INTERNATIONAL ST. CROIX RIVER WATERSHED BOARD

ANNUAL REPORT

2019

ST. CROIX RIVER
MAINE AND NEW BRUNSWICK

2019 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 2020

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1.0 GENERAL

1.1 Synopsis for 2019

During the year, reservoir levels at East Grand Lake, Spednic Lake, and Grand Falls Flowage were operated within prescribed levels in the Commission's Orders.

At Vanceboro Dam, the Commission's Order for minimum flow was maintained throughout the year.

Figure 1: St. Croix River, Spednic Lake, June 2019

At Forest City Dam, the Commission's Order for minimum flow was maintained throughout the year, except on 17 September 2019 and 1 December 2019 when flows dropped below the minimum flow. The low flow in September was a short term occurrence (25 minutes) when gates were adjusted to ensure the safety of contractors conducting repairs at the Forest City Dam. The low flow in December (about 9 hours) was caused by buildup of ice at the outflow gates during extreme cold-weather conditions. Both occurrences were promptly addressed by Woodland Pulp and there was no reports of adverse effects to fish or aquatic resources in Forest City Stream.

The annual mean river flow of the St. Croix River, as measured at the Forest City Stream, Vanceboro, and Baring stations, was higher than the long term mean value. At Forest City Stream, the annual mean flow was about 23% higher than the long term mean, while at Vanceboro the annual mean flow was about 45% above, and at Baring the annual mean flow was about 28% above. The annual mean water levels measured at East Grand Lake, Grand Falls Flowage, and Spednic Lake were within 1% of the long term mean.

Real time water quality is monitored at the Forest City Station, in the upper watershed, and at two stations in the lower watershed, just above Milltown Dam in the dam headpond and ½ mile upstream of Milltown Dam in a free flowing section of the river. The dissolved oxygen concentrations at all stations remained above the International Joint Commission's (IJC) objective of 5.0 mg/L for aquatic health.

The Board also monitors the aquatic health of the river with water quality samples collected at the Forest City station and the Milltown Dam headpond station. These samples are analyzed in the lab for a suite of parameters and the water quality rated using the Canadian Council of Ministers of the Environment (CCME) index.

Using the CCME index, water quality in 2019 at Forest City station remained in excellent condition with respect to freshwater aquatic life. As in previous years, no parameters exceeded guidelines.

In 2019, the Milltown Dam headpond station recorded occasional CCME guideline exceedances for phosphorus (2), total aluminum (4), iron (3), copper (1), and zinc (1). As a result, the water quality index at the Milltown Dam headpond station rated "fair" in 2019, decreasing from a rating of "good" in 2018 (see discussion in Section 3.2.3 of report).

During the year, the Board held several meetings in the watershed. The Board and IJC met with the St. Croix International Waterways Commission on Tuesday, June 4th, in St. Stephen, New Brunswick. The annual Board and Partners meeting, as well as Board's annual public meeting were held on Tuesday, June 4th in St. Stephen, New Brunswick.

In 2019, 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). Projects were fish counts at the Milltown Dam, completion of the interactive web-based tool for understanding fish passage efficiency and harvest management outcomes for alewife restoration, and initiation of a study on fish passage opportunities at Woodland and Grand Falls Dams.

1.2 Board Membership

International St. Croix River Watershed Board - Membership	
Canadian Section	**U.S. Section**
Bill Appleby, Canadian Co-Chair Director, Climate Services and Special Projects, 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
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	Sean Ledwin Director, Division of Sea Run Fisheries & Habitat Maine Department of Marine Resources Bangor, Maine
Vacant with position to be filled in 2020	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 (IJC) 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. Board membership in 2019 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 4th at the Garcelon Civic Centre in St. Stephen, New Brunswick. About 30 people attended the meeting. The meeting included a Board presentation by Board Co-Chair, Mr. Bill Appleby, and a presentation/workshop by Dr. Betsy Barber, University of Maine. Dr. Barber presented the interactive web-based tool for understanding fish passage efficiency and harvest management outcomes for alewife restoration on the St. Croix River. Tool development was supported in part through the IJC's International Watersheds Initiative (IWI). As part of the IWI project presentation, multiple computers were set up and provided participants the opportunity to test the tool for themselves, ask questions, and provide comments. Participants also had the opportunity to engage and interact with the Board members and IJC staff during the meeting.

