at Forest City, Vanceboro, and Grand Falls (owned and operated by Woodland Pulp, LLC) and Milltown (owned and operated by New Brunswick Power) to the owners. During the 2018 reporting period, the Board reviewed conditions prevailing in the river by the following means:

- a continuous record of water elevations of East Grand Lake and a continuous record of discharge below Forest City Dam
- a continuous record of water elevations of Spednic Lake and a continuous record of discharge at Vanceboro
- a continuous record of water levels above the dam at Grand Falls
- a continuous record of discharge at Baring
- water level data from a continuous monitoring station in the head pond at Milltown Dam

1.6 St. Croix River: Map of Flow, Level, and Water Quality Monitoring Stations



The above map shows United States Geological Survey (USGS) and Environment and Climate Change Canada (ECCC) data collection sites in the St. Croix River Watershed.

2.0 MANAGEMENT OF WATER LEVELS AND FLOWS

2.1 Summary

In 2018, the annual mean water level at East Grand Lake was 131.965 meters (432.98 feet), which is higher than the long term mean value of 131.831 meters (432.54 feet).

The annual mean flow from the lake at Forest City Stream was 7.21 m^3/s (255 cfs), 8.5% higher than the long term mean value of 6.64 m^3/s (235 cfs).

In 2018, the annual mean water level at Spednic Lake was 116.70 meters (382.88 feet), higher than the long term mean value of 116.336 meters (381.70 feet).

The annual mean flow as recorded at Vanceboro was 26.1 m^3/s (922 cfs), 24% higher than the long term mean value of 21.1 m^3/s (745 cfs).

In 2018, the annual mean water level at Grand Falls Flowage was 61.738 meters (202.56 feet), which is lower than the long term mean value of 61.763 meters (202.64 feet).

The annual mean flow at Baring was 84.8 m^3/s (2,990 cfs), which is 12.7% higher than the long term mean value at Baring of 75.3 m^3/s (2,660 cfs).

Figure 3: St. Croix River, June 2018

2.2 East Grand Lake Reservoir and Discharges Below Forest City Dam

During the period from January 1 to December 31, East Grand Lake reservoir was operated between a maximum daily mean water level of 132.411 meters (434.44 feet) on April 30th and a minimum daily mean of 131.324 meters (430.87 feet) on October 23rd. The maximum water level as prescribed by the Commission's Order is 132.571 meters (434.94 feet); the minimum is 130.436 meters (427.94 feet). The Order was maintained throughout the year. The daily mean water levels are presented in Table I and depicted in Figure I in Appendix 3 and 4.

Table II and Figure II in Appendix 3 and 4 present the daily mean discharges below the Forest City Dam at the outlet of East Grand Lake for 2018. The maximum daily mean flow for the reporting period was 36.5 m^3/s (1,290 cfs) on April 30th and the minimum daily mean was 2.37 m^3/s (83.7 cfs) on June 20th.

The mean discharge for the year was 7.22 m^3/s (202 cfs). The Commission's Order of 2.12 m^3/s (75 cfs) as a minimum flow was maintained throughout the year.

2.3 Spednic Lake Reservoir and Discharges below Vanceboro Dam

During the year, levels in the Spednic Lake reservoir, ranged from a maximum daily mean water level of 117.409 meters (385.22 feet) on January 1st, to a minimum daily mean water level of 115.808 meters (379.97 feet) on October 23rd. The maximum limit specified in the Commission's Order is 117.610 meters (385.86 feet). The allowable minimum level is 113.233 meters (371.50 feet) for the period January 1 to April 30 and October 1 to December 31 inclusive, and 114.757 meters (376.50 feet) for the period May 1 to September 30 inclusive. These orders were maintained throughout the year. The daily mean elevations for the Spednic Lake Reservoir during the year are presented in Table III and depicted in Figure III in Appendix 3 and 4.

The maximum daily mean discharge recorded from the outflow at the reservoir at Vanceboro was 115 m^3/s (4,061 cfs) on May 1st and the minimum daily mean discharge recorded was 5.66 m^3/s (200 cfs), on June 6th. The Commission's Order of a minimum flow of 5.66 m^3/s (200 cfs) was maintained throughout the year.

Daily mean discharges are presented in Table IV and Figure IV in Appendix 3 and 4.

2.4 Water Levels above Grand Falls Dam

Table V and Figure V in Appendix 3 and 4 include water level elevations of the headpond above the Grand Falls Dam. The recorded maximum daily mean elevation was 62.000 meters (203.41 feet) on April 11th and the minimum recorded elevation was 61.738 meters (201.52 feet) on September 20th. The maximum prescribed elevation of 62.106 meters (203.76 feet), as set by the Commission, was maintained throughout the year.

2.5 Discharges at Baring, Maine

Table VI and Figure VI in Appendix 3 and 4 present the daily mean discharges of the St. Croix River at Baring, Maine. The mean discharge for the report period was 84.8 m^3/s (2,990 cfs). The maximum daily mean was 348 m^3/s (12,300 cfs) on April 28th. The minimum daily mean was 24.4 m^3/s (860 cfs) on June 27th.

Woodland Pulp LLC met the minimum flow requirements set at 21.2 m^3/s (750 cfs); this is the minimum flow requirement as considered by the Maine Department of Environmental Protection.

2.6 Headwater Elevations above Milltown Dam

Table VII and Figure VII in Appendix 3 and 4 present and depict daily water elevations in the forebay of the New Brunswick Power Corporation plant at Milltown, New Brunswick. These elevations refer to mean sea level datum. In 2009, Environment Canada established a continuous water-level and water quality monitoring station. The supplied data for 2018 was extracted from this gauging station located on the headpond.

3.0 WATER QUALITY

3.1 U.S. Geological Survey (USGS) Milltown Monitor

Water-quality values for the St. Croix River at USGS Milltown monitor[1] were within the extreme values for the period of daily record during the summer of 2018, based on record since September 1969. The exception is the August 2018 maximum water temperature of 29.7 °C, which exceeded the previous maximum value of 28.4 °C from July 2002. Values were above the water-quality objectives for the river.

Table 1
St. Croix River at Milltown, USGS Station # 01021050
Water-Quality Monitor, June – September 2018.

Dissolved Oxygen (mg/L) IJC objective = 5.0 mg/L minimum
Observed Maximum for the season: 8.9 mg/L, Observed Minimum for the season: 5.7 mg/L

Water Temperature (°C)

	June	July	August	September
Minimum	16.3	22.2	22.4	15.9
Maximum	23.4	27.8	**29.7**[1]	25.0
Mean	20.2	25.1	25.5	20.7

[1]*New maximum for the period of record*

Dissolved Oxygen (mg/L)

	June	July	August	September
Minimum	7.2	6.2	5.7	6.9
Maximum	8.8	7.8	8.2	8.9
Mean	8.1	6.9	7.2	7.9

pH (standard units)

	June	July	August	September
Minimum	6.7	6.6	6.6	6.9
Maximum	7.2	7.1	7.2	7.2
Mean	7.0	6.8	7.0	7.1

Specific conductance (microsiemens per centimeter at 25 C)

	June	July	August	September
Minimum	63	72	34	64
Maximum	117	120	118	125
Mean	98	96	95	94

[1] This station is located ~0.5 miles upstream of the Milltown Dam in the river channel.

3.2 Environment and Climate Change Canada Monitoring Stations – Forest City and Milltown

Environment and Climate Change Canada (ECCC), in partnership with the New Brunswick Department of Environment and Local Government, maintains two automated real-time water quality monitoring stations on the St. Croix River system. The first station is located at the Milltown dam in Milltown (St. Stephen), New Brunswick and the second station is located in Forest City, Maine.

The ECCC Milltown Dam Station and the USGS Milltown Station monitor water quality in the "urban" area below Baileyville but generally above St. Stephen/Calais. The Forest City Station monitors water quality in the northern portion of the watershed that is primarily forested land.

The Milltown station records hourly measurements of temperature, dissolved oxygen, pH, specific conductance, and turbidity, while the Forest City station records hourly measurements of temperature and specific conductance. In order to maintain and calibrate the measuring devices and to collect a grab sample for water quality analysis, the sites were visited every 5 to 6 weeks during the warmer months of the year, and less frequently during the colder months when fouling of the sensors is less problematic.

Real time monitoring allows an observer to assess several river water quality parameters quickly at any particular instant in time. This can alert managers to sudden changes in the characteristics of the river and relate them to particular events such as rapid spilling of water, accidental discharges from industry, severe weather events or remote introduction of atmospheric or other pollutants which might threaten the health of aquatic organisms or humans using the river. It could also allow responsible agencies to take rapid intervention to correct the problem.

Appendix 5 includes monthly summaries and annual charts of the real-time data for 2018.

3.2.1 Interpretation of Real-Time Monitoring Data

Milltown Station

This station is located just above the Milltown dam at a depth of 1.8 to 3.0 metres depending on head pond elevation.

Temperature

Water temperature at the site increased gradually through the spring and summer until it reached its maximum of 29.6˚C on August 9th. The lowest temperatures recorded were all in January. The daily mean water temperature stayed over 20˚C for 98 days, which is 30 days more than most previous years. Water temperature was below 5˚C for 161 days in 2018, similar to the 2015 and 2017 data. Water temperature at this station in 2018 averaged 10.7˚C.

Dissolved Oxygen

Dissolved oxygen readings followed a similar, but inverse, trend to water temperature, reaching the lowest concentration of 5.7 mg/L on August 11-12, and the highest concentration of 14.55 mg/L on December 29. Dissolved oxygen averaged 11.01 mg/L in 2018. On three days the daily average dissolved oxygen concentrations were below the minimum Canadian Council of Ministers of the Environment (CCME) Guideline for the Protection of Aquatic Life of 6.5 mg/L (August 11 - 13). The field measurements of dissolved oxygen were similar to automated measurements.

pH

As in 2010 to 2017, measurements of pH in 2018 stayed within the CCME guideline range of 6.5-9.0 for most of the year, except for summer when it was closer to 7 and for parts of autumn and winter (January – February) when it was below 6.5. The minimum pH measurement was 5.3 pH units, recorded in February; and the maximum pH was 7.1, recorded in September. The 2018 annual average pH at this station was 6.7, which was almost the same value as in 2017. In total, there were 75 days in which pH was below the CCME guideline of 6.5. The field measurements of pH in most cases were higher than measurements in the real time dataset.

Specific Conductance

Specific conductance is a measure of how well water can conduct an electrical current. It increases with increasing concentration of ions in the water, such as chloride, calcium, magnesium, sodium, nitrate, phosphate, and iron. Specific conductance readings

fluctuated moderately between 25.8 and 124.1 µS/cm and averaged 63.0 µS/cm during 2018. These values are similar to those of 2014-2017. Measurements of specific conductance reached their highest of 124.1 µS/cm on September 29, and their lowest on January 26. A sharp drop in specific conductance is usually associated with a rise in stream height or volume. The dam controls stream discharge at this location, but ion concentrations can change depending on rainfall events and/or spring melt/freshet conditions. The lowest specific conductance measured in mid-January and May was closely timed with the highest primary water level measured at this site. The field measurements of specific conductance closely resemble the real time values

Turbidity

Daily mean turbidity stayed below 10 NTU for almost 50% of measurements although turbid events (spikes) occurred once or twice per month (for the period of the record). Turbidity ranged from 0 to 3000 NTU (currently set as our maximum). As in 2016 and 2017, the bulk of the elevated turbidity measurements occurred in November-December with some occurrence during spring freshet. There were some problems with monitoring real time turbidity, as the self cleaning sensor was obstructed by sediment build-up multiple times during 2018. The obstruction lasted from a few days to more than a month (see November readings in Appendix 5). The real time readings show the beginning of such events quite clearly as turbidity increases exponentially. Then, because the obstruction of the sensor continues beyond the actual event, the turbidity readings at the site remained elevated until the sensor is properly cleaned. This observation is verified with the field measurements (green stars in Appendix 5) which are usually close to 1 NTU in comparison to the real time values. In fact, the turbidity concentrations for all grab samples and field visits at Milltown in 2018 were below 10 NTU. The graph in Appendix 5 was created by removing all the values above 200 NTU to improve the visibility of the spikes and to increase the visibility of the non-spike concentration occurrences.

Forest City Station

This station is located immediately downstream of the East Grand Lake dam in Forest City, Maine. The real-time water quality station at Forest City was operational for the whole 2018 year. Monthly summaries of the real-time data from the Forest City station for each parameter are shown below. Annual charts showing daily means for specific conductance and temperature are presented in Appendix 5.

Temperature

Water temperature at the site increased gradually through the spring and summer until it

reached its maximum of 28.22°C on August 8. Water temperatures above 20°C were recorded on 85 days between June and September, which is a similar frequency to 2016-2017. There were 155 days when water temperature was below 5°C, which is similar to 2017, 2015 and 2014.

Specific conductance

The highest specific conductance reading of 42.39 µS/cm was recorded in late November while the lowest of 18.4 µS/cm was recorded on May 24. A mean of 31.37 µS/cm was recorded for the year, similar to mean values recorded from 2015 to 2017. The general trend of the specific conductance data is an increasing trend towards the summer months and a decreasing trend in November and December as well as during spring freshet. There were a few spikes of specific conductance in the span from mid-March to September, which sometimes coincided with periods of low flow at the station. The field measurements of specific conductance were slightly higher than measurements with in-situ real time instruments.

3.3 Daily Mean Water Temperature in Recent Years

Forest City Station Water Temperature 2009-2018

A daily mean of water temperature at Forest City was calculated for the time-period between 2009 and 2018 (Figure 4). The number of days with water temperatures above 20˚C was also calculated, based on daily mean. The greatest number of days with water temperatures above 20˚C have been recorded in the last two years at Forest City, while the fewest number of days above 20˚C were recorded in 2009 and 2010.

Milltown Station Water Temperature 2012-2018

A daily mean of water temperature at Milltown was calculated for the time-period between 2012 and 2018 (Figure 5). The number of days of water temperature above 20˚C was also calculated, based on daily mean. The greatest number of days of water temperature above 20˚C have been recorded in the last two years at Milltown.

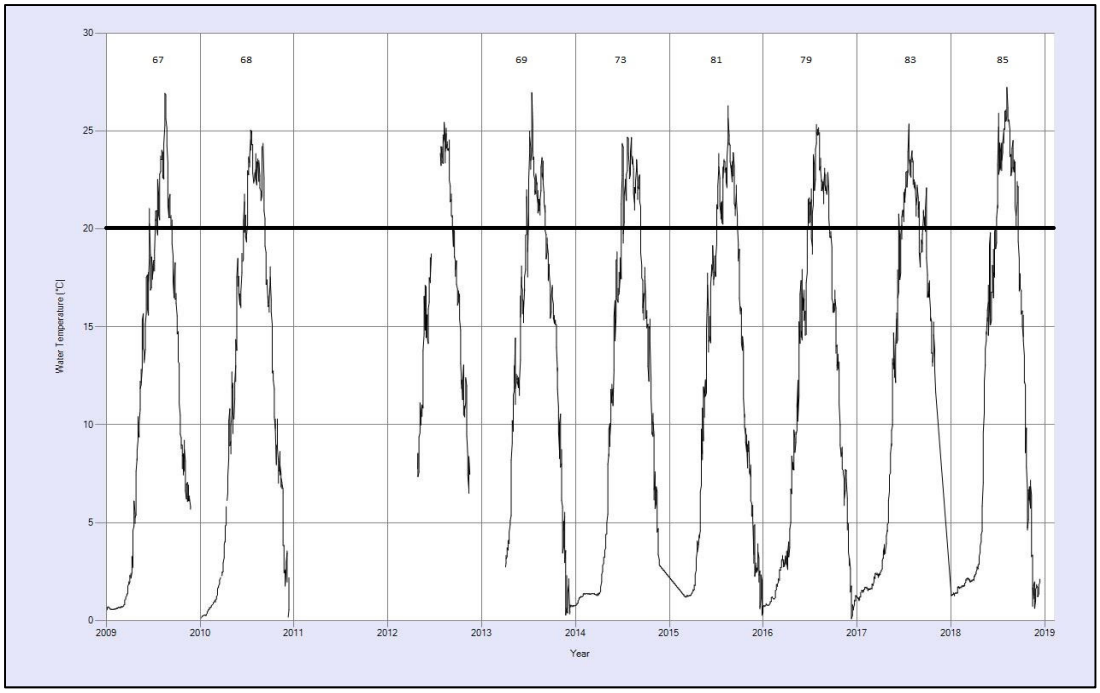


Figure 4: Mean Daily Water Temperatures at Forest City between 2009 and 2018

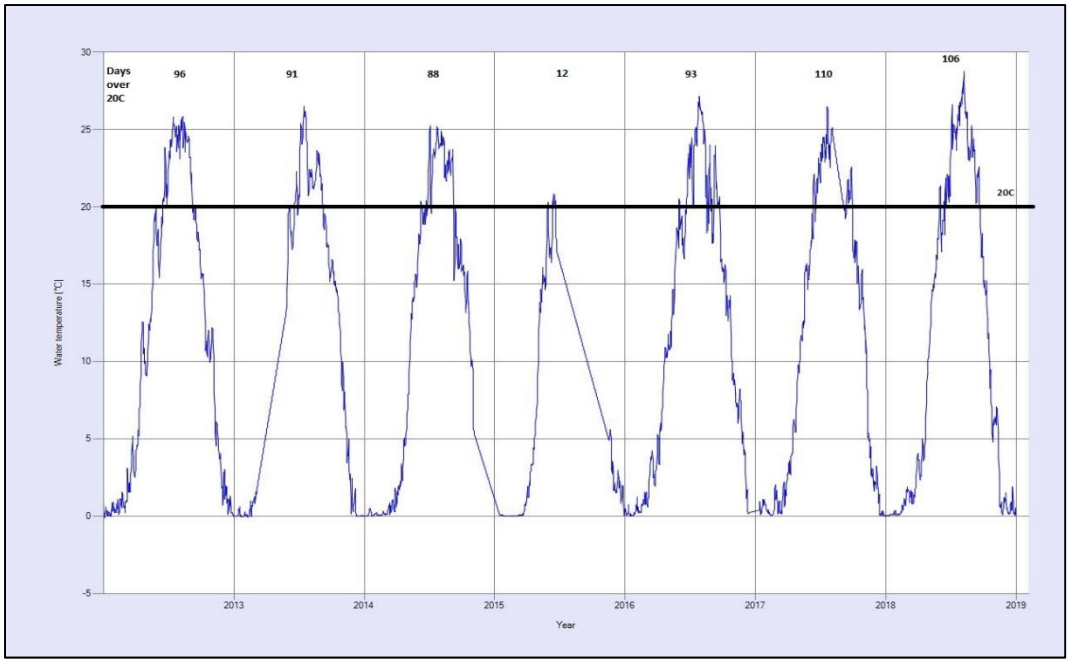


Figure 5: Mean daily temperatures at Milltown between 2012 and 2018
(Note: sensor was not operational for summer/fall 2015).

3.2.3 Interpretation of Grab Samples Results

Eight grab samples were collected in 2018 at the Milltown station and seven at the Forest City station, as well as one blank and one duplicate at each station.

Samples were analysed at ECCC's Atlantic Laboratory for Environmental Testing located in Moncton, NB. That laboratory is accredited by the Canadian Association for Laboratory Accreditation (CALA) for all the parameters reported here.

St. Croix River at Milltown, NB

Results for each sample taken at Milltown are shown in Appendix 5, along with the applicable CCME guideline for the protection of aquatic life. Where no CCME guideline exists for a parameter, the most pertinent guidelines from another province were used as reference. A summary of the parameters analyzed is included below.

- Total aluminum exceeded the CCME guideline of 100 micrograms per litre (µg/L) in five out of eight samples in 2018. Elevated levels of aluminum are fairly common in Atlantic Canada although the aquatic life seems to be in good health. This is believed to be because most of the aluminum in Atlantic Canada rivers is complexed with organic compounds and therefore not bio-available to aquatic life. Dennis and Clair (2012) produced data which supported that theory and they developed an algorithm for calculating the amount of complexed aluminum based on measured total organic carbon (TOC) in Atlantic rivers. With TOC values ranging from 7.25 to 12.1 the calculated complexed aluminum concentrations made up a large proportion of the measured total aluminum (at least 75%).

- One exceedance to the guideline for iron was observed in late July 2018. Typically the site at Milltown will have one or more exceedance to iron guidelines in any given year. The source of iron in this watershed is probably natural as iron is the fourth most abundant element in the earth's crust and the most abundant heavy metal. The presence of iron in natural waters can also be attributed to acidic mine water drainage, landfill leachates, sewage effluents and iron-related industries (CCME 1987). The concentration of iron in well aerated waters is seldom high as iron will settle out or be absorbed onto surfaces and therefore it is not surprising to have the highest concentration of iron during the July grab sampling event (Appendix 5) as the time of the year coincides with the highest water temperatures and lowest dissolved oxygen.

- In 2018, no samples had cadmium concentrations above the calculated CCME cadmium guideline, based on water hardness, which is in contrast to 2016, where four samples were above the guideline and two others were near the guideline value while no values exceeded guidelines in 2017.

- The CCME guidelines for cadmium, copper, nickel and lead are all based on a formula that uses water hardness to determine guideline concentration and also has a minimum regardless of water hardness. Based on the range of water hardness at the Milltown station, we used the minimum values stated in the CCME guidelines for these metals (Appendix 5). No values exceeded those guidelines.

- Total phosphorus is up to 9 times higher at Milltown than at Forest City and four measurements exceeded the Ontario Ministry of the Environment (OMOE, 1994) phosphorus guideline of 0.03 mg/L. The exceedances all occurred in the summer months (June to September). Similarly, nitrate is also higher at Milltown than Forest City, although well below the CCME guideline. This indicates that sources such as municipal and industrial wastewater are likely contributing nutrient loads. These loads may increase algal production in the downstream reaches of the river and the receiving estuary. This is corroborated with the elevated values occurring during the warmest water temperature months (and when grabs occurred) in the period from June to September.

- pH values (grab samples) were not measured outside the 6.5 to 9 range, recommended by the CCME except for the field blank.

St. Croix River at Forest City, ME

Results for the samples taken at Forest City are shown in Appendix 5, along with the applicable guideline for the protection of aquatic life. Where no CCME guideline exists for a parameter, the most pertinent guidelines from another province were used as reference.

As in previous years, no parameters exceeded applicable guidelines in 2018.

Water Quality Index

The CCME water quality index (WQI) is a useful communication tool to assess general water quality at monitoring sites visited regularly. It measures the frequency and extent to which selected parameters exceed water quality guidelines and reports the results as a single score. This allows for a quick assessment of the status of the water body and can be used as an indicator of overall aquatic health. Further analysis should always be completed on individual parameters in addition to other assessments (e.g. biological) for a full evaluation of aquatic health. More information on the CCME WQI is available at: http://www.ccme.ca/ourwork/water.html?category_id=102.

The WQI ratings were calculated each year using samples from the current year and those from the previous two years. Three-year rolling scores dampens strong fluctuations that may result from having small sample sizes and provides a more accurate representation of overall water quality. The parameters and guidelines used in the index are included in Table 2. These are consistent with most parameters used by New Brunswick Department of Environment and Local Government in the Canadian Environmental Sustainability Indicators project, with the exception of ammonia, which is not included in ECCC water quality monitoring sampling. Guidelines used are for the protection of aquatic life and thus, WQI scores will reflect this intended water use only.

Table 2
Parameters and Guidelines used in the WQI Calculations

Parameter	Units	Lower Guideline	Upper Guideline	Guideline Source
Arsenic	µg/L		5	CCME, 1997
Chloride	mg/L		120	CCME, 2011
Copper	µg/L		2, for hardness 0 to 82 mg\L	CCREM, 1987
Iron	mg/L		0.3	CCREM, 1987
Nitrate	mg/L as Nitrogen		3	CCME, 2012
Dissolved Oxygen	mg/L	6.5		CCME, 1999a
Phosphorous	mg/L		0.03	OMOE, 1994
pH	pH units	6.5	9.0	CCREM, 1987
Turbidity	NTU		10	CCME, 1999b
Zinc	µg/L		calculated	BC MOE, 1999

Notes: µg/L – micrograms per Litre; mg/L – milligrams per Litre; NTU – nephelometric turbidity units

WQI ratings range from 0 to 100, with higher scores indicating better water quality.

At Forest City, WQI scores stayed consistent at 100, or “excellent”, over the last three year period (2016-2018) as well as during the entire ten year period (2008-2018) with no guideline exceedances.

At Milltown, scores were very consistent from 2007 to 2015 – varying between 82.5 and 88.2, or “good”. However, in 2016, several exceedances of total phosphorus and an elevated turbidity measurement, in addition to some zinc and iron exceedances that typically occur here, resulted in a decreased score of 76.7 or “fair”. Scores in 2017 and 2018 were again back into the “good” category with a score of 87.6 registered in 2018. Increased levels of zinc, phosphorus and iron between the two stations on the St Croix River are probably indicative of wastewater discharge from municipal and industrial sources.

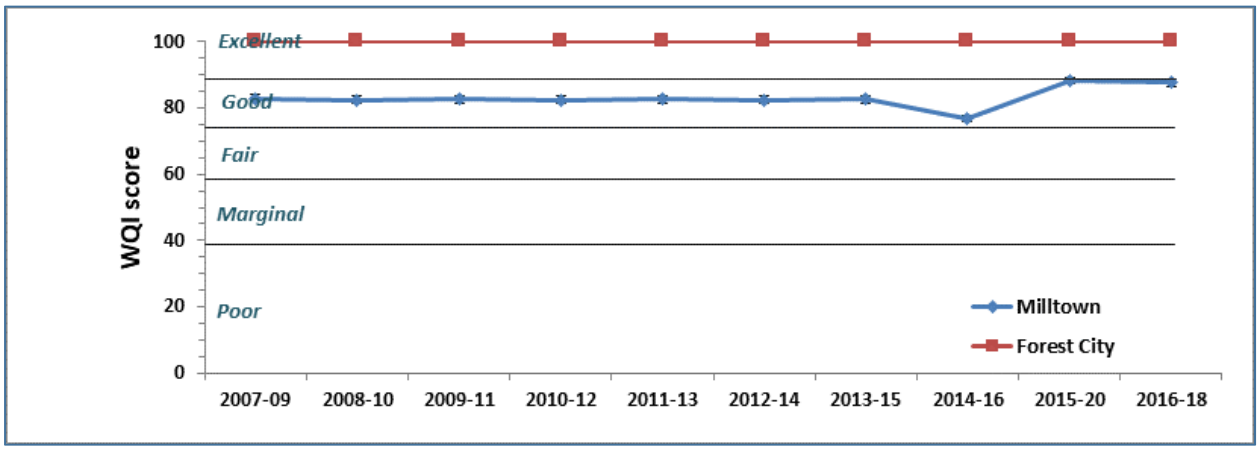


Figure 6: Water Quality Index scores, 2007 to 2018

Rreferences

[BC MOE] British Columbia Ministry of Environment. 1999. Ambient water quality guidelines for zinc: Overview report.

[CCME] Canadian Council of Ministers of the Environment.1997.Canadian Water Quality Guidelines for the Protection of aquatic life: Arsenic. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg, Manitoba (www.ccme.ca/publications/ceqg_rcqe.html).

[CCME] Canadian Council of Ministers of the Environment. 1999a. Canadian Water Quality Guidelines for the Protection of aquatic life: Dissolved Oxygen (freshwater). In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg, Manitoba (www.ccme.ca/publications/ceqg_rcqe.html).

[CCME] Canadian Council of Ministers of the Environment. 1999b. Canadian Water Quality Guidelines for the Protection of aquatic life: Turbidity. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg, Manitoba (www.ccme.ca/publications/ceqg_rcqe.html).

[CCME] Canadian Council of Ministers of the Environment 2004. Canadian Environmental Quality Guidelines. Phosphorus: Canadian guidance framework for the management of freshwater systems.

[CCME] Canadian Council of Ministers of the Environment. 2007 Canadian Water Quality guidelines. Ottawa, ON, 1484 pages.

[CCME] Canadian Council of Ministers of the Environment. 2011. Canadian Water Quality Guidelines for the Protection of aquatic life: Chloride. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg, Manitoba (www.ccme.ca/publications/ceqg_rcqe.html).

[CCME] Canadian Council of Ministers of the Environment. 2012. Canadian Water Quality Guidelines for the Protection of aquatic life: Nitrate. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg, Manitoba (www.ccme.ca/publications/ceqg_rcqe.html).

[CCREM] Canadian Council of Resource and Environment Ministers. 1987. Canadian water quality guidelines. Task Force on Water Quality Guidelines. Ottawa, Canada.

Dennis IF and Clair TA. 2011. The distribution of dissolved aluminum in Atlantic salmon (*Salmo salar*) rivers of Atlantic Canada and its potential effect on aquatic populations. Can J Aquat Sci 69:1174-1183.

[OMOE] Ontario Ministry of the Environment. 1994. Water Management Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment [reprinted February 1999]. Ontario Ministry of the Environment. 67 pp.

4.0 STATUS OF POLLUTION ABATEMENT

4.1 Maine

Baileyville: The Baileyville Wastewater Treatment Facility permit compliance reporting to the Maine Department of Environmental Protection noted four Sanitary Sewer Overflow events in 2018. There were no reports of numeric limitation violations in 2018. One of these events (January) was related to excess inflow and infiltration (I/I) in the Town's wastewater collection system. A small amount of flow bubbled up from a manhole cover and it is unknown whether this made its way to a surface water. Two of these events were associated with construction work being done on the collection system and pump stations. It is estimated that approximately 750 gallons of wastewater associated with these two events discharged to Stony Brook. The fourth event was related to a line break that did not result in a discharge to a surface water. The Town continues to work on a 3-phase approach to addressing the I/I problems. This effort is showing signs of success as large rain/snow melt events are having less adverse impact on the collection system and wastewater treatment facility. The Maine Department of Environmental Protection's most recent inspection was on November 21, 2017. This inspection was routine in nature and there were no significant problems identified during the inspection. The next inspection will be conducted prior to October 2019.

Calais: The City of Calais Wastewater Treatment Facility permit compliance reporting to the Maine Department of Environmental Protection noted one Total Suspended Solids (TSS) loading violation, weekly average and two Sanitary Sewer Overflow events in 2018. The TSS violation and one of the Sanitary Sewer Overflow events was due to high flows during rain and rain/snow melt events. The other Sanitary Sewer Overflow event happened during a construction project. The facility is part of the Maine Department of Environmental Protection's Combined Sewer Overflow (CSO) program and has a Department approved CSO Master Plan which was updated in December 2014. The updated CSO Master Plan lists the many I/I projects that have been completed as well as a tentative schedule for completing the projects that remain. The tentative schedule lists projects out to the year 2019. The Maine Department of Environmental Protection's most recent inspection was on June 19, 2018. This was a 3560-compliance inspection of the City's 10-pumping stations and there were no significant problems identified during the inspection.

Woodland Pulp: In 2018 the Woodland Pulp Mill (Mill) in Baileyville reported 3 exceedances related to wastewater discharge permit numeric limitations. A copper

loading exceedance occurred January 9th with an effluent discharge of 5.9 pounds on a daily maximum limit of 3.2 pounds. A letter of warning (LOW) was issued by the Department. A temperature exceedance occurred June 4th with an effluent daily maximum temperature of 108°F on a limit of 105 °F. The exceedance was 3% over the limit and no action was taken by the Department. A furan exceedance occurred on December 3rd with a 21.7 pg/L concentration on a daily maximum limit of <10 pg/L. Furan is generally associated with other organo-halides and none of the other organo-halides in the test were at detectable levels. A retest of water from the same sample event was non-detect. The mill has been asked to conduct another sampling event for this parameter. A zinc loading exceedance occurred on December 5th with an effluent discharge of 35.6 pounds on a daily maximum limit of 32 pounds.

Four discharge to water events were reported in 2018. The four events occurred on January 15th, March 23rd, August 10th, and October 9th.

- Between January 15th and January 19th, the landfill leachate lagoon bypassed an estimated 50,000 gallons through the overflow structure and settling pond to a wetland and then the St. Croix River. This was during a rain storm. During the summer the leachate lagoon was dredged to remove sediment that was reducing capacity. The leachate wastewater line was cleaned to increase carrying capacity of the pumps designed to move the wastewater to the Mill's wastewater treatment system. Valving that would allow the use of an alternate pond was installed. A notice of violation (NOV) was issued by the Department.

- On March 23rd, there was a spill of 2 cubic yards of wood chips to the St. Croix River. The Mill shut down the pneumatic pipe that moves the wood chips, repaired the pipe and cleaned up the chips that day.

- On August 10th, a force main rupture spilled 530,000 gallons of primary treated wastewater to Wapskahegan Brook. The Mill was shut down. The rupture was repaired and the Mill was operational on August 13th. The entire force main from the stream to Route 1 was replaced by December 12th. An NOV was issued by the Department.

- On October 9th, the Mill found an abandoned sewer line on Mill property. The line had an active bathroom tied to it. An unknown amount of sewage had spilled from the abandoned line to a storm drain which discharged to Wapskahegan Brook. The Mill eliminated the sewer line November 11th. The Department is pursuing a Consent Agreement for the discharge violations listed above.

The Mill continued work on efforts to pursue site specific water quality criteria for cadmium, lead, copper and zinc and completed water sampling for the work during 2018. The Permit contains a 2018 deadline for complying with cadmium limits already in the Permit or establishing new limitations based on the site-specific criteria study. The Maine Department of Environmental Protection conducted compliance inspections on August 13th and March 1st.

4.2 New Brunswick

McAdam: The McAdam wastewater treatment facility continues to meet the effluent requirements of the Province of New Brunswick. The McAdam wastewater treatment facility is an oxidation type system that uses an activated sludge process.

St. Stephen: The wastewater lagoon system along Dennis Stream continues to meet the effluent requirements of the Province of New Brunswick. Two wastewater bypass events were reported in 2018. They were the result of an equipment malfunction in January and a power outage in July, respectively.

Champlain Industrial Park: The extended aeration facility treats the domestic wastewater of its employees as well as the industrial inputs from the industrial park. Effluent currently meets the limits set in the Certificate of Approval to Operate, except for suspended solids exceedance from August to October. Current loadings on this facility suggest that there is a reduction of activity within the Industrial Park which will lead to improved effluent standards though the effluent currently meets the new limitations based on the Sector Standard for Non-Municipal Wastewater Works.

Evergreen Acres: The facultative lagoon treats the domestic wastewater of the 58 mobile homes in the park. The facility discharges treated effluent to the marshy headwaters of Meadow Brook. In 2014 a new owner purchased this property and made upgrades to both the potable and domestic systems. In 2018 another new owner has purchased this property and received an Approval to Operate containing an effluent monitoring program. Prior to taking ownership, the purchaser was aware of the responsibility that the property owner would have to undertake and are thus fully cognizant of his Wastewater Approval compliance obligations to the Province.

5.0 FISHERIES

5.1 Anadromous Fisheries

Anadromous fish have been counted at the research trap at the Milltown dam fishway since 1981. The dam, located at the head-of-tide on the St. Croix River between New Brunswick and Maine, is property of the New Brunswick Power Corporation (NB Power). Both the fishway and the research trap are on the Canadian side of the river and are under the jurisdiction of Canada's Department of Fisheries and Oceans (DFO).

From 1981 to 2006, the counting facility was operated seasonally for up to seven months each year to document inbound fish, notably Atlantic salmon (*Salmo salar*) and river herring. River herring is a collective term used for alewives/gaspereau (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*). Since 2007, a reduced operation in May to July has focused on documenting the annual river herring run. Results of the annual fish counts from 1981 to 2007 are provided in Appendix 6.

In 2018 the St. Croix International Waterway Commission (SCIWC) operated the Milltown research trap and collected relevant data under agreements and partnerships with DFO, NB Power, U.S. Fish & Wildlife Service (USFWS), the IJC, the Atlantic Salmon Federation, Maine Department of Marine Resources (DMR), and the Pleasant Point Passamaquoddy Tribe Environmental Department.

The Milltown research trap was activated on April 28 and monitored until July 16, when the trap was lifted at the presumed end of the river herring run. NB Power continues to operate the fishway until mid-November, as required by federal agreement, but with no fish count. All fish species captured in the trap are recorded in Table 3.

A total of 270,659 river herring were recorded at the Milltown trap in 2018. In addition, 255 American Shad (*Alosa sapidissima*) were recorded in the trap in 2018. No shad were recorded in 2016, after appearing in the St. Croix in 2015 for the first time since 1999. Several other species were documented at the trap (See Table 3). No Atlantic salmon were recorded.

The 2018 run of 270,659 river herring was higher than previous years. River herring generally return to their natal river to spawn between four and five years of age, indicating that the large run in 2018 are likely the offspring from the year 2013 and 2014. This year the biggest run was seen on May 29 with 25,199 fish entering the fishway, representing 9.3% of the yearly total.

TABLE 3

Counts of inbound fish at the Milltown fishway research trap,
St. Croix River, April 28 to July 16, 2018

Species	2018 trap count
River herring: alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*)	270,659
White sucker (*Catostomus commersonii)*	87
Smallmouth bass *(Micropterus dolomieu)*	23
Brook trout *(Salvelinus fontinalis)*	3
Common shiner (*Luxilus cornutus*)	1
American shad (*Alosa sapidissima*)	255
Fallfish (*Semotilus corporalis)*	2

In 2018, the hydroelectric turbine adjacent to the fishway was intermittently turned on and off. This was done to see how the turbine affects the fish run. The fishway is designed to operate with all turbines working, so this configuration may have altered flow conditions above and below the fishway which in turn may have influenced fish passage. A gas infusion system (GIS) was also installed in the fishway. This system is designed to saturate the water in the fishway with oxygen. The GIS was also intermittently on and off to see how it would affect the fish run.

In addition to the counting operation, Milltown fisheries staff supplied a sample of ninety-eight fish to be reviewed by the Maine Division of Marine Resources for scale aging. Of these, 41 were alewife and 57 were blueback herring.

The overall average age of river herring (alewife and blueback) was found to be 3.59 years, with females averaging 3.6 and males averaging 3.63. The average age of Alewife (*Alosa pseudoharengus*) was 3.83 years, with females averaging 3.90 years and males 3.79 years. Blueback (*Alosa aestivalis*) were found to have an average age of 3.42, with females being 3.38 years and males 3.79 years. The oldest fishes sampled were 5 years old and included both alewife and blueback herring.

Of the samples, the overall length of all fish was 224.54 mm. Alewife were an average of 240.90 mm, with females being 245.04 mm and males 237.16 mm. Blueback had an average length of 212.77 mm, with females being 216.34 mm and males 208.21 mm.

Of the 98 fish sampled, 19 had spawned previously: 3 alewife (1 female, 2 male) and 16 blueback (7 female, 9 male). 79 fish spawned for the first time. The average age of fish that spawned for the first time was 3.39 years, and the average fork length was 224.25 mm.

5.2 Shellfish Harvesting

New Brunswick: Shellfish harvesting occurs principally in Oak Bay, either for direct marketing within areas designated as conditionally approved, or for depuration in areas designated as restricted. Environment and Climate Change Canada sampled St. Croix River and Oak Bay marine water quality stations on five occasions from June 25 to November 20, 2018. Additional water quality sampling was performed as part of the bay's Conditional Management Plan (CMP), which allows shellfish harvesting during dry/low rainfall conditions.

Bacterial densities in 2018 ranged from <2 to 49 MPN FC per 100 mL under rainfall conditions ranging from dry to 42 mm within 72 hours of sampling. The survey results indicate that water throughout the conditionally approved portions of Oak Bay had returned to acceptable levels three days following a 42 mm rainfall event on 18 August 2018. Overall, the 2011 to 2018 survey data confirm the continued need for a large portion of the bay waters to be managed conditionally based on rainfall.