Figure 2: Annual Public Meeting

Figure 3: Modeling Tool Demonstration

Partners Meeting (June): A Board and Partners meeting was held on Tuesday, June 4th in Calais, Maine. About 30 people attended the meeting including representatives from the IJC, Peskotomuhkati/Passamaquoddy, Fisheries and Oceans Canada, US Fish and Wildlife Service, US Geological Survey, University of Maine, and the St. Croix Waterway Commission. Presentations were provided by attendees focusing on current activities related to alewife restoration, water quality, and current lake levels and flows.

Partners Meeting (December): A Board and Partners meeting was also held on Wednesday, December 4th (afternoon) and Thursday, December 5th (morning) in Bangor, Maine. About 27 people attended the meeting including representatives from the IJC, Peskotomuhkati/Passamaquoddy, New Brunswick Power (NB Power), Fisheries and Oceans Canada, US Geological Survey, and the St. Croix Waterway Commission.

Mr. Danny Kane, NB Power representative, provided a presentation on the proposed plans for decommissioning of Milltown Dam. Ms. Lita O'Halloran, Peskotomuhkati Nation at Skutik representative, provided a progress report on their inventory of fish passage barriers for the St. Croix River watershed and the West Fundy drainage area. Updates were also provided on an Environment and Climate Change Canada (ECCC) water quality trends report, the Maine Water Quality Standards for Tribal Sustenance Fishing waters, and river flow conditions.,

St. Croix International Waterways Commission Meeting: In 2019, the Board and IJC held a meeting with St. Croix International Waterways Commission[1] (SCIWC). The meeting was held on Tuesday, June 4th at the Garcelon Centre in St. Stephen, New Brunswick. The purpose of the meeting was to build stronger relationships and look for partnership opportunities between the Board and the SCIWC.

[1] The St. Croix International Waterways Commission (SCIWC) was established through a 1986 Memorandum of Understanding and 1987 Legislative Acts by the State of Maine and the Province of New Brunswick and extends the full length of the St. Croix boundary waters, from their origin at the source of Monument Brook in Aroostook and York Counties to their confluence with Passamaquoddy Bay in Washington and Charlotte Counties. Also part of the Waterway is a 250 feet/75 meter corridor of adjacent shore lands in both countries. (Source: https://www.linkedin.com/company/sciwc)

1.4 Annual Site Visit of Facilities in the Basin

On June 5th, Board members conducted their annual site visit of facilities with IJC Orders. Board members met with New Brunswick Power Corporation officials to tour the Milltown Dam in St. Stephen, New Brunswick, and with Woodland Pulp LLC officials to tour the Grand Falls, Forest City, and Vanceboro Dams. (See Appendix 2 for additional information on facilities with IJC Orders.) Woodland Pulp LLC, at the request of the Board, also organized a tour of the Woodland Dam fish ladder.