Maine: The Calais, Robbinston, and Perry, Maine shoreline has limited habitat for commercial shellfish. Most of the shellfish areas are classified as prohibited (no harvesting allowed or water use allowed for processing) or restricted (depuration and/or relay harvesting only) by the Maine Department of Marine Resources, Division of Shellfish Management to protect public health. However, there is one small cove that may be open on a limited seasonal conditional basis depending on water quality. For additional information go to: https://www.maine.gov/dmr/shellfish-sanitation-management/closures/documents/62.pdf

6.0 INTERNATIONAL WATERSHED INITIATIVE PROGRAM

The following are project in the St. Croix watershed that are supported in part by the IJC's International Watershed Initiative (IWI) program.

6.1 Alewife Count at Milltown

In 2018, the IWI program continued to provide support for the alewife count at Milltown Dam in partnership with the efforts of government and non-governmental organizations. The collected data is discussed in Section 5.0 of this report and detailed counts over time are presented in Appendix 6.

6.2 Tool for Understanding Likely Fish Passage and Harvest Management Outcomes for Alewife on the St. Croix River

In 2018, the IWI program continues to provide support for a project focused on developing a tool (model) to estimate potential fish passage and harvest management outcomes for alewife on the St. Croix River. As a result of the project, a working beta version of an interactive online tool has been developed, and the last component is currently being tested. To date, the tool has undergone a round of limited user review and feedback looking at the ease and intuitiveness of the tool. A second and larger round of user review and feedback is planned in April 2019. A tutorial video, an introduction video with background information, and a technical document on the model have been developed as part of the project.

6.3 USGS Lake Level Study East Grand Lake

In 2018 the USGS completed the report entitled "Estimation of unregulated monthly, annual, and peak streamflows in Forest City Stream and lake levels in East Grand Lake, United States-Canada border between Maine and New Brunswick: U.S. Geological Survey Scientific Investigations Report 2018–5044".

The report is availed at: https://doi.org/10.3133/sir20185044, the Abstract from the USGS Report is provided below.

"The U.S. Geological Survey, in cooperation with the International Joint Commission, compiled historical data on regulated streamflows and lake levels and estimated unregulated streamflows and lake levels on Forest City Stream at Forest City, Maine, and East Grand Lake on the United States-Canada border between Maine and New Brunswick to study the effects on streamflows and lake levels if two or all three dam gates are left open. Historical regulated monthly mean streamflows in Forest City Stream at the outlet of East Grand Lake (referred to as Grand Lake by Environment Canada) fluctuated between 114 cubic feet per second (ft3 /s) (3.23 cubic meters per second [m3 /s]) in November and 318 ft3 /s (9.01 m3 /s) in September from 1975 to 2015 according to Environment Canada stream gaging data. Unregulated monthly mean streamflows at this location estimated from regression equations for unregulated sites range from 59.2 ft3 /s (1.68 m3 /s) in September to 653 ft3 /s (18.5 m3 /s) in April. Historical lake levels in East Grand Lake fluctuated between 431.3 feet (ft) (131.5 meters [m]) in October and 434.0 ft (132.3 m) in May from 1969 to 2016 according to Environment Canada lake level data for East Grand Lake. Average monthly lake levels modeled by using the estimated hydrology for unregulated flows, and an outflow rating built from a hydraulic model with all gates at the dam open, range from 427.7 ft (130.4 m) in September to 431.1 ft (131.4 m) in April. Average monthly lake levels would likely be from 1.8 to 5.4 ft (0.55 to 1.6 m) lower with the gates at the dam opened than they have been historically. The greatest lake level changes would be from June through September."

7.0 OTHER ITEMS TO REPORT

7.1 Water Quality Trend Analysis Study By ECCC

At the request of the Board, Environment and Climate Change Canada conducted a trend analysis on water quality grab samples collected at the Forest City and Milltown stations. Analysis was conducted for most parameters over a 12 year period from 2007 – 2018, and for select metal parameters over a seven year period from 2011 – 2018 due to changes in methodology in 2010. For nutrients evaluated, total nitrogen showed a statistically significant increasing trend over the past ten years at the Milltown station. Sources of total nitrogen are varied and may include wastewater treatment facilities, failing septic systems, atmospheric deposition and certain industrial discharges, as well as natural sources (e.g. return of alewife). Although there is no statistically significant increasing trend for total phosphorus (TP) at Milltown, the median values and scatter of the data around the median were the higher in the last three years at Milltown. Furthermore, the median value observed for TP in 2018 is close to the eutrophic trigger value (0.035 mg/L) for Canadian Lakes and rivers (CCME 2004). The full draft report on the trend analysis of all parameters will be provided for Board review in 2019. After Board and IJC review, the report will be made available on the Board's website.

7.2 Biomonitoring in the St. Croix Watershed

The Canadian Aquatic Biomonitoring Network (CABIN) program[2] is a national aquatic biological monitoring program led by Environment and Climate Change Canada (ECCC). CABIN assesses freshwater quality by looking at aquatic benthic macroinvertebrates using standardized methods. CABIN compliments ECCC's various water quality monitoring programs to enable an integrated approach to watershed monitoring and assessment.

CABIN primarily uses the Reference Condition Approach (RCA) for study design and site assessment. It utilizes measures of benthic macroinvertebrates, including immature forms of aquatic insects, snails, crustaceans, worms, and mites. They are a commonly used indicator as they are widespread, abundant, and have long enough life cycles to reflect the pollution 'history' of a river (Rosenberg & Resh, 1993). The CABIN protocol incorporates other important elements of stream assessment such as water quality, substrate characteristics, and channel dimensions, thus making it an integrative method of ecological, chemical, and physical parameters for assessing streams habitat.

[2] https://www.canada.ca/fr/environnement-changement-climatique/services/reseau-canadien-biosurveillance-aquatique/science.html

CABIN biomonitoring results showed that all four sites sampled by ECCC in the St. Croix watershed appear to be in relatively good condition, however some concerns regarding specific metrics calculated on the benthic macroinvertebrates were raised. More data collection is required to gain a full understanding of the condition of the St. Croix River and its tributaries.

The draft report on biomontoring has been prepared by ECCC for the St. Croix River and will be provided for Board and IJC review in 2019. After Board and IJC review, the report will be made available on the Board's website.

7.3 St. Croix International Waterway Commission Water Quality Monitoring Project

The St. Croix International Waterway Commission (SCIWC) received funding from the New Brunswick Environmental Trust Fund (ETF) to conduct water quality monitoring in the watershed in partnership with the Sipayik Environmental Department and the Indian Township Environmental Department. Support from the Canadian Heritage River Society and Canada 150 also supported the effort.

Sampling was conducted in 2017 and results were reported in 2018. Sample sites were chosen to repeat and compare results from water quality sampling that was conducted in 1998-1999 as part of a preliminary water classification study. A total of 35 water quality samples, distributed among 20 different sites in New Brunswick, were collected in 2017. Sites were sampled between August and October.

The 2017 sampling effort was less than initially planned, primarily due to low water levels in 2017 which made many streams too dry to sample.

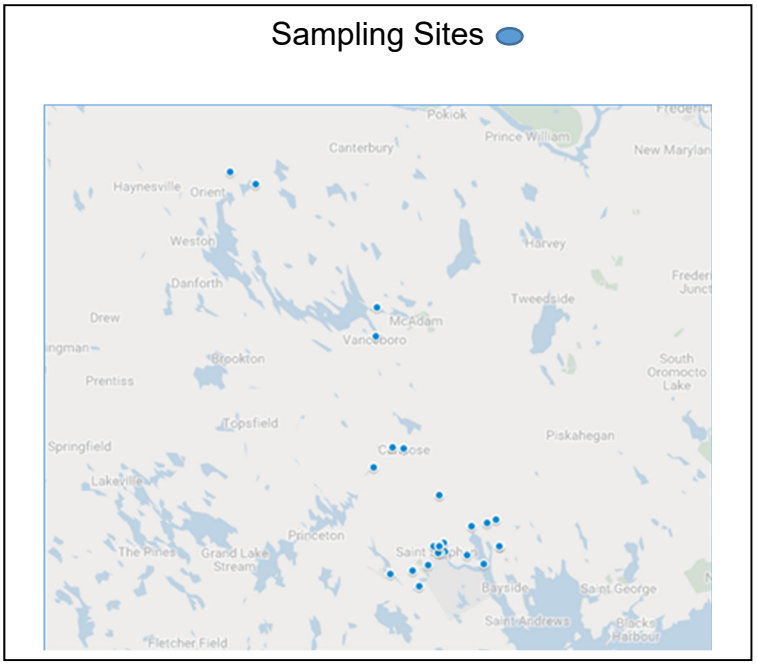


Figure 7: SCIWC Water Quality Monitoring

Sampling conducted on-site included pH, conductivity, temperature and dissolved oxygen (DO). Surface water samples were also collected and analyzed at the RPC lab

in Fredericton for surface water chemistry, surface water metals, total suspended solids, and *E. coli*. A number of the sites sampled showed elevated levels of calcium, chloride, total phosphorus, conductivity, iron and *E. coli* when compared to the Canadian Environmental Quality Guidelines for the protection of Aquatic Life. These sites were mainly in the lower watershed, in and around the community of St. Stephen.

7.4 Next Steps Working Group

The Next Steps Working group includes representatives from the Passamaquoddy Tribes in the U.S., the Peskotomuhkati Nation at Skutik, U.S. Federal agencies (Environmental Protection Agency), U.S. Fish and Wildlife Service, Bureau of Indian Affairs, National Atmospheric and Oceanic Administration, Fisheries and Oceans Canada, Global Affairs Canada, the International St. Croix River Board, and the State Department. The working group has monthly calls and annual meetings to discuss restoration of the St. Croix River. Current topics of discussion include: improving fish passage; monitoring and research activities; and prioritization and coordination of activities including fish stocking, barrier surveys, and fish counting.

7.5 Fisheries and Oceans Canada (DFO) Coastal Restoration Fund in the St. Croix

DFO's Coastal Restoration Fund is part of Canada's national Oceans Protection Plan, which was launched May 2017. The fund provides $75 million over five years to support projects that help to restore coastal aquatic habitats. The fund addresses threats to marine habitats and species located on Canada's coasts and supports efforts that: contribute to strategic planning as well as identifying and responding to restoration priorities; rehabilitate aquatic habitats; contribute to long-term sustainability; and encourage and build local community capacity.

In 2018, DFO announced that the Passamaquoddy Recognition Group (Peskotomuhkati First Nation) will receive $1.65 million over five years to help restore fish passage and improve habitat quality on the Skutik (St. Croix), Waweig, Magaguadavic and Letang rivers in New Brunswick, and to support restoration of key migratory fish species, including Atlantic and Shortnose Sturgeon, Striped Bass, Atlantic Salmon, and American Eel, to their native spawning ground.

7.6 USGS Tide Gauge Station

The USGS established a tide gage station at the international bridge in Calais, Maine. The gage has been operational since 2015. Water level data collected at the tide gage will be used to document trends over time and capture real time storm surges at the mouth of the river. The average daily tide range at the site has been recorded at approximately 24 feet. The link to the real time data site is provided below. Data for 2018 is shown in Figure 8.

http://waterdata.usgs.gov/me/nwis/uv/?site_no=01021060&PARAmeter_cd=00065,00060

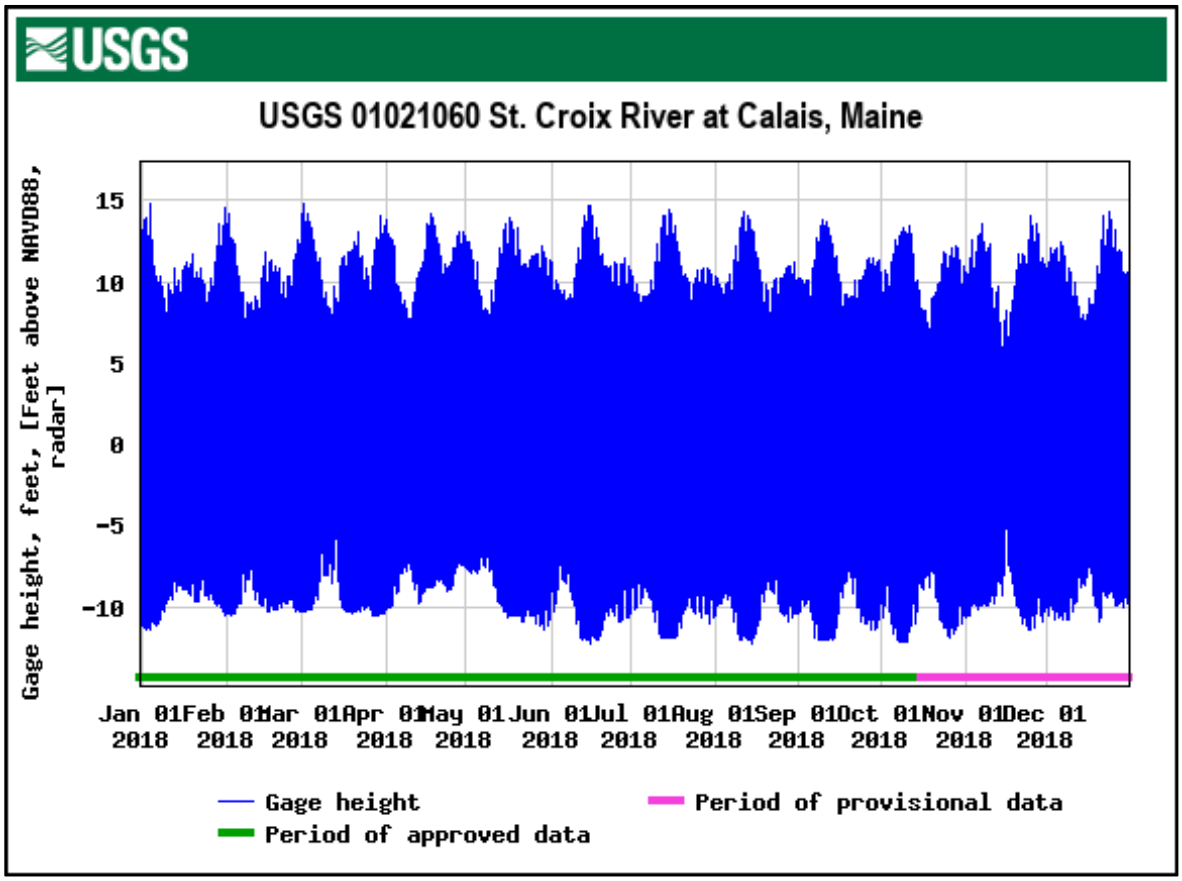


Figure 8: USGS Tide Gage Station 01021060 St. Croix River, Calais, Maine

7.7 U.S. Federal Energy Regulatory Commission (FERC) Licensing

Note: The FERC licensing information provided in the Board's Annual Report is for general information purposes only.

Forest City Dam: Forest City Dam (Forest City Project) is owned and operated by Woodland Pulp LCC (Woodland) based out of Baileyville, Maine. The operation of the dam is subject to licensing by the U.S. Federal Energy Regulatory Commission (FERC). In November 2015, FERC issued a new 30-year license to Woodland for continued operation and maintenance of the project. The license included a number of new conditions. In December 2015, Woodland filed a request for rehearing of license conditions. The rehearing was denied. In December 2016, Woodland filed an application with FERC to surrender the FERC license at Forest City Dam citing that the new licensing requirements rendered the project uneconomical. The surrender application proposed removing the gates on the U.S. side of the dam.

In addition to the surrender application, Woodland is also exploring the possibility of transferring ownership of the U.S. side of the dam to the State of Maine.
In June 2017, Maine Legislature approved a Bill to take ownership of the U.S. side of the dam pending confirmation of several conditions, including declaration from FERC that a FERC license would no longer be required for the Forest City Dam.

In July 2017, Woodland filed a request for declaratory order with FERC, seeking a determination that the Forest City Project would not be required to be licensed if transferred to the Maine Department of Inland Fisheries and Wildlife. In December 2017, FERC denied the petition. Woodland Pulp subsequently filed a request for a rehearing on the decision, and in February 2018 FERC granted a request for rehearing. Depending on the result of the rehearing, Woodland Pulp may continue with the ownership transfer, continue pursuing the surrender option, or consider other options.

Vanceboro Dam/Spednic Lake: Vanceboro Dam is also owned and operated by Woodland and used for hydropower storage. Energy is generated downstream at Grand Falls and Woodland Dams. In March 22, 2016 FERC issued a new 30-year license to Woodland for continued operation of the Vanceboro Dam for hydropower storage. Woodland is working on implementation of the license requirements including providing eel passage at the dam.

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Tim	Leblanc	New Brunswick Department of Environment and Local Government
Joyce	Wong	New Brunswick Department of Environment and Local Government
John	Morrow	New Brunswick Department of Transportation and Infrastructure
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Betsy	Barber	University of Maine at Orono
Edward	Arsenault	Village of McAdam

APPENDIX 1

SUMMARY - ORDERS OF APPROVAL & BASIN MAP

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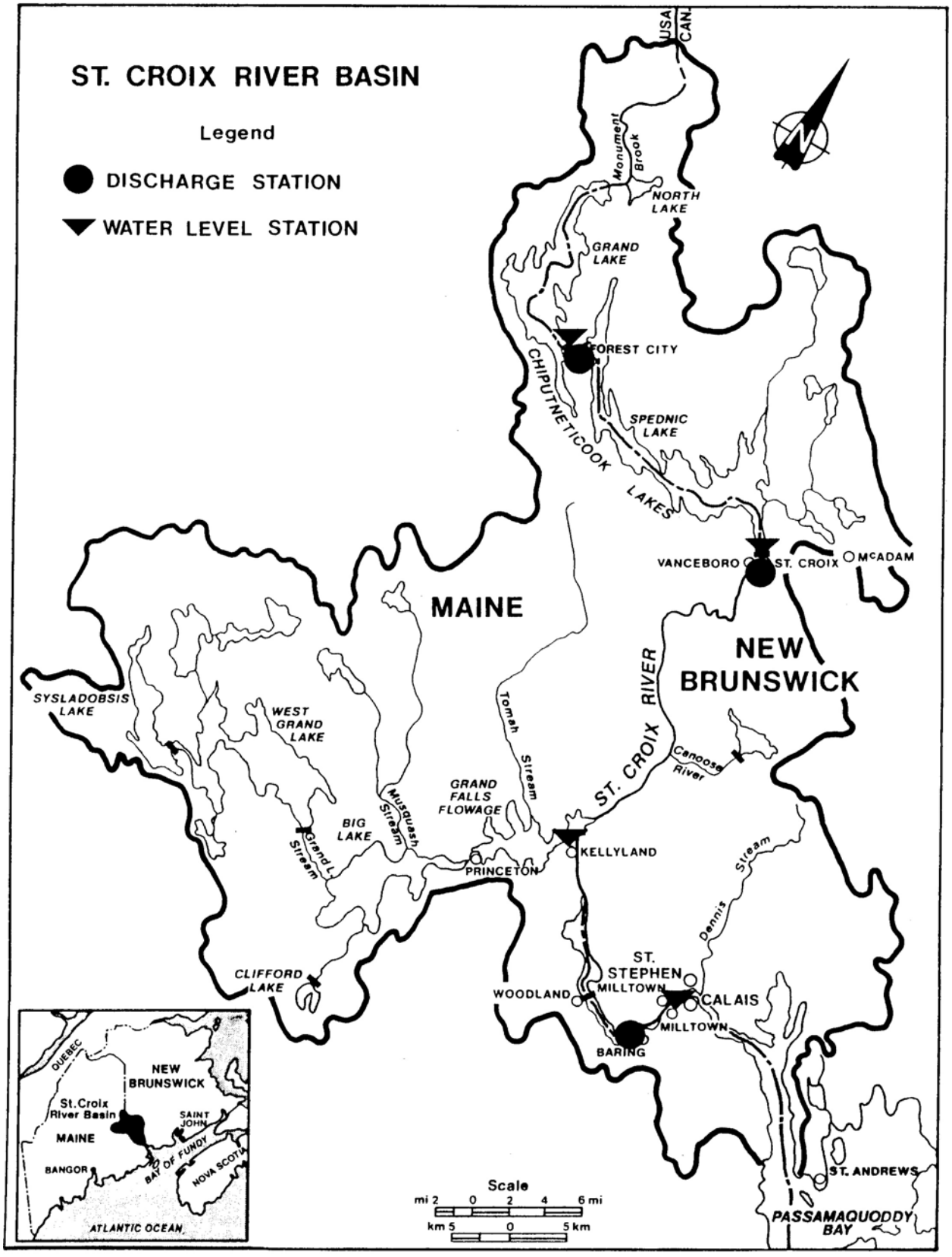
SUMMARY ST. CROIX RIVER ORDERS OF APPROVAL

INTERNATIONAL JOINT COMMISSION

9 November 1915	For approval of a dam and power canal and the obstruction, diversion and use of the waters of the St. Croix River at Grand Falls in the State of Maine and the Province of New Brunswick: Maximum elevation 202.0 feet m.s.l.
3 October 1923	Erection and repairs of fishways in the St. Croix River at St. Croix Gas and Light and Canadian Cottons Mill Dam. (St. Croix Gas and Light Dam was destroyed by fire in 1924. The Canadian Cotton Mills Dam was reconstructed in 1934 and is known as Milltown Dam.)
6 October 1931	For the obstructions of the waters of the St. Croix River at Grand Falls in the State of Maine and the Province of New Brunswick: Increase in elevation to 203.5 feet m.s.l.
2 October 1934	For the reconstruction of a dam across the St. Croix River from Milltown in the Province of New Brunswick to Milltown in the State of Maine.
15 October 1965	For the construction of a storage dam in the St. Croix River at Vanceboro, Maine and St. Croix, New Brunswick: Discharge from Spednic Lake: 200 cfs (5.66 m3\s) minimum Elevation of Spednic Lake: 385.86 feet (117.611 metres) maximum Between 1 October and 30 April: 371.50 feet (113.233 metres) minimum Between 1 May and 30 September: 376.50 feet (114.759 metres) minimum Discharge from East Grand Lake: 75 cfs (2.12 m3\s) minimum Elevation of East Grand Lake: 434.94 feet (132.571 metres) maximum 427.94 feet (130.438 metres) minimum
16 November 1982	For the reconstruction of the diversion dike in the St. Croix River near Baileyville, Maine.


ST. CROIX RIVER BASIN
Legend
DISCHARGE STATION
WATER LEVEL STATION
USA
CAN.
Monument Brook
NORTH LAKE
GRAND LAKE
FOREST CITY
CHIPUTNETICOOK LAKES
SPEDNIC LAKE
VANCEBORO
ST. CROIX
McADAM
MAINE
NEW BRUNSWICK
ST. CROIX RIVER
SYSLADOBSIS LAKE
WEST GRAND LAKE
Tomah Stream
Canoose River
GRAND FALLS FLOWAGE
Musquash Stream
BIG LAKE
Grand L. Stream
KELLYLAND
PRINCETON
Dennis Stream
CLIFFORD LAKE
ST. STEPHEN
MILLTOWN
WOODLAND
CALAIS
MILLTOWN
BARING
ST. ANDREWS
PASSAMAQUODDY BAY
Scale
mi 2 0 2 4 6 mi
km 5 0 5 km
QUEBEC
NEW BRUNSWICK
St.Croix River Basin
SAINT JOHN
MAINE
BAY OF FUNDY
BANGOR
NOVA SCOTIA
ATLANTIC OCEAN

APPENDIX 2

MILLTOWN, GRAND FALLS, VANCEBORO AND FOREST CITY DAMS
2018

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GENERAL DESCRIPTION OF MILLTOWN,
GRAND FALLS, VANCEBORO & FOREST CITY DAMS

Milltown Dam & Fish Passage Facilities

The Milltown facility is located in Milltown, New Brunswick across the river from Calais, Maine and approximately one mile upstream from the international bridge between Calais and St. Stephen, New Brunswick. It consists of a powerhouse with 6 hydroelectric generating units (installed capacity is 3.6 MW), an upstream fish passage facility that goes from the lower pool around the side of the powerhouse to the upper pool. The spillway is located adjacent to the powerhouse and has 6 openings with large wooden stop logs that can be removed or installed via a railed vertical lifting mechanism. Other sections of the spillway have been equipped with wooden flashboards that are meant to fail and increase the spillway's capacity during high flows. At the far end of the spillway, running perpendicular from the spillway to the river bank, is a gatehouse with 5 vertical lift gates used to control the forebay elevation. A wooden-chute downstream fish passage facility is located in the area between the spillway and the gatehouse.

Grand Falls Dam & Fish Passage Facilities

Grand Falls Flowage Dam is approximately 8 miles upstream of the town of Baileyville, Maine and can store approximately 88,000 acre-feet of water. This dam has 9 steel tainter gates on the right (facing downstream) of the spillway, and a concrete emergency spillway approximately 800 to 850 feet in length running from the concrete gatehouse and ending at the left shoreline. The gatehouse is located between the gates and the emergency spillway. A floating walkway allows access to the entire upstream length of the spillway. Lake levels are recorded by a gauging station on the right bank of the dam.

The downstream side of the emergency spillway/dam has a concrete face sloping at an angle of approximately 45 degrees, and supported by concrete buttresses along its length. The space between these buttresses has been enclosed with a pressure-treated timber log system. This log system was installed to minimize the temperature differential in the downstream face area during freezing conditions to reduce possible degradation of the concrete face.

Water is impounded behind Grand Falls Dam and delivered to the hydroelectric plant and fish passage facilities via a channel on the right side of the impoundment, approximately 1000 feet upstream of the dam.

Water flows to the turbines via three steel penstocks. A Denil fishway is located on the side of the hydroelectric plant. It is a concrete structure with a series of bays equipped with guide slots that allow for the installation of wooden V notched weirs to modify flows to levels acceptable for fish migration.

Vanceboro Dam & Fish Passage Facilities

Vanceboro Dam consists of an earth embankment with a concrete gate structure and with rock filled gabions on the upstream face. The concrete structure is 69 feet (21 m) long, and contains a fishway and two tainter gates, each 22'-6" (6.9 m) wide by 14'-6" (4.4 m) high. These gates are operated by electrical cable lifts. The gate structure is located on the International Boundary line between the United States and Canada. Gate sill elevation is at 371.5 feet (113.23 m) NGVD. Normal full pond elevation is at 385.86 feet (117.61 m), with an impounded surface of 20,870 acres (84.5 km2). There are approximately 221,200 acre-feet (0.27 km3) of useable storage at normal full pond. The fishway is a vertical slot fish ladder and is to the left of the tainter gates and consists of 10 bays or pools. There are 5 vertical lift wooden gates to regulate flow through the ladder. There is a steel trash rack on the upstream face of the fish passage.

Forest City Dam & Fish Passage Facilities

Forest City Dam is a small timber crib rock filled structure with three wooden sluice gates operated with a wooden ratchet lever system that lifts the gates using a steel cable or steel chain. These gates have openings of 8'-4" (2.54 m) and a sill elevation of 427.94 feet (130.44 m) NGVD. Full pond elevation is at elevation 434.94 feet (132.57 m) NGVD, and impounds 105,300 acre-feet (0.130 km3) of water. The fishway is located on the right side (facing upstream) of the dam and consists of timber baffle system with an upstream timber trash rack.

FACILITY SITE VISITS IN 2018

Board members met with New Brunswick Power Corporation officials (NB Power) on 19 June 2018 at the Milltown Dam in New Brunswick and participated in a site visit of the facility.

Board members met with Woodland Pulp LLC officials on 20 June 2018 at the Woodland Mill at Baileyville, Maine and participated in site visits at Grand Falls, Forest City, and Vanceboro Dams. The Board also visited the Woodland Dam to view the fish ladder.

IJC and Board Participants included in the NB Power and Woodland Pulp LLC meetings and site visits are shown below.

IJC Representatives

Name	Affiliation
Richard Morgan	IJC Commissioner, Canadian Section
Glenn Benoy	IJC Senior Advisor, Canadian Section
Susan Daniel	IJC Senior Advisor, US Section
Dave Herman	IJC Senior Advisor, US Section
Paisley Meyer	IJC Intern, US Section

Board Representatives

Colonel Conde	St. Croix Board, Chair, U.S. Section
Bill Appleby	St. Croix Board, Chair, Canadian Section
Robert Lent	St. Croix Board, U.S. Section
Susanne Miller	St. Croix Board, U.S. Section
Sean Ledwin	St. Croix Board, U.S. Section
Ralph Abele	St. Croix Board, U.S. Section
Jessie Davies	St. Croix Board, Canadian Section
Robert Stephenson	St. Croix Board, Canadian Section
Kathryn Parlee	Secretary, St. Croix Board, Canadian Section
Barbara Blumeris	Secretary, St. Croix Board, U.S. Section

Facility Representatives:

Jeff Babcock	Hydro Manager, NB Power
Jay Beaudoin	Environmental Manager, Woodland Pulp LLC
Chris Newman	Woodland Pulp LLC

Forest City Dam: Woodland Pulp LLC operates and maintains the dam. The US Federal Energy Regulatory Commission (FERC) conducts periodic dam safety inspections at the site.

Forest City Dam (20 June 2018) View of Dam from upstream

Vanceboro Dam: Woodland Pulp LLC operates and maintains the dam. FERC conducts periodic dam safety inspections at the site.

Vanceboro Dam (20 June 2018) View of Dam from Downstream

Grand Falls Dam: Woodland Pulp LLC operates and maintains the dam. The Maine Emergency Management Agency, Dam Safety Program and the owner Woodland Pulp LLC conduct periodic dam safety inspections at the site.

Grand Falls Dam (20 June 2018) View of Gates at Dam

Milltown Dam: New Brunswick Power Generation Corporation operates and maintains the dam. New Brunswick Power conducts an annual inspection at the dam and an independent engineering inspection is conducted every 4 years. The recent Quadrennial Inspection by Hatch Engineering was in 2016.

Milltown Dam (19 June 2018) View of Dam from Downstream

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APPENDIX 3

WATER LEVELS AND FLOWS

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GRAND LAKE AT FOREST CITY
DAILY MEAN WATER LEVEL IN METERS FOR 2018

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	131.714	132.161	132.278	132.105	132.406	132.163	132.124	131.971	131.868	131.514	131.395	131.739	1
2	131.710	132.169	132.272	132.108	132.395	132.174	132.116	131.964	131.855	131.500	131.411	131.744	2
3	131.707	132.170	132.260	132.109	132.380	132.159	132.114	131.959	131.843	131.499	131.477	131.769	3
4	131.718	132.174	132.256	132.127	132.369	132.147	132.111	131.979	131.840	131.482	131.517	131.786	4
5	131.747	132.214	132.251	132.158	132.384	132.152	132.106	132.001	131.823	131.474	131.528	131.784	5
6	131.745	132.226	132.242	132.166	132.372	132.157	132.112	131.997	131.812	131.455	131.554	131.786	6
7	131.743	132.240	132.234	132.174	132.361	132.153	132.105	131.998	131.799	131.442	131.589	131.789	7
8	131.744	132.264	132.238	132.175	132.340	132.153	132.090	132.000	131.787	131.426	131.607	131.790	8
9	131.747	132.268	132.240	132.169	132.322	132.149	132.079	132.026	131.768	131.417	131.616	131.790	9
10	131.744	132.278	132.239	132.162	132.306	132.144	132.074	132.039	131.750	131.412	131.647	131.790	10
11	131.741	132.290	132.234	132.154	132.297	132.135	132.069	132.029	131.736	131.411	131.670	131.789	11
12	131.753	132.290	132.225	132.146	132.273	132.127	132.061	132.018	131.733	131.431	131.668	131.789	12
13	131.854	132.288	132.219	132.158	132.258	132.122	132.048	132.011	131.723	131.420	131.680	131.787	13
14	131.912	132.285	132.240	132.166	132.240	132.144	132.039	132.000	131.714	131.408	131.714	131.785	14
15	131.946	132.281	132.243	132.169	132.238	132.146	132.030	131.989	131.703	131.390	131.700	131.786	15
16	131.973	132.277	132.233	132.170	132.231	132.140	132.026	131.985	131.694	131.393	131.712	131.786	16
17	131.998	132.272	132.223	132.184	132.223	132.131	132.031	131.972	131.683	131.376	131.725	131.793	17
18	132.023	132.270	132.211	132.193	132.215	132.130	132.048	131.980	131.680	131.375	131.725	131.807	18
19	132.038	132.265	132.199	132.200	132.201	132.150	132.039	131.977	131.675	131.355	131.723	131.806	19
20	132.050	132.265	132.189	132.210	132.208	132.138	132.030	131.965	131.655	131.345	131.727	131.805	20
21	132.059	132.267	132.180	132.219	132.205	132.137	132.021	131.956	131.630	131.345	131.732	131.814	21
22	132.066	132.273	132.171	132.227	132.190	132.128	132.012	131.944	131.625	131.334	131.737	131.870	22
23	132.088	132.278	132.158	132.236	132.194	132.118	132.006	131.945	131.609	131.324	131.732	131.906	23
24	132.115	132.276	132.148	132.248	132.191	132.118	131.997	131.935	131.593	131.345	131.720	131.931	24
25	132.123	132.276	132.138	132.266	132.189	132.127	131.988	131.925	131.570	131.353	131.721	131.950	25
26	132.132	132.274	132.126	132.323	132.195	132.122	131.992	131.912	131.566	131.341	131.723	131.963	26
27	132.138	132.274	132.115	132.366	132.186	132.113	132.010	131.907	131.572	131.333	131.726	131.971	27
28	132.146	132.274	132.105	132.389	132.179	132.113	132.000	131.899	131.560	131.367	131.732	131.980	28
29	132.150		132.093	132.399	132.180	132.131	131.998	131.899	131.545	131.377	131.743	131.995	29
30	132.155		132.098	132.411	132.172	132.126	131.993	131.900	131.529	131.391	131.739	131.997	30
31	132.158		132.102		132.165		131.982	131.886		131.389		131.998	31
TOTAL	4089.937	3703.139	4098.160	#######	4100.065	3964.147	4093.451	#######	3950.940	4073.424	3949.690	4087.075	TOTAL
MEAN	131.933	132.255	132.199	132.210	132.260	132.138	132.047	131.967	131.698	131.401	131.656	131.841	MEAN
MAX	132.158	132.290	132.278	132.411	132.406	132.174	132.124	132.039	131.868	131.514	131.743	131.998	MAX
MIN	131.707	132.161	132.093	132.105	132.165	132.113	131.982	131.886	131.529	131.324	131.395	131.739	MIN

SUMMARY FOR THE YEAR 2018
Mean water level, 131.850 m
Maximum daily water level, 132.411 m On 2018-04-30
Minimum daily water level, 131.324 m On 2018-10-23

NOTE: WATER LEVELS ARE PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT CANADA IN COOPERATION WITH WOODLAND PULP LLC

TABLE I

FOREST CITY STREAM BELOW FOREST CITY DAM
DAILY MEAN DISCHARGE CUBIC METERS PER SECOND FOR 2018

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	3.46	4.50	8.34	13.2	36.4	2.84	2.98	2.97	6.96	9.00	2.70	2.84	1
2	3.47	4.51	8.35	13.2	36.1	2.82	2.98	2.96	6.91	8.89	2.76	2.87	2
3	3.47	4.54	8.34	13.3	35.9	2.80	2.98	2.96	6.89	8.85	2.91	2.90	3
4	3.49	4.57	8.34	13.5	34.7	2.78	2.99	3.00	6.86	8.67	2.98	2.90	4
5	3.54	4.63	9.20	14.3	33.8	2.77	2.98	3.03	6.80	8.55	3.01	2.91	5
6	3.54	4.67	10.4	15.8	33.5	2.78	2.98	3.03	6.76	8.34	3.08	2.93	6
7	3.54	4.72	10.4	16.3	33.2	2.75	2.96	3.03	6.69	8.20	3.15	2.93	7
8	3.56	4.74	10.5	16.3	29.9	2.73	2.96	3.04	6.63	8.01	3.18	2.92	8
9	3.55	4.78	11.1	16.3	24.1	2.70	2.96	3.09	6.56	7.92	3.20	2.94	9
10	3.55	4.80	11.8	16.2	20.7	2.69	2.96	3.09	6.53	7.87	3.28	2.95	10
11	3.55	4.84	11.8	16.2	19.5	2.67	2.97	3.94	6.48	7.86	3.29	2.97	11
12	3.60	5.65	11.8	16.2	17.2	2.66	2.96	5.17	6.45	7.96	3.28	2.84	12
13	3.78	6.94	11.8	16.6	15.0	2.63	2.96	5.16	6.43	7.80	3.33	2.68	13
14	3.87	6.97	11.9	17.1	11.7	2.52	2.94	5.15	6.42	7.66	3.34	2.70	14
15	3.95	7.58	11.9	17.2	8.87	2.38	2.93	4.39	6.36	7.48	3.28	2.70	15
16	4.01	8.21	11.9	17.9	8.86	2.38	2.94	3.59	6.31	7.56	3.35	2.68	16
17	4.06	8.21	11.8	18.5	8.84	2.39	2.97	3.58	6.30	7.33	3.37	2.69	17
18	4.11	8.23	11.8	18.6	8.74	2.38	2.97	3.61	7.29	5.82	3.37	2.68	18
19	4.15	8.24	11.7	19.6	8.69	2.38	2.97	3.60	9.46	4.34	3.38	2.69	19
20	4.18	8.25	11.7	20.2	8.68	2.37	2.97	3.59	10.40	4.26	3.39	2.70	20
21	4.20	8.25	11.7	20.3	8.65	2.38	2.96	3.58	9.13	4.29	3.39	2.73	21
22	4.23	8.25	11.7	20.4	7.67	2.65	2.95	3.58	7.48	4.19	3.38	2.81	22
23	4.31	8.29	11.6	20.5	5.22	2.92	2.95	3.56	7.38	4.09	3.38	2.83	23
24	4.33	8.29	11.6	20.7	4.21	2.93	2.95	4.15	7.29	3.21	3.39	2.88	24
25	4.34	8.32	11.6	20.8	4.18	2.95	2.95	4.92	7.19	2.58	3.41	2.91	25
26	4.38	8.32	11.5	27.1	4.14	2.95	2.96	4.91	7.19	2.55	3.41	2.96	26
27	4.42	8.30	12.4	33.3	4.11	2.95	2.98	4.89	8.24	2.54	3.44	2.99	27
28	4.43	8.32	13.2	36.1	4.08	2.96	2.99	4.90	9.43	2.63	3.09	3.04	28
29	4.44		13.1	36.2	4.05	2.97	2.98	4.89	9.29	2.63	2.83	2.97	29
30	4.46		13.2	36.5	4.02	2.97	2.97	4.89	9.14	2.66	2.84	2.97	30
31	4.46		13.2		3.54		2.97	6.00		2.68		2.98	31
TOTAL	122	186	350	598	488	81.1	91.9	122	221	186	96.2	88.5	TOTAL
MEAN	3.95	6.64	11.3	19.9	15.8	2.70	2.97	3.94	7.38	6.01	3.21	2.85	MEAN
MAX	4.46	8.32	13.2	36.5	36.4	2.97	2.99	6.00	10.4	9.00	3.44	3.04	MAX
MIN	3.46	4.50	8.34	13.20	3.54	2.37	2.93	2.96	6.30	2.54	2.70	2.68	MIN
DAM3	10600	16100	30200	51700	42200	7000	7900	10600	19100	16100	8300	7600	DAM3

SUMMARY FOR THE YEAR 2018
Total discharge 227400 DAM
Mean discharge, 7.22 m^3/s
Maximum daily discharge, 36.5 m^3/s On 2018-04-30
Minimum daily discharge, 2.37 m^3/s On 2018-06-20

NOTE: DISCHARGE DATA ARE PROVISIONAL AND ARE
SUPPLIED BY ENVIRONMENT CANADA IN
COOPERATION WITH WOODLAND PULP LLC
E ESTIMATE