Figure 4: Board Site Visits, June 2019

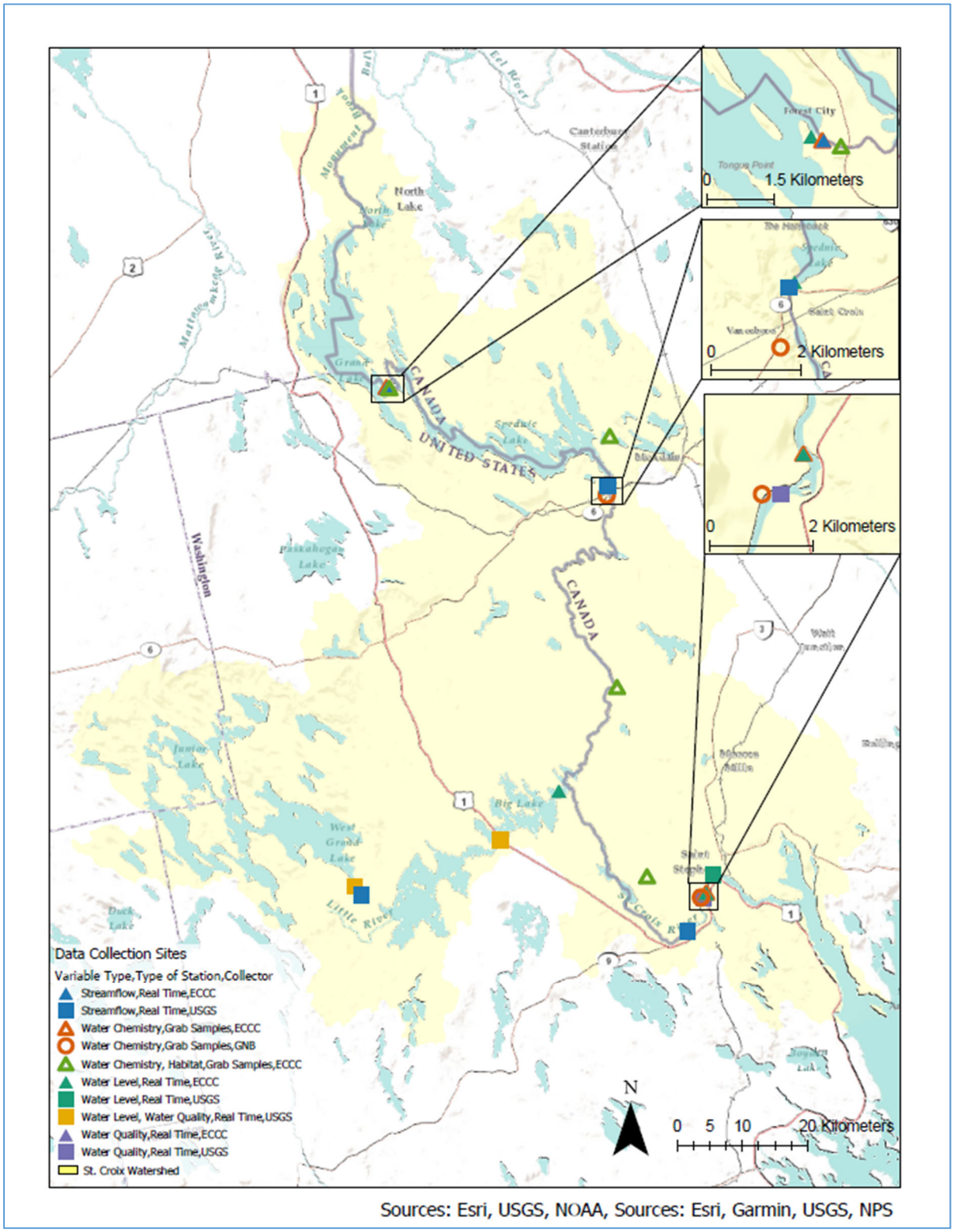
It is the responsibility of the dam owners, operators, and appropriate jurisdictional agencies to conduct the necessary dam inspections and maintenance to ensure the safety and security of the dams.

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 2019 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



2.0 MANAGEMENT OF WATER LEVELS AND FLOWS

2.1 Summary

In 2019, the annual mean water level at East Grand Lake was 131.850 meters (432.58 feet), which is slightly higher (0.02%) than the long term mean value of 131.827 meters (432.50 feet).