TABLE II

SPEDNIC LAKE AT ST. CROIX
DAILY MEAN WATER LEVEL IN METERS FOR 2018

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	116.748	117.375	116.911	116.339	117.354	116.759	116.795	116.651	116.392	116.020	115.943	116.824	1
2	116.749	117.369	116.898	116.348	117.349	116.781	116.794	116.644	116.375	116.000	115.968	116.837	2
3	116.749	117.353	116.876	116.348	117.332	116.757	116.802	116.632	116.360	116.009	116.043	116.877	3
4	116.769	117.339	116.851	116.369	117.319	116.746	116.804	116.636	116.358	115.992	116.146	116.903	4
5	116.799	117.363	116.826	116.424	117.342	116.751	116.798	116.649	116.343	115.985	116.174	116.920	5
6	116.798	117.359	116.802	116.455	117.313	116.761	116.817	116.637	116.342	115.964	116.222	116.935	6
7	116.800	117.356	116.775	116.487	117.293	116.756	116.811	116.633	116.332	115.952	116.289	116.947	7
8	116.804	117.363	116.767	116.508	117.256	116.760	116.796	116.624	116.325	115.932	116.341	116.959	8
9	116.811	117.347	116.742	116.520	117.220	116.757	116.787	116.620	116.309	115.921	116.371	116.965	9
10	116.812	117.337	116.730	116.523	117.184	116.752	116.784	116.632	116.292	115.915	116.424	116.973	10
11	116.812	117.327	116.715	116.524	117.169	116.740	116.781	116.614	116.283	115.901	116.505	116.978	11
12	116.823	117.306	116.690	116.524	117.111	116.735	116.772	116.598	116.285	115.929	116.509	116.985	12
13	116.945	117.283	116.678	116.554	117.073	116.724	116.757	116.583	116.273	115.918	116.535	116.984	13
14	117.050	117.257	116.679	116.591	117.031	116.739	116.751	116.567	116.259	115.910	116.641	116.980	14
15	117.122	117.234	116.664	116.615	116.999	116.752	116.747	116.559	116.244	115.882	116.609	116.979	15
16	117.177	117.209	116.645	116.627	116.976	116.749	116.743	116.562	116.233	115.918	116.632	116.977	16
17	117.226	117.181	116.623	116.659	116.949	116.737	116.751	116.542	116.214	115.876	116.666	116.982	17
18	117.267	117.155	116.600	116.702	116.923	116.738	116.789	116.552	116.198	115.902	116.682	116.996	18
19	117.296	117.124	116.578	116.738	116.889	116.776	116.775	116.545	116.182	115.848	116.694	116.987	19
20	117.315	117.102	116.553	116.779	116.886	116.761	116.759	116.534	116.156	115.839	116.712	116.974	20
21	117.330	117.082	116.531	116.818	116.872	116.759	116.748	116.522	116.127	115.848	116.728	116.968	21
22	117.337	117.063	116.511	116.854	116.837	116.748	116.732	116.511	116.138	115.830	116.739	117.030	22
23	117.356	117.041	116.482	116.885	116.827	116.735	116.724	116.517	116.111	115.808	116.747	117.091	23
24	117.393	117.023	116.456	116.913	116.809	116.740	116.720	116.497	116.092	115.833	116.753	117.120	24
25	117.404	117.001	116.431	116.951	116.795	116.742	116.710	116.482	116.063	115.848	116.764	117.133	25
26	117.409	116.981	116.404	117.051	116.801	116.745	116.712	116.469	116.061	115.836	116.774	117.134	26
27	117.407	116.957	116.379	117.182	116.789	116.734	116.719	116.462	116.075	115.810	116.786	117.129	27
28	117.407	116.932	116.354	117.268	116.781	116.732	116.702	116.448	116.058	115.840	116.800	117.119	28
29	117.404		116.333	117.314	116.787	116.779	116.699	116.443	116.049	115.873	116.812	117.122	29
30	117.400		116.328	117.342	116.771	116.789	116.686	116.438	116.031	115.909	116.819	117.108	30
31	117.389		116.336		116.759		116.670	116.413		115.925		117.087	31
TOTAL	3630.108	3281.819	3615.148	#######	3627.796	3502.534	3619.435	#######	3486.560	3592.973	3495.828	3627.003	TOTAL
MEAN	117.100	117.208	116.618	116.707	117.026	116.751	116.756	116.555	116.219	115.902	116.528	117.000	MEAN
MAX	117.409	117.375	116.911	117.342	117.354	116.789	116.817	116.651	116.392	116.020	116.819	117.134	MAX
MIN	116.748	116.932	116.328	116.339	116.759	116.724	116.670	116.413	116.031	115.808	115.943	116.824	MIN

SUMMARY FOR THE YEAR 2018
Mean water level, 116.170 m
Maximum daily water level, 117.409 m On 2018-01-26
Minimum daily water level, 115.808 m On 2018-10-23

NOTE: WATER LEVELS ARE IN METERS AND ARE REFERENCED TO GEODETIC SURVEY OF CANADA DATUM. WATER LEVELS ARE PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT CANADA IN COOPERATION WITH WOODLAND PULP LLC

TABLE III

ST. CROIX RIVER AT VANCEBORO

DAILY MEAN DISCHARGE IN METERS PER SECOND FOR 2018

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	9.09B	36.8	44.7	39.9	115	7.84	6.88	12.5	19.5	21.5	6.43	8.33	1
2	9.09B	36.8	44.5	39.9	115	7.50	6.91	12.4	19.4	21.4	6.48	8.35	2
3	9.09B	36.5	44.2	39.9	114	7.48	6.91	12.4	19.3	21.5	6.68	8.38	3
4	9.09B	36.5	44.2	40.2	112	7.45	6.91	12.4	15.0	21.4	6.82	8.35	4
5	9.09B	39.4	43.9	40.8	110	6.65	6.91	12.4	9.03	21.4	6.88	8.38	5
6	9.09B	41.6	43.6	41.1	110	5.66	6.97	12.4	11.1	21.3	6.97	8.41	6
7	9.09B	41.6	43.3	41.6	109	6.23	6.94	12.4	12.5	21.2	6.99	8.41	7
8	9.09B	41.6	43.3	41.9	106	6.85	6.91	12.4	12.5	21.0	6.99	8.47	8
9	9.09B	43.0	43.3	41.9	96.0	6.85	6.91	12.6	12.4	20.9	7.05	8.44	9
10	9.09B	44.5	43.0	41.9	85.0	6.85	6.91	12.8	12.3	20.9	7.16	8.44	10
11	9.09B	44.5	43.0	41.9	79.9	6.57	6.91	15.9	14.8	20.8	7.31	8.47	11
12	9.09B	44.5	42.8	41.9	72.5	6.31	6.88	19.3	16.9	21.0	7.28	9.74	12
13	9.09B	44.2	42.8	43.3	67.1	6.29	6.85	19.2	16.9	20.9	7.33	11.0	13
14	11.0B	43.9	42.8	44.5	63.7	6.34	6.85	19.2	18.3	20.8	7.56	12.7	14
15	14.4B	45.6	42.8	44.5	53.5	6.23	6.82	15.0	19.3	20.8	7.48	13.9	15
16	14.2B	46.7	42.5	45.0	45.9	6.31	6.80	11.9	19.2	20.9	8.16	13.8	16
17	15.9B	46.7	42.5	47.9	44.2	6.34	6.85	11.8	19.1	20.7	8.04	13.8	17
18	18.9B	46.4	42.2	49.3	41.3	6.34	10.3	11.9	20.6	20.8	8.07	16.0	18
19	21.7	46.2	41.9	51.8	39.9	6.37	12.7	11.8	27.2	16.6	8.07	19.5	19
20	23.5	46.2	41.6	53.8	39.9	6.37	12.6	11.8	29.4	13.7	8.10	21.0	20
21	24.6	45.9	41.3	54.1	39.6	6.91	12.6	11.8	25.3	14.1	8.13	23.9	21
22	26.8	45.9	41.3	54.4	37.9	7.02	12.6	11.8	19.4	14.3	8.21	33.1	22
23	30.6	45.6	41.1	56.6	34.3	6.99	9.23	12.3	19.3	14.3	8.18	38.2	23
24	35.1	45.3	40.8	58.9	30.0	6.99	6.94	14.1	19.2	14.4	8.16	38.2	24
25	38.2	45.3	40.5	62.0	19.7	6.99	6.91	15.4	19.1	12.4	8.18	38.2	25
26	37.9	45.3	40.5	72.5	14.4	7.02	8.66	15.4	19.0	9.49	8.21	38.2	26
27	38.2B	45.0	40.2	85.8	14.4	6.91	12.6	15.3	20.5	7.99	8.21	38.2	27
28	37.7	44.7	39.9	96.8	14.4	6.82	12.6	15.3	21.7	8.04	8.24	38.2	28
29	37.7	55.5	39.9	106	14.3	6.91	12.5	15.3	21.6	7.16	8.30	38.2	29
30	37.4		39.9	113	14.3	6.88	12.5	17.4	21.5	6.37	8.33	38.2	30
31	36.8		39.9		11.5		12.5	19.5		6.43		37.9	31
TOTAL	619	1272	1308	1633	1863	202	272	436	551	524	228	625	TOTAL
MEAN	20.0	43.9	42.2	54.4	60.1	6.74	8.79	14.1	18.4	16.9	7.60	20.2	MEAN
MAX	38.2	55.5	44.7	113	115	7.84	12.7	19.5	29.4	21.5	8.33	38.2	MAX
MIN	9.09	36.5	39.9	39.9	11.5	5.66	6.80	11.8	9.03	6.37	6.43	8.33	MIN
DAM3	53500	109900	113000	141100	161000	17500	23500	37700	47600	45300	19700	54000	DAM3

SUMMARY FOR THE YEAR 2018
Total discharge 823800 DAM
Mean discharge, 26.1 m^3/s
Maximum daily discharge, 115 m^3/s On 2018-05-01
Minimum daily discharge, 5.66 m^3/s On 2018-06-06

NOTE: DATA ARE SUPPLIED BY THE UNITED STATES GEOLOGICAL SURVEY AND ARE PROVISIONAL
B - BACKWATER

TABLE IV

GRAND FALLS FLOWAGE AT GRAND FALLS
DAILY MEAN WATER LEVEL IN METERS FOR 2018

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	61.702	61.855	61.796	61.863	61.834	61.855	61.954	61.616	61.550	61.476	61.733	61.809	1
2	61.688	61.869	61.792	61.889	61.817	61.851	61.964	61.610	61.556	61.476	61.732	61.820	2
3	61.682	61.860	61.797	61.917	61.792	61.838	61.959	61.595	61.557	61.488	61.785	61.860	3
4	61.681	61.843	61.817	61.919	61.789	61.844	61.947	61.588	61.550	61.479	61.823	61.916	4
5	61.702	61.874	61.826	61.926	61.821	61.856	61.931	61.607	61.542	61.462	61.794	61.932	5
6	61.688	61.891	61.829	61.936	61.827	61.853	61.930	61.608	61.523	61.465	61.775	61.928	6
7	61.680	61.909	61.827	61.926	61.819	61.850	61.917	61.601	61.509	61.475	61.739	61.919	7
8	61.674	61.898	61.831	61.892	61.803	61.840	61.906	61.591	61.501	61.480	61.735	61.895	8
9	61.674	61.877	61.850	61.854	61.797	61.828	61.890	61.589	61.481	61.492	61.688	61.857	9
10	61.666	61.856	61.850	61.810	61.823	61.817	61.865	61.588	61.476	61.483	61.686	61.827	10
11	61.660	61.832	61.850	61.789	61.825	61.806	61.842	61.567	61.481	61.496	61.716	61.809	11
12	61.656	61.802	61.838	61.770	61.800	61.810	61.828	61.546	61.486	61.542	61.692	61.803	12
13	61.758	61.764	61.818	61.831	61.804	61.801	61.814	61.552	61.481	61.573	61.672	61.785	13
14	61.885	61.734	61.861	61.915	61.789	61.790	61.801	61.545	61.479	61.582	61.714	61.769	14
15	61.979	61.737	61.887	61.921	61.820	61.796	61.789	61.553	61.477	61.585	61.698	61.764	15
16	62.010	61.728	61.828	61.862	61.859	61.800	61.777	61.567	61.472	61.618	61.712	61.754	16
17	62.017	61.698	61.842	61.789	61.852	61.793	61.765	61.565	61.475	61.608	61.750	61.737	17
18	62.003	61.674	61.824	61.801	61.825	61.799	61.761	61.584	61.471	61.622	61.779	61.717	18
19	61.974	61.648	61.807	61.817	61.806	61.805	61.750	61.601	61.445	61.618	61.772	61.689	19
20	61.930	61.637	61.780	61.776	61.824	61.800	61.743	61.606	61.421	61.632	61.761	61.667	20
	61.891	61.647	61.754	61.746	61.871	61.782	61.736	61.601	61.463	61.632	61.751	61.658	
21	61.845	61.676	61.713	61.716	61.895	61.774	61.723	61.597	61.494	61.636	61.729	61.719	21
22	61.816	61.720	61.684	61.695	61.908	61.775	61.719	61.606	61.477	61.627	61.704	61.846	22
23	61.843	61.762	61.660	61.722	61.915	61.772	61.714	61.598	61.460	61.634	61.707	61.887	23
24	61.884	61.785	61.625	61.728	61.925	61.773	61.700	61.598	61.457	61.679	61.704	61.866	24
25													25
	61.922	61.802	61.605	61.743	61.910	61.783	61.691	61.595	61.488	61.697	61.693	61.829	
26	61.931	61.811	61.622	61.829	61.884	61.786	61.664	61.587	61.497	61.677	61.689	61.817	26
27	61.919	61.813	61.637	61.878	61.865	61.805	61.648	61.581	61.483	61.684	61.718	61.779	27
28	61.883		61.657	61.861	61.844	61.878	61.646	61.573	61.485	61.740	61.769	61.776	28
29	61.844		61.688	61.849	61.833	61.933	61.639	61.559	61.479	61.763	61.796	61.780	29
30	61.821		61.774		61.841		61.628	61.546		61.747		61.768	30
31													31
TOTAL	1916.308	1730.002	1914.969	#######	1917.017	1854.493	1915.641	#######	1844.716	1909.168	1852.016	1915.982	TOTAL
MEAN	61.816	61.786	61.773	61.832	61.839	61.816	61.795	61.585	61.491	61.586	61.734	61.806	MEAN
MAX	62.017	61.909	61.887	61.936	61.925	61.933	61.964	61.616	61.557	61.763	61.823	61.932	MAX
MIN	61.656	61.637	61.605	61.695	61.789	61.772	61.628	61.545	61.421	61.462	61.672	61.658	MIN

SUMMARY FOR THE YEAR 2018
Mean water level, 61.738 m
Maximum daily water level, 62.017 m On 2018-01-17
Minimum daily water level, 61.421 m On 2018-09-20

NOTE: WATER LEVELS ARE IN METERS AND ARE REFERENCED TO GEODETIC SURVEY OF CANADA DATUM. WATER LEVELS ARE PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT CANADA IN COOPERATION WITH WOODLAND PULP LLC

TABLE V

ST. CROIX RIVER AT BARING MAINE
DAILY MEAN DISCHARGE IN METERS PER SECOND FOR 2018

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	45.3B	92.0	112	108	311	27.9	44.2	26.0	25.8	37.1	66.8	44.7	1
2	45.0B	95B	113	130	303	26.1	45.0	25.8	25.9	36.5	64.8	53.2	2
3	41.6B	93B	113	133	289	25.5	47.0	25.7	25.9	33.4	107	64.3	3
4	39.6B	92B	114	163	278	25.6	44.2	25.7	25.8	38.5	148	69.9	4
5	42.8B	119B	114	188	278	25.9	39.6	25.7	25.6	33.4	144	79.0	5
6	37.7B	130B	114	188	278	27.1	41.3	25.7	26.0	29.7	137	89.5	6
7	36.5B	139	113	199	276	29.7	39.9	25.9	25.7	29.7	151	80.4	7
8	36.2B	151B	115	189	250	30.9	37.4	25.8	25.4	28.3	140	76.5	8
9	36.2B	144B	114	179	220	29.4	36.5	26.0	25.6	28.0	134	65.4	9
10	36.0B	140B	115	162	193	26.8	36.2	25.3	25.6	27.9	134	65.7	10
11	34.5B	139	114	147	189	25.7	33.4	29.7	26.1	29.4	134	57.2	11
12	36.5B	137	113	136	155	25.0	30.0	30.0	25.8	30.6	129	49.6	12
13	118B	133B	113	137	143	25.0	29.7	26.4	26.1	28.3	129	46.2	13
14	135B	117	101	174	129	25.5	29.7	26.7	25.9	29.4	135	46.4	14
15	164B	108	104	205	102	25.3	29.4	27.3	25.9	31.7	108	42.5	15
16	185	109	124	219	88.6	26.0	28.9	26.9	26.2	34.8	102	40.2	16
17	184	108B	103	223	87.8	26.3	30.9	26.4	26.8	33.1	85.0	49.8	17
18	176B	108	110	222	87.2	25.4	29.4	27.0	27.4	33.1	70.2	57.5	18
19	165B	106	111	243	86.6	25.4	28.2	26.8	35.4	29.2	67.7	55.5	19
20	155	109	111	257	83.8	24.8	26.8	26.4	41.9	26.7	67.4	53.5	20
21	146	114	110	250	61.2	24.9	26.4	26.6	29.2	26.5	66.8	64.6	21
22	140	116	109	244	59.7	24.9	26.4	26.9	30.3	26.1	65.1	175	22
23	142	113	105	220	60.0	24.9	26.5	28.9	27.0	25.9	53.5	169	23
24	160	113	104	204	59.7	25.2	26.4	28.6	26.4	26.6	45.6	197	24
25	153B	112	104	214	59.5	25.5	26.3	27.0	26.5	27.0	48.1	197	25
26	150B	112	91.5	269	59.7	24.8	26.3	26.2	27.1	26.6	50.7	165	26
27	150B	112	83.8	317	58.9	24.4	29.4	26.3	28.9	26.7	53.5	140	27
28	151	112	86.9	348	57.8	26.9	27.2	26.4	31.1	31.1	57.5	123	28
29	146	259	85.8	337	50.7	39.1	26.3	26.6	32.6	37.4	48.1	121	29
30	142		89.8	326	44.5	42.5	26.2	26.6	32.8	45.0	43.6	112	30
31	117		92.3		36.2		26.2	26.2		62.3		92.0	31
TOTAL	3346	3530	3303	6333	4438	813	1002	828	837	990	2788	2742	TOTAL
MEAN	108	122	107	211	143	27.1	32.3	26.7	27.9	31.9	92.9	88.4	MEAN
MAX	185	259	124	348	311	42.5	47.0	30.0	41.9	62.3	151	197	MAX
MIN	34.5	92.0	83.8	108	36.2	24.4	26.2	25.3	25.4	25.9	43.6	40.2	MIN
DAM3	289100	305000	285400	547200	383500	70200	86600	71500	72300	85600	240900	236900	DAM3

SUMMARY FOR THE YEAR 2018
Total discharge 2674200 DAM
Mean discharge, 84.8 m^3/s
Maximum daily discharge, 348 m^3/s On 2018-04-28
Minimum daily discharge, 24.4 m^3/s On 2018-06-27

NOTE: DATA ARE SUPPLIED BY THE UNITED STATES GEOLOGICAL SURVEY AND ARE PROVISIONAL
B - BACKWATER

TABLE VI

ST. CROIX RIVER AT MILLTOWN DAM
DAILY MEAN WATER LEVEL IN METERS FOR 2018

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	13.744	13.711	13.869	13.852	13.886	13.706	13.711	---	13.697	13.700	13.785	13.713	1
2	13.739	13.703	13.875	13.860	13.864	13.702	13.704	---	13.698	13.677	13.789	13.714	2
3	13.747	13.723	13.884	13.854	13.838	13.710	13.704	13.628	13.700	13.686	13.799	13.725	3
4	13.744	13.723	13.887	13.890	13.814	13.723	13.693	13.628	13.699	13.678	13.812	13.713	4
5	13.753	13.730	13.884	13.917	13.808	13.742	13.687	13.635	13.699	13.675	13.789	13.722	5
6	13.748	13.720	13.882	13.916	13.806	13.743	13.690	13.632	13.701	13.684	13.777	13.719	6
7	13.742	13.734	13.861	13.925	13.793	13.732	13.707	13.654	13.704	13.687	13.757	13.717	7
8	13.737	13.723	13.881	13.901	13.718	13.736	13.665	13.652	13.693	13.687	13.742	13.717	8
9	13.736	13.718	13.882	13.893	13.701	13.728	13.694	13.637	13.692	13.677	13.812	13.715	9
10	13.742	13.721	13.884	13.886	13.659	13.733	13.691	13.649	13.691	13.683	13.804	13.720	10
11	13.739	13.710	13.866	13.873	13.655	13.735	13.675	13.677	13.690	13.697	13.797	13.718	11
12	13.772	13.721	13.862	13.865	13.634	13.729	13.670	13.706	13.697	13.719	13.789	13.715	12
13	13.868	13.726	13.863	13.877	13.620	13.724	13.700	13.656	13.692	13.715	13.796	13.710	13
14	13.838	13.683	13.885	13.885	13.608	13.732	13.699	13.666	13.652	13.717	13.796	13.710	14
15	13.871	13.743	13.890	13.918	13.601	13.752	13.703	13.694	13.657	13.715	13.785	13.710	15
16	13.881	13.707	13.884	13.928	13.663	13.726	13.700	13.718	13.695	13.714	13.786	13.709	16
17	13.877	13.740	13.894	13.952	13.732	13.715	13.709	13.713	13.695	13.715	13.786	13.718	17
18	13.860	13.721	13.898	13.943	13.726	13.730	13.716	13.708	13.694	13.718	13.774	13.714	18
19	13.826	13.713	13.891	13.960	13.722	13.727	13.701	13.700	13.689	13.718	13.767	13.714	19
20	13.791	13.768	13.888	13.972	13.724	13.716	13.693	13.701	13.690	13.720	13.766	13.721	20
21	13.741	13.801	13.863	13.959	13.725	13.714	13.689	13.702	13.691	13.722	13.754	13.717	21
22	13.732	13.846	13.860	13.944	13.721	13.716	13.691	13.703	13.685	13.717	13.723	13.764	22
23	13.729	13.868	13.853	13.912	13.719	13.720	---	13.699	13.674	13.731	13.695	13.738	23
24	13.792	13.854	13.882	13.878	13.716	13.727	---	13.699	13.650	13.690	13.704	13.745	24
25	13.758	13.862	13.888	13.903	13.713	13.721	---	13.699	13.687	13.710	13.705	13.742	25
26	13.774	13.870	13.863	13.945	13.715	13.720	---	13.700	13.689	13.709	13.706	13.730	26
27	13.771	13.864	13.878	13.966	13.709	13.711	---	13.700	13.689	13.708	13.707	13.739	27
28	13.737	13.859	13.874	13.947	13.702	13.707	---	13.703	13.683	13.803	13.714	13.727	28
29	13.750		13.860	13.939	13.707	13.755	---	13.706	13.680	13.720	13.714	13.727	29
30	13.756		13.867	13.915	13.710	13.713	---	13.706	13.674	13.774	13.714	13.730	30
31	13.734		13.852		13.703		---	13.697		13.796		13.715	31
TOTAL	427.029	385.262	430.150	417.375	425.412	411.745	301.292	396.768	410.627	425.062	412.844	425.388	TOTAL
MEAN	13.775	13.759	13.876	13.913	13.723	13.725	13.695	13.682	13.688	13.712	13.761	13.722	MEAN
MAX	13.881	13.870	13.898	13.972	13.886	13.755	13.716	13.718	13.704	13.803	13.812	13.764	MAX
MIN	13.729	13.683	13.852	13.852	13.601	13.702	13.665	13.628	13.650	13.675	13.695	13.709	MIN

SUMMARY FOR THE YEAR 2018
Mean water level, 13.753 m
Maximum daily water level, 13.972 m On 2018-04-20
Minimum daily water level, 13.601 m On 2018-05-15

NOTES: WATER LEVELS ARE IN METERS AND ARE REFERENCED TO GEODETIC SURVEY OF CANADA DATUM. THE WATER LEVEL DATA ARE PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT CANADA IN COOPERATION WITH NEW BRUNSWICK POWER.
--- MISSING DATA
A PARTIAL DAY

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APPENDIX 4

Hydrographs

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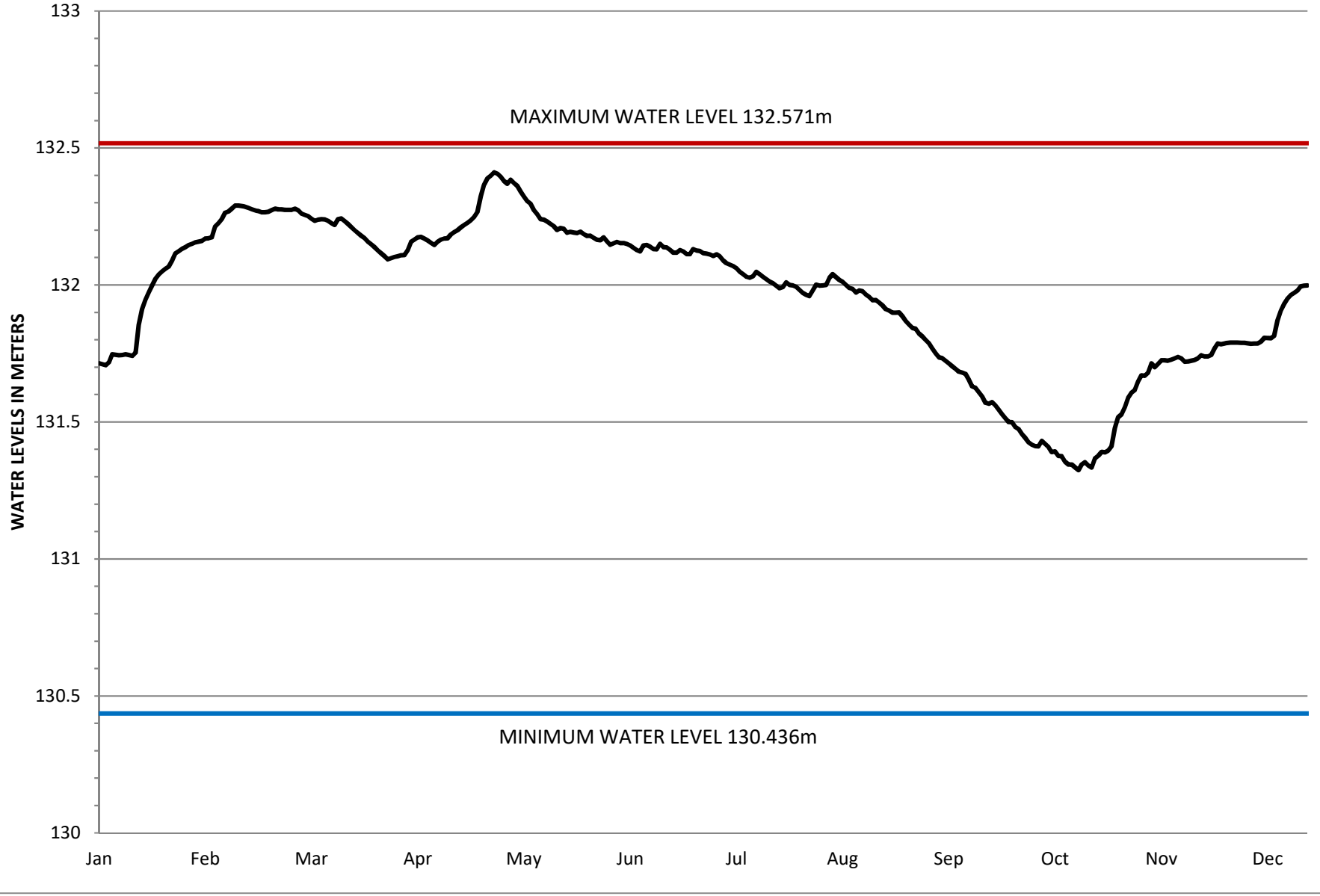
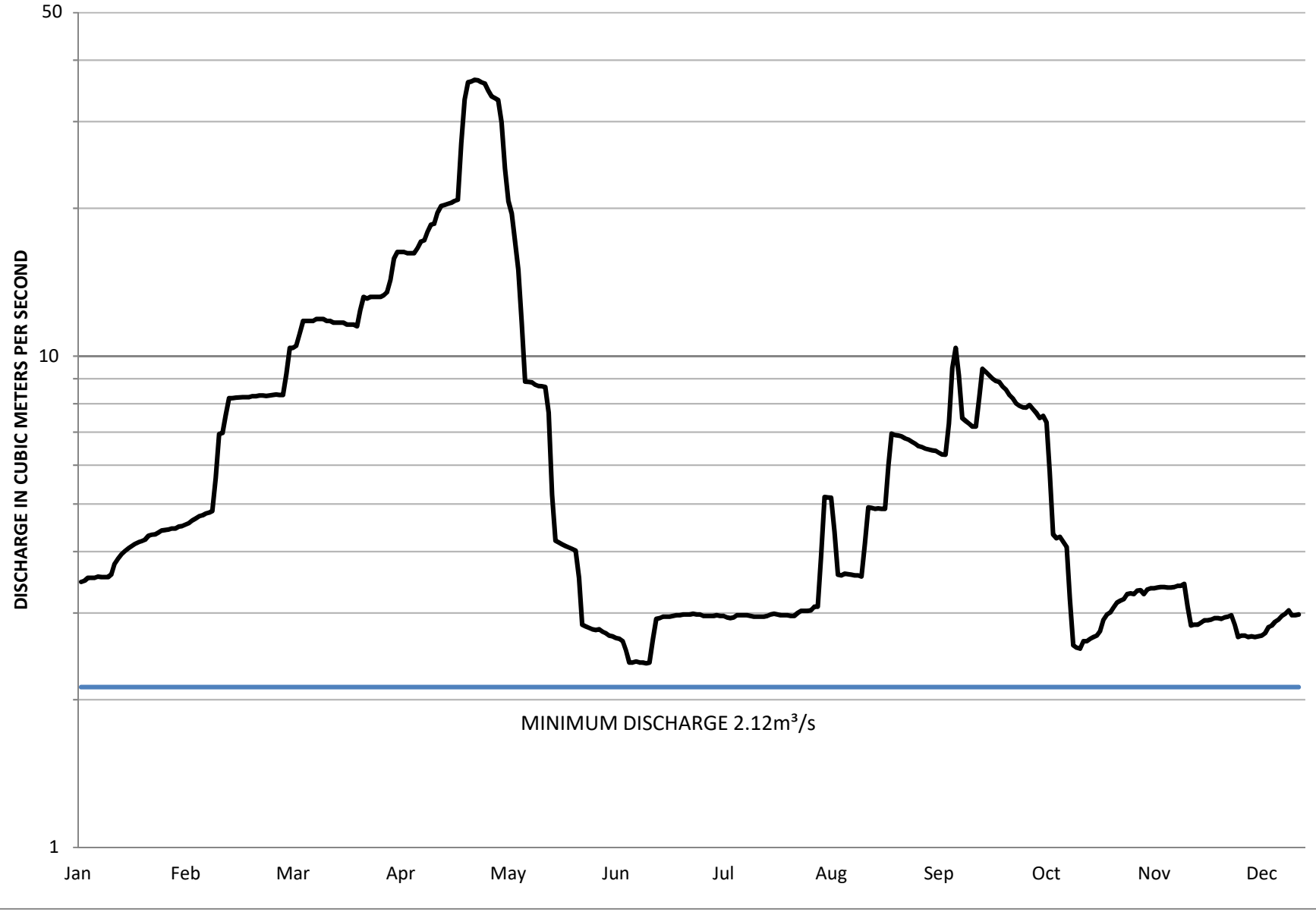
YEAR: 2018 STATION ID: 01AR009 - GRAND LAKE AT FOREST CITY

FIGURE I



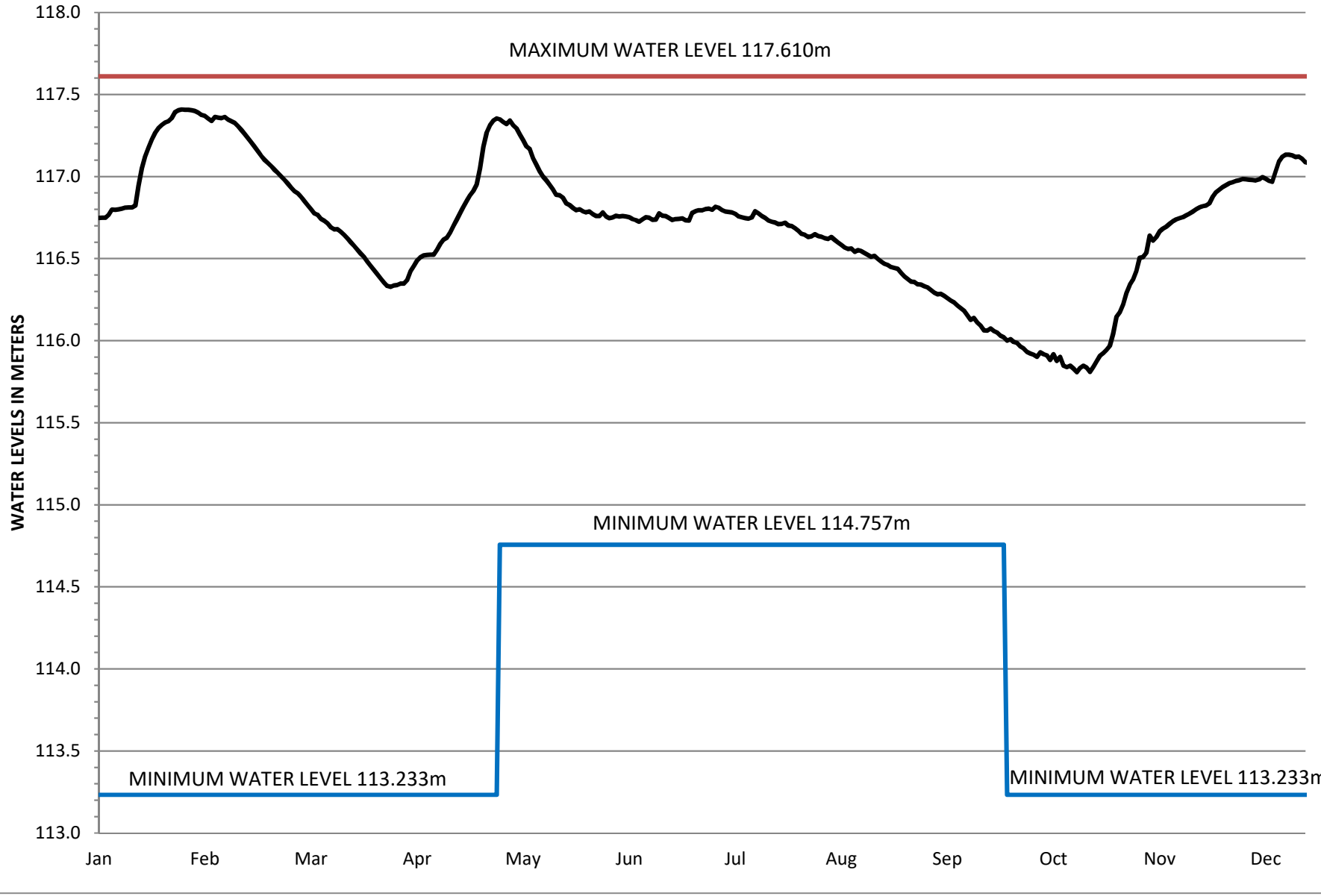
YEAR: 2018 STATION ID: 01AR011 - FOREST CITY STREAM BELOW FOREST CITY DAM

FIGURE II



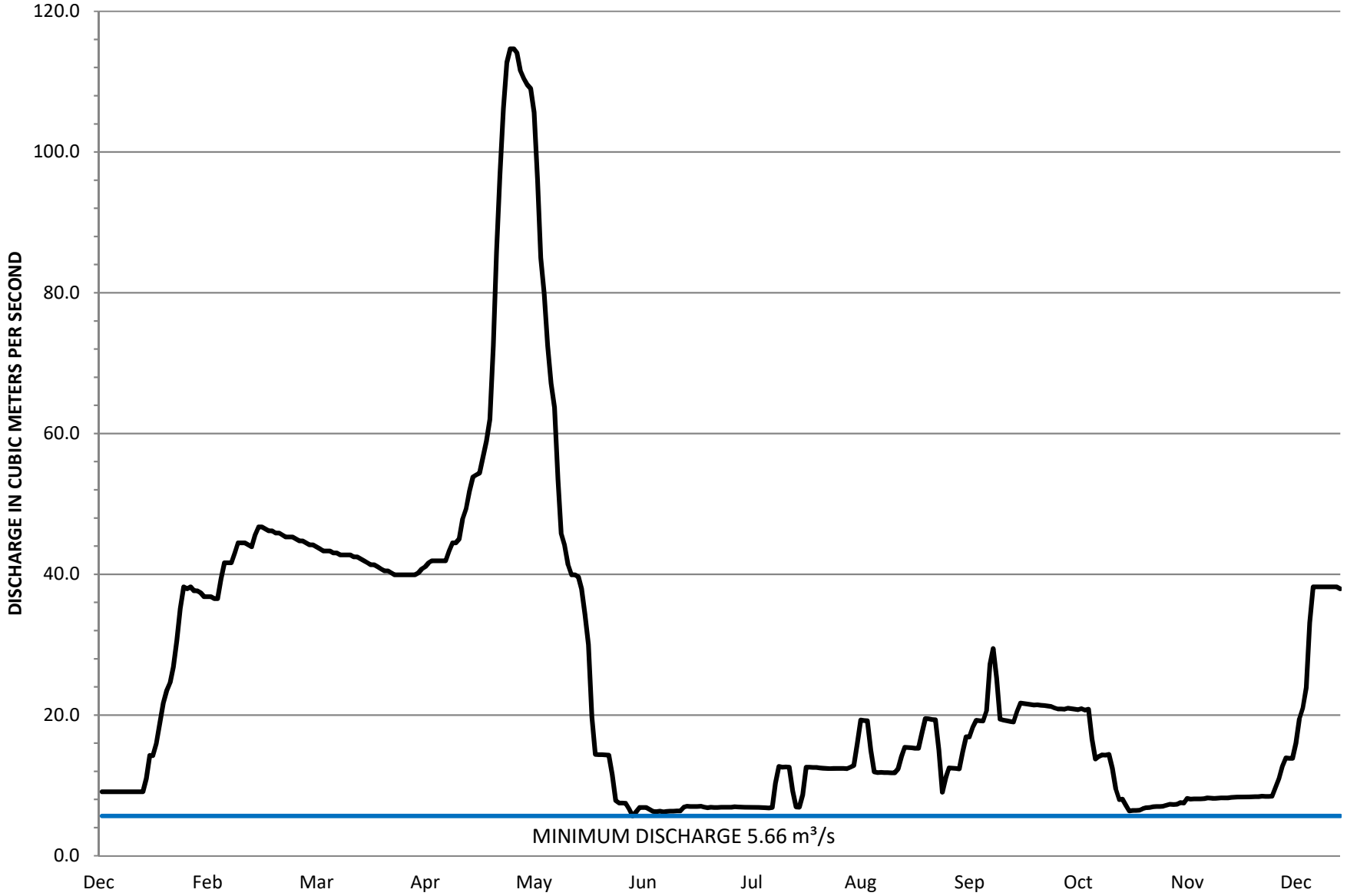
YEAR: 2018 STATION ID: 01AR010 - SPEDNIC LAKE AT ST. CROIX

FIGURE III



YEAR: 2018 STATION ID: 01AR004 - ST. CROIX RIVER AT VANCEBORO

FIGURE IV

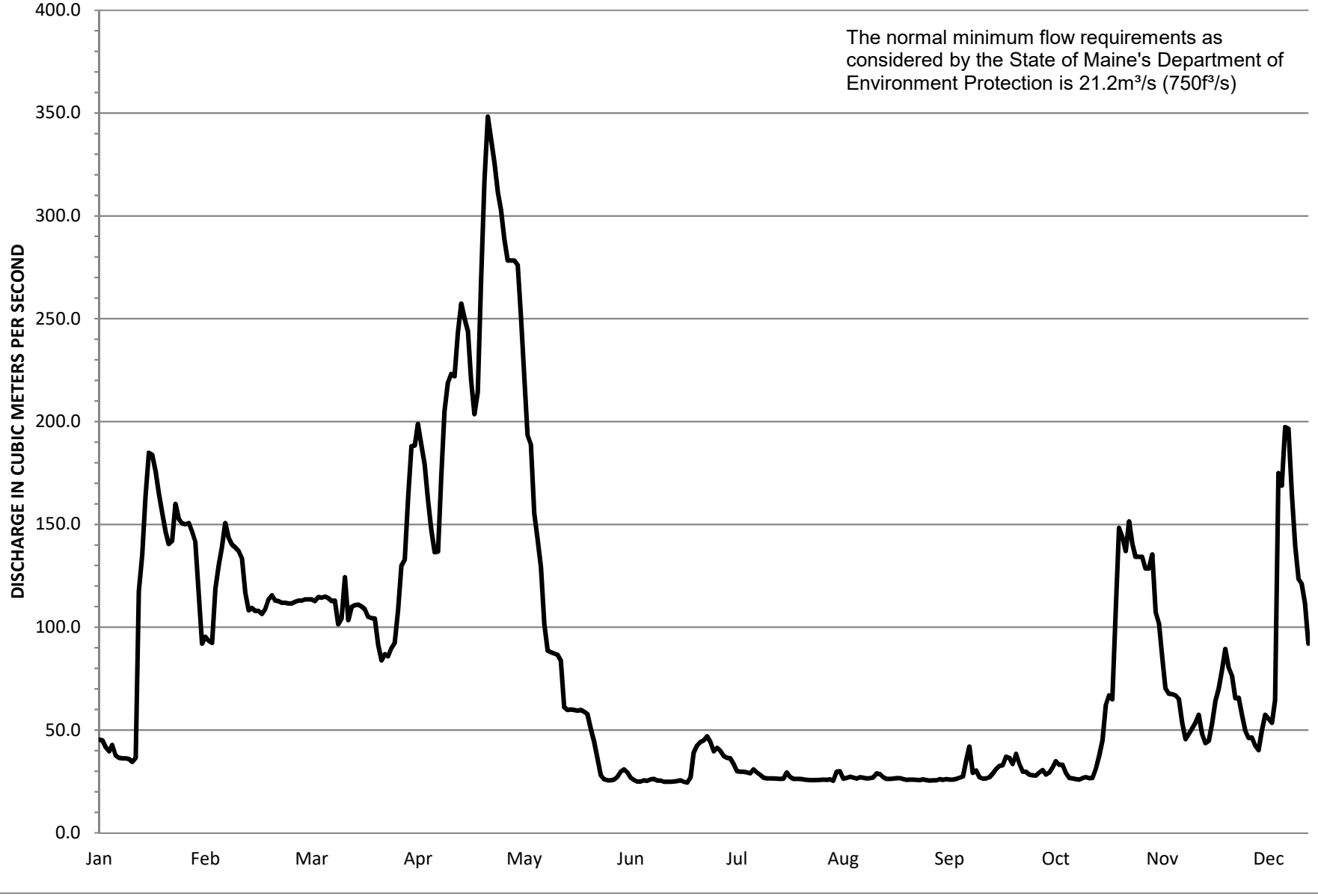


YEAR: 2018 STATION ID: 01AR013 - GRAND FALLS FLOWAGE AT GRAND FALLS

FIGURE V

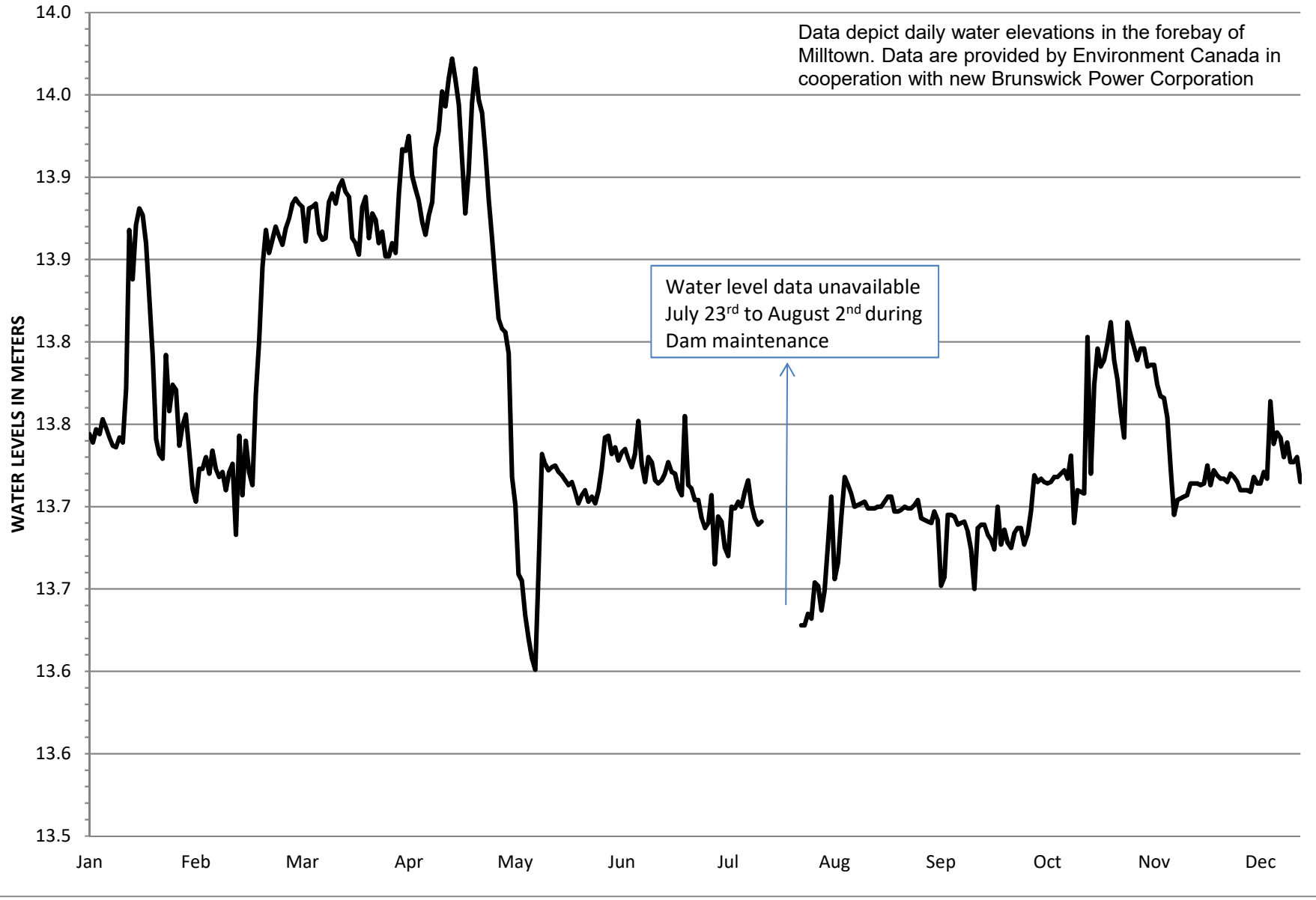
YEAR: 2018 STATION ID: 01AR005 - ST. CROIX RIVER AT BARING MAINE

FIGURE VI



YEAR: 2018 STATION ID: 01AR014 - ST. CROIX RIVER AT MILLTOWN DAM

FIGURE VII



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APPENDIX 5

WATER QUALITY DATA

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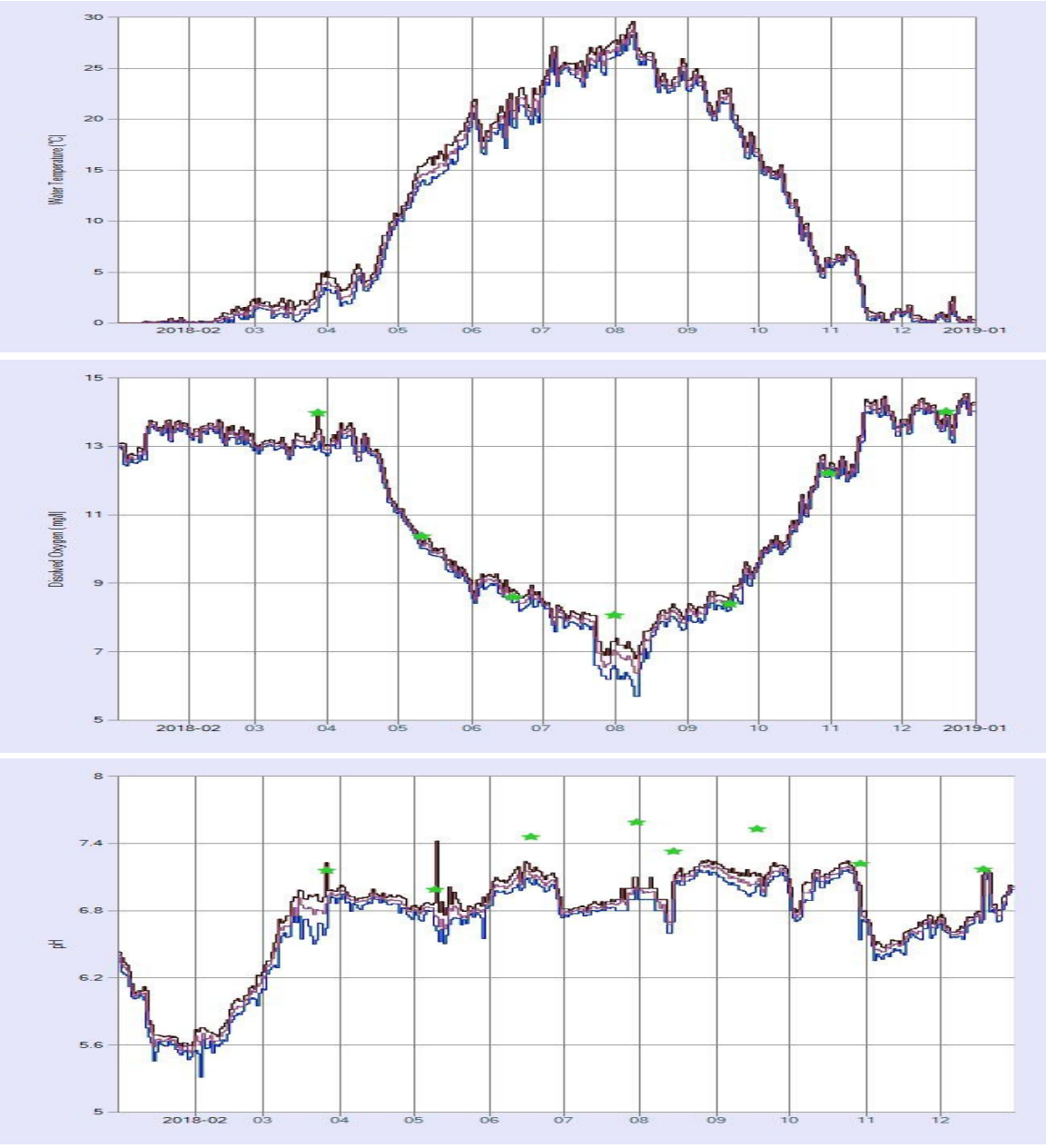
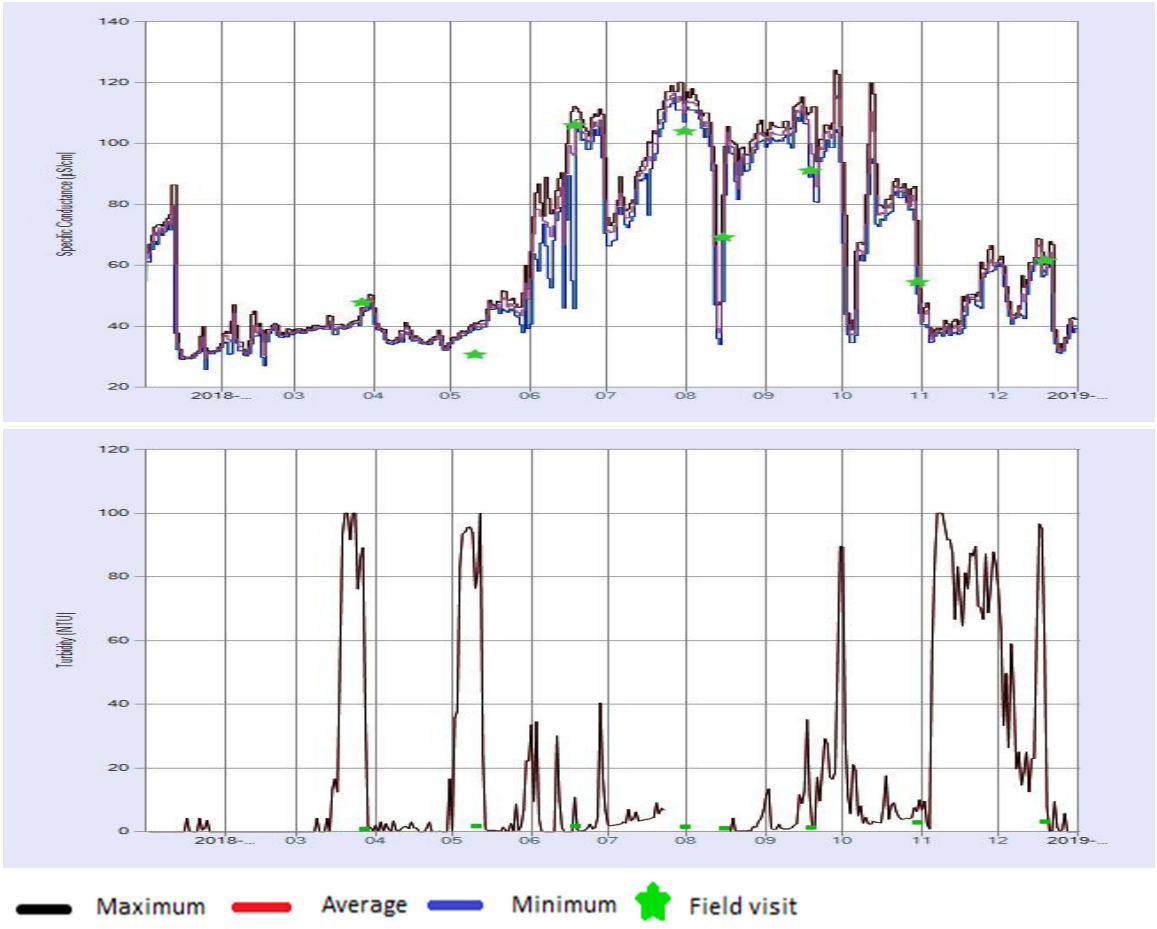
1. Milltown Real Time Data

Daily mean, maximum, and minimum temperature, dissolved oxygen, pH, specific conductance, and turbidity on the St. Croix River at Milltown, NB, 2018. Field measurements (green stars) are also shown on the real time graphs.




Specific Conductance (µS/cm)
140
120
100
80
60
40
20
2018-...
03
04
05
06
07
08
09
10
11
12
2019-...
Turbidity (NTU)
120
100
80
60
40
20
0
Maximum
Average
Minimum
Field visit

St. Croix River at Milltown, NB ECCC Station
Water-Quality Monitor, January-December 2018

Water Temperature (°C)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	0.02	0.056	0.119	1.667	9.974	16.537	22.432	22.552	16.11	4.41	0.06	0.01
Max	0.592	2.399	5.073	10.823	20.636	23.307	27.7	29.6	24.966	16.55	7.54	2.62
Mean	0.099	0.524	1.748	5.065	15.145	20.24	25.268	25.508	20.729	10.729	3.058	0.543

Dissolved Oxygen (mg/L)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	12.432	12.873	12.613	11.044	8.759	8.184	6.2	5.7	7.839	9.562	11.962	13.1
Max	13.776	13.783	13.97	13.691	11.192	9.284	8.48	8.403	9.631	12.763	14.474	14.55
Mean	13.232	13.372	13.062	12.697	9.963	8.764	7.698	7.44	8.645	10.949	13.307	13.954

pH (pH units)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	5.457	5.314	6.093	6.743	6.506	6.766	6.736	6.6	6.928	6.54	6.355	6.543
Max	6.44	6.225	7.23	7.031	7.422	7.24	7.1	7.253	7.24	7.246	6.801	7.16
Mean	5.852	5.822	6.696	6.898	6.782	7.043	6.846	7.019	7.101	7.029	6.57	6.774

Specific Conductance (µS/cm)

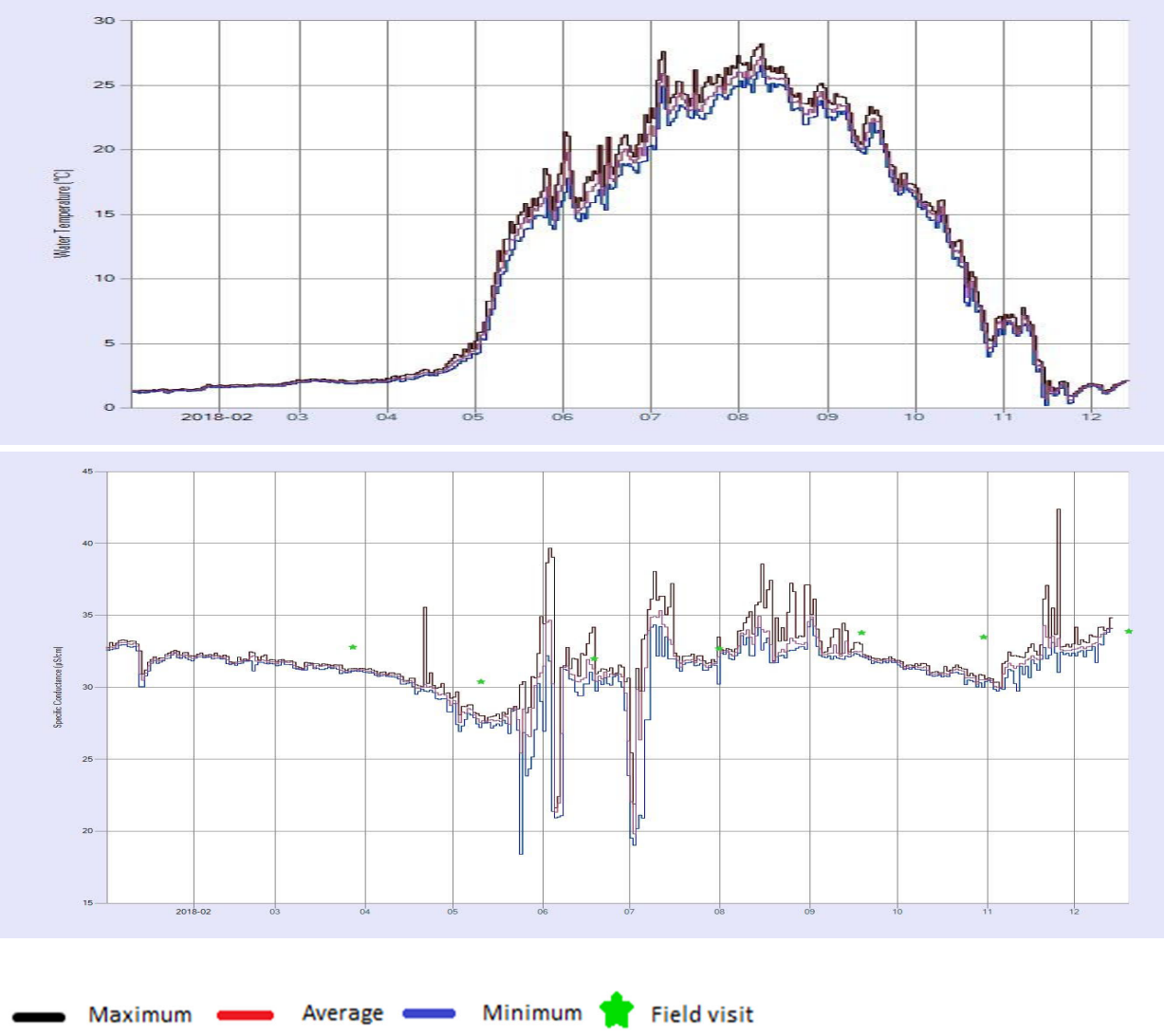
	January	February	March	April	May	June	July	August	September	October	November	December
Min	25.8	27.034	37.273	32.109	34.236	40.718	66.398	34	80.707	34.589	34.667	31.1
Max	86.392	47.048	50.45	46.059	59.956	112.126	120	118	124.075	119.934	66.528	68.815
Mean	47.266	36.668	40.818	36.291	43.041	88.433	93.961	95.517	103.552	73.554	45.994	49.5

Turbidity (NTU)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	0	0	0	0	0	0	0	0	0	0.7	1.4	0
Max	651.44	0	762.58	2760	3000	2842	57.6	126.1	2671	1153	3000	3000
Mean	1.286	0	75.059	10.383	308.967	23.748	0.658	0.995	54.997	11.133	1852.728	1268.453

2. Forest City Real Time Data

Daily mean, maximum, and minimum temperature and specific conductance on the St. Croix River at Forest City, NB, 2018. Field measurements for specific conductance (green stars) are also shown on the real time graphs.



St. Croix River at Forest City, NB ECCC Station
Water-Quality Monitor, January-December 2018

Water Temperature (°C)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	1.144	1.565	1.866	2.028	4.154	14.447	20.007	21.954	16.402	3.962	0.207	1.09
Max	1.836	2.207	2.311	5.016	18.961	22.727	27.616	28.225	24.361	17.061	7.783	2.146
Mean	1.405	1.77	2.066	2.95	12.461	18.145	24.058	24.813	20.474	11.044	3.303	1.661

Specific Conductance (µS/cm)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	30.057	31.148	30.963	28.306	18.403	20.934	19.031	31.712	31.665	29.997	29.73	31.72
Max	33.301	32.471	31.934	35.577	34.93	39.68	38.066	38.582	36.144	31.883	42.39	34.84
Mean	32.282	31.968	31.439	30.313	28.136	30.215	31.503	33.134	32.436	31.052	31.944	33.19

3. Grab Samples Milltown and Forest City

Grab water samples at St. Croix River at Milltown (NB01AR0021), 2018

		St. Croix River at Milltown (NB01AR0021)										
Analyte	Units	Guideline**	27-Mar-18	27-Mar-18	27-Mar-18	10-May-18	18-Jun-18	31-Jul-18	15-Aug-18	18-Sep-18	30-Oct-18	19-Dec-18
				RepT	FB							
Alkalinity, Total (CaCO3)	mg/L		9.46	9.39	<1	6.37	21.4	21.2	12.7	20.7	11.2	12.1
Aluminum (Total)*	µg/L	100	91.8	90.8	<4.1	112	121	119	73.3	76.2	141	192
Antimony (Total)*	µg/L		0.04	0.03	<0.02	0.03	0.05	0.05	0.05	0.04	0.05	0.05
Arsenic (Total)*	µg/L	5	0.3	0.31	<0.05	0.3	0.6	0.89	0.73	0.56	0.53	0.43
Barium (Total)*	µg/L		5.5	5.5	<1	4.2	11.4	11.3	7.9	11.9	4.9	9.1
Beryllium (Total)*	µg/L		0.01	0.01	<0.01	0.013	0.008	0.011	0.005	0.005	0.011	0.015
Boron (Total)*	µg/L		<10.2	<10.2	<10.2	3	5	5	4	5	4	5
Cadmium (Total)*	µg/L	calculated	0.02	<0.02	<0.02	0.01	0.04	0.05	0.06	0.05	0.02	0.05
Calcium (Total)	mg/L		3.8	3.78	<0.01	2.52	4.25	5	4.03	4.49	3.7	4.37
Carbon, Total Organic	mg/L		7.25	7.28	<0.25	7.86	12.1	10.4	7.48	8.27	11.1	12
Chloride	mg/L	120	4.5	4.4	<0.2	2.4	9.3	9.5	5.8	8.9	3.4	6.1
Chromium (Total)*	µg/L	8.9	0.16	0.15	<0.02	0.18	0.21	0.16	0.14	0.1	0.25	0.23
Cobalt (Total)*	µg/L		0.06	0.05	<0.01	0.04	0.05	0.09	0.04	0.04	0.09	0.07
Colour, apparent	Colour units		61	65	<5	72	90	91	62	70	104	121
Conductivity	µS/cm		47.8	48	0.8	30.7	106	104	69.2	91.1	54.5	61.6
Copper (Total)*	µg/L	calculated	0.44	0.37	0.01	0.4	0.5	0.6	1.4	0.4	0.6	0.5
Iron (Total)*	mg/L	0.3	0.13	0.13	<0.02	0.133	0.215	0.911	0.227	0.137	0.273	0.213
Lead (Total)*	µg/L	calculated	0.11	0.09	<0.03	0.11	0.11	0.15	0.14	0.12	0.17	0.18
Magnesium (Total)	mg/L		0.68	0.68	<0.05	0.469	0.698	0.798	0.674	0.707	0.724	0.738
Manganese (Total)*	µg/L	73	33.8	34.2	<2	23.7	66.8	99	58.7	59.2	51	54.4
Molybdenum (Total)	µg/L		0.1	0.08	<0.01	0.08	0.18	0.19	0.17	0.16	0.11	0.1
Nickel (Total)*	µg/L	calculated	0.26	0.24	<0.01	0.25	0.3	0.4	0.35	0.24	0.45	0.4
Nitrate as N	mg/L	2.9	0.04	0.04	<0.03	<0.03	0.1	0.09	0.09	0.09	0.04	0.03
Nitrogen, Total	mg/L		0.35	0.34	<0.02	0.3	0.48	0.48	0.41	0.45	0.46	0.54
pH	pH units	6.5-9.0	7.16	7.07	5.51	6.99	7.46	7.59	7.33	7.53	7.22	7.17
Phosphorus, Total	mg/L	0.03***	0.013	0.012	<0.002	0.014	0.042	0.042	0.032	0.044	0.018	<0.007
Potassium (Total)	mg/L		0.6	0.6	<0.4	0.36	2.02	1.92	1.13	1.41	0.97	0.82
Selenium (Total)*	µg/L	1	0.03	0.06	<0.03	0.05	0.05	0.06	0.06	0.04	0.06	0.08
Silver (Total)*	µg/L	0.1	<0.01	<0.01	<0.01	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005
Sodium (Total)	mg/L		4.77	4.7	<0.02	2.49	13.4	13	7.64	11.4	5.48	6.81
Strontium (Total)*	µg/L		18.8	18.8	<1	14.2	27.4	27.2	24.2	24.7	19.7	23.2
Sulfate	mg/L		4.8	4.7	<0.2	2.7	12.7	11.7	8.1	7.2	6.6	5.9
Thallium (Total)*	µg/L	0.8	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Tin (Total)*	µg/L		<0.05	<0.05	<0.05	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02
Turbidity	NTU	15	0.8	0.8	<0.1	1.8	1.8	1.6	1.1	1.3	2.8	3.1
Uranium (Total)*	µg/L		0.08	0.08	<0.01	0.071	0.094	0.083	0.061	0.077	0.064	0.084
Vanadium (Total)*	µg/L		0.23	0.22	<0.02	0.25	0.47	0.47	0.33	0.35	0.4	0.33
Zinc (Total)*	µg/L	30****	2.07	1.81	<0.05	1.4	4.2	4.3	4.2	3.4	1.9	4.4

Notes:

µg/L - microgram per litre; mg/L - milligrams per litre; CaCO3 - calcium carbonate; µS/cm - microSiemens per centimetre; NTU - nephelometric turbidity units

Highlighted cell indicates exceedence.

* *Measured as total recoverable.*

** *Guidelines refer to the Canadian Council of Ministers of the Environment (CCME) guidelines unless otherwise indicated.*

*** *OMOE, 1994.*

**** *BC MOE, 1999.*

RepT; duplicate sample; FB; field blank

Grab water samples at St. Croix River at Forest City (NB01AR0151), 2018

		St. Croix River at Forest City (NB01AR0151)									
Analyte	Units	Guideline**	27-Mar-18	10-May-18	10-May-18	10-May-18	18-Jun-18	31-Jul-18	18-Sep-18	30-Oct-18	19-Dec-18
					RepT	FB					
Alkalinity, Total (CaCO3)	mg/L		11.4	10.4	10.4	<1	10.7	10.9	11.1	10.9	11.3
Aluminum (Total)*	µg/L	100	8.2	16.9	16.4	<1.5	17.8	14.6	11.6	8.5	10.5
Antimony (Total)*	µg/L		0.03	0.03	0.03	<0.02	0.04	0.03	0.03	0.05	0.03
Arsenic (Total)*	µg/L	5	0.25	0.19	0.2	<0.02	0.22	0.25	0.24	0.25	0.27
Barium (Total)*	µg/L		<1	1.5	1.5	<0.1	1.7	1.8	1.9	1.8	1.8
Beryllium (Total)*	µg/L		<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Boron (Total)*	µg/L		<10.2	2	2	<1	3	2	2	2	2
Cadmium (Total)*	µg/L	calculated	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium (Total)	mg/L		4.26	3.61	3.63	<0.01	3.76	3.97	4.07	4.01	4.2
Carbon, Total Organic	mg/L		3.09	3.71	3.71	0.41	5.19	3.73	3.52	3.63	3.59
Chloride	mg/L	120	1.6	1.5	1.5	<0.2	1.7	1.8	1.7	1.7	1.8
Chromium (Total)*	8	8.9	0.05	0.05	0.05	<0.02	0.07	0.05	0.05	0.05	0.06
Cobalt (Total)*	µg/L		<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Colour, apparent	Colour units		10	19	15	<5	15	14	13	14	15
Conductivity	µS/cm		32.8	30.4	30.3	0.8	32	32.7	33.8	33.5	33.9
Copper (Total)*	µg/L	calculated	0.26	0.2	0.2	<0.1	0.3	0.3	0.4	0.4	0.5
Iron (Total)*	mg/L	0.3	<0.02	0.018	0.017	<0.5	0.02	0.016	0.01	0.019	0.027
Lead (Total)*	µg/L	calculated	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04
Magnesium (Total)	mg/L		0.64	0.538	0.543	<0.001	0.562	0.58	0.589	0.567	0.582
Manganese (Total)*	µg/L		2.5	3.1	3	<0.2	5.7	6.1	4.7	7.5	9.5
Molybdenum (Total)	µg/L	73	0.07	0.06	0.06	<0.02	0.05	0.06	0.06	0.06	0.06
Nickel (Total)*	µg/L	calculated	0.12	0.1	0.11	<0.05	0.18	0.12	0.14	0.13	0.15
Nitrate as N	mg/L		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.02
Nitrogen, Total	mg/L	2.9	0.17	0.17	0.17	<0.02	0.18	0.19	0.19	<0.02	0.16
pH	pH units	6.5-9.0	7.24	7.25	7.3	5.5	7.32	7.45	7.4	7.35	7.32
Phosphorus, Total	mg/L	0.03***	0.004	0.005	0.006	<0.002	0.007	0.005	0.005	0.005	0.005
Potassium (Total)	mg/L		<0.4	0.25	0.25	<0.03	0.27	0.26	0.27	0.29	0.33
Selenium (Total)*	µg/L	1	0.03	0.03	0.03	<0.03	0.04	0.03	0.04	0.04	0.04
Silver (Total)*	µg/L	0.1	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium (Total)	mg/L		1.45	1.25	1.28	<0.02	1.31	1.46	1.47	1.43	1.51
Strontium (Total)*	µg/L		23.3	21.1	21.7	<0.15	24	22.7	22.2	22.8	23.9
Sulfate	mg/L		1.5	1.6	1.6	<0.2	1.6	1.8	1.7	1.7	1.9
Thallium (Total)*	µg/L	0.8	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Tin (Total)*	µg/L		<0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Turbidity	NTU	15	0.2	0.5	0.5	0.2	0.5	0.5	0.4	0.5	0.6
Uranium (Total)*	µg/L		0.02	0.023	0.023	<0.005	0.022	0.022	0.023	0.019	0.02
Vanadium (Total)*	µg/L		0.04	0.06	0.06	<0.02	0.07	0.07	0.07	0.06	0.06
Zinc (Total)*	µg/L	30****	0.16	0.7	0.8	<0.2	1.9	0.2	1.8	0.7	1.2

Notes:

µg/L - microgram per litre; mg/L - milligrams per litre; CaCO3 - calcium carbonate; µS/cm - microSiemens per centimetre; NTU - nephelometric turbidity units

Highlighted cell indicates exceedence.

* *Measured as total recoverable.*

** *Guidelines refer to the Canadian Council of Ministers of the Environment (CCME) guidelines unless otherwise indicated.*

*** *OMOE, 1994.*

**** *BC MOE, 1999.*

RepT; duplicate sample; FB; field

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APPENDIX 6

MILLTOWN FISH DATA

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Table 1. St. Croix River ME/NB alewife/gaspereau/blueback herring spawning runs, 1981- present **(bold = 7-day peak)**

Sources: Fisheries & Oceans Canada (1981-1990), Atlantic Salmon Federation (2012-2014), St. Croix International Waterway Commission (1991-2011, 2015-present).

YEARS >>>	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
April 30-May2	--	0	0	0	0	5460	0	0	0	0	0	0	0	0	0	0	0	0
May 3-9	--	0	0	0	0	16410	9400	24410	0	29690	170	0	0	0	0	2814	0	0
May 10-16	7510	32160	16970	6000	0	75150	171500	468750	0	305370	14740	8910	0	0	5898	11178	0	**77394**
May 17-23	47450	64120	**44050**	40300	70000	429400	559500	760280	200610	319380	133820	**74120**	12000	94304	**109388**	202188	**122478**	25705
May 24-30	47770	**74800**	33760	**67100**	**149890**	**772800**	**674700**	**764990**	**464390**	**411090**	**154560**	45520	**146600**	99150	99847	188538	93000	71534
May 31- June 6	**48310**	56930	20770	26200	96740	628300	645300	370750	424550	141490	51110	24780	102800	**125900**	50946	**231870**	4091	2684
June 7-13	16000	4610	35650	13300	26900	57200	480400	187800	63940	132030	4010	50420	2260	15400	0	9390	5951	0
June 14-20	1760	250	620	0	21040	0	83900	13770	11370	0	0	0	26060	0	0	0	0	0
June 21-27	790	210	0	0	1060	0	0	0	0	0	0	0	0	0	0	0	0	0
June 28 - July 4	30	20	0	0	3270	0	0	0	0	0	0	0	0	0	0	0	0	0
July 5-11	0	1	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 12-18	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 19-25	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 26 - later			0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Escapement	169620	233102	151952	152900	368900	1984720	2624700	2590750	1164860	1339050	358410	203750	289720	334754	266079	645978	225521	177317
Harvest	0	0	0	0	0	0	0	0	0	192200	228500	0	8000	15400	8000	0	0	0
TOTAL RUN	169620	233102	151952	152900	368900	1984720	2624700	2590750	1164860	1531250	586910	203750	297720	350154	274079	645978	225521	177317

YEARS >>>	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
April 14-29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
April 30-May2	0	0	0	0	0	0	0	0	--	--	--	--	--	--	--	--	0	0
May 3-9	0	**3966**	0	2	0	0	0	18	0	0	0	0	0	993	342	0	0	0
May 10-16	195	142	160	6	3	0	0	577	0	4	1	9748	1657	343	362	7	16	125
May 17-23	5933	2011	505	23	603	0	2	3111	0	33	12	**17731**	**13053**	**22260**	178	16	126	269
May 24-30	**13615**	377	**2625**	325	2115	0	20	**3155**	2	119	3740	17008	1227	11190	**10542**	29	**32637**	**14304**
May 31-June 6	5476	2067	1735	**494**	**3163**	0	5277	2540	0	**11797**	42	8520	7750	1175	5107	**19971**	16875	12781
June 7-13	108	6	123	35	999	**951**	**6220**	1096	**1225**	61	2	4700	1387	197	37	6775	27150	3038
June 14-20	0	0	54	15	1018	108	113	1227	66	23	**6627**	1126	50	10	83	95	11871	2000
June 21-27	0	0	0	0	0	79	0	105	1	221	26	255	10	0	23	143	3817	471
June 28-July 4	0	0	0	0	--	150	--	--	--	3	0	45	7	--	3	267	816	27
July 5-11	0	0	0	0	--	11	--	--	--	--	--	9	1	--	--	9	161	1
July 12-18	0	0	0	0	--	0	--	--	--	--	--	3	--	--	--	--	34	--
July 19-25	0	0	0	0	--	0	--	--	--	--	--	--	--	--	--	--	--	--
July 26 - later	0	0	0	0	--	0	--	--	--	--	--	--	--	--	--	--	--	--
Escapement	25327	8569	5202	900	7901	1299	11632	11829	1294	12261	10450	59145	25142	36168	16677	27312	93503	33016
Harvest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL RUN	25327	8569	5202	900	7901	1299	11632	11829	1294	12261	10450	59145	25142	36168	16677	27312	93503	33016

Table 1. St. Croix River ME/NB alewife/gaspereau/blueback herring spawning runs, 1981- present continued

YEARS >>>	2017	2018
April 14-29	--	0
April 30-May2	0	0
May 3-9	0	5
May 10-16	369	13028
May 17-23	29946	43260
May 24-30	44110	**130538**
May 31-June 6	42406	43657
June 7-13	27681	29292
June 14-20	8790	7804
June 21-27	3787	2163
June 28-July 4	571	821
July 5-11	69	86
July 12-18	21	5
July 19-25	0	0
July 26 - later	--	--
Escapement	157750	270659
Harvest	0	
TOTAL RUN	157750	

Note 1. Enumeration. Prior to 1999, river herring were enumerated by counting all fish for 10min/hr and multiplying by 6 to yield an hourly total, for each hour the fishway was open. In 1999 and 2000, "light" run periods were enumerated by shutting off the fishway exit for 4 hour intervals and then individually counting all fish in the trap, while "heavy" run periods were enumerated as in previous years. Since 2001. all fish have been counted individually.

Note 2. Upstream passage. Beginning in 1995, the State of Maine blocked the upstream fishways at Woodland and Grand Falls to spawning river herring. In 2001, Fisheries & Oceans Canada began to truck a portion of the spawning run from Milltown to Woodland Flowage. Number of river herring transported to Woodland: 2001 (3756), 2002 (807), 2003 (6805), 2004 (392), 2005 (7100), 2006 (6653), 2007 (1169). In 2008, Maine removed the Woodland fishway barrier, allowing river herring direct access to Woodland Flowage, and Fisheries & Oceans discontinued its trucking operation. In 2013, Maine removed the Grand Falls fishway barrier, allowing river herring access the upper watershed.

Note 3. Duration of count. Monitoring was discontinued on June 27 in 2006, 2007 and 2012; on July 3 in 2008; July 4 in 2009 and 2013; July 8 in 2014; July 11 in 2011 and 2016; July 18 in 2015 and July 19 in 2010 at the presumed end of each year's run. Any fish entering the river after these dates were not recorded

Note 4. Correction of 1994, 1995 and 2010 counts. In 2016, errors in the day counts for these three years was discovered and corrected. This increased earlier reported totals for 1995 and 2010 and decreased 1994.