The annual mean flow from the lake at Forest City Stream was 8.21 m^3/s (290 cfs), 23% higher than the long term mean value of 6.66 m^3/s (235 cfs).

In 2019, the annual mean water level at Spednic Lake was 116.17 meters (381.13 feet), which is slightly lower (1%) than the long term mean value of 116.316 meters (381.60 feet).

The annual mean flow as recorded at Vanceboro was 30.6 m^3/s (1080 cfs), 45% higher than the long term mean value of 21.2 m^3/s (749 cfs).

Figure 5: St. Croix River, below Milltown Dam, June 2019

In 2019, the annual mean water level at Grand Falls Flowage was 61.788 meters (202. 62 feet), which is slightly higher (0.05%) than the long term mean value of 61.758 meters (202.62 feet).

The annual mean flow at Baring was 96.7 m^3/s (3,410 cfs), which is 27.8% higher than the long term mean value at Baring of 75.7 m^3/s (2,670 cfs).

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 132.551 meters (434.88 feet) on April 21st and a minimum daily mean of 131.531 meters (431.53 feet) on October 16th. 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 1 and depicted in Figure 1 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 2019. The maximum daily mean flow for the reporting period was 39.2 m^3/s (1,380 cfs) on April 24th and the minimum daily mean was 2.45 m^3/s (86.5 cfs) on August 7th. The mean discharge for the year was 8.21 m^3/s (290 cfs). The Commission's Order of 2.12 m^3/s (75 cfs) as a minimum flow at Forest City Dam was maintained throughout the year, except on 17 September 2019 and 1 December 2019 when flows dropped below the minimum required flow.

The low flow on 17 September 2019 was a short term occurrence (25 minutes) when outlet gates were adjusted to ensure the safety of contractors conducting repairs at the Forest City Dam. The low flow on 1 December 2019 (about 9 hours) was caused by buildup of ice at the gates during extreme cold-weather conditions. Both occurrences were promptly addressed by Woodland Pulp LLC and there was no reports of adverse effects to fish or aquatic resources in Forest City Stream.

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 117.287 meters (375.78 feet) on April 22nd, to a minimum daily mean water level of 116.170 meters (381.13 feet) on October 22nd. 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 193 m^3/s (6,820 cfs) on April 27th and the minimum daily mean discharge recorded was 6.70 m^3/s (236 cfs), on June 19th. 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 62.042 meters (203.55 feet) on April 29th and the minimum recorded elevation was 61.406 meters (201.46 feet) on February 28th. 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 97.2 m^3/s (3,430 cfs). The maximum daily mean was 433 m^3/s (15,300 cfs) on April 29th. The minimum daily mean was 27.0 m^3/s (953 cfs) on August 21st.

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 2019 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[2] were within the extreme values for the period of daily record during the summer of 2019, based on records since September 1969. Values were above the IJC's water-quality objective for the river.

Table 1
St. Croix River at Milltown, USGS Station # 01021050
Water-Quality Monitor, June – September 2019.

Dissolved Oxygen (mg/L) IJC objective = 5.0 mg/L minimum
Maximum for the season: 9.8 mg/L
Minimum for the season: 6.0 mg/L

	June	July	August	September
Maximum	9.8	8.3	8.3	9.2
Minimum	7.3	6.0	6.1	7.2
Mean	8.2	7.0	7.0	8.3

Water Temperature (degrees Celsius)

	June	July	August	September
Maximum	22.5	27.3	27.0	22.5
Minimum	13.5	18.8	21.3	15.7
Mean	19.3	23.9	24.0	18.6

pH (standard units)

	June	July	August	September
Maximum	7.0	6.8	7.2	7.1
Minimum	6.6	6.5	6.8	6.8
Mean	6.8	6.7	6.9	7.0

Specific conductance (µS per centimeter at 25 C)

	June	July	August	September
Maximum	88	84	104	82
Minimum	35	46	62	50
Mean	61	63	90	67

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

[2] This station is located ~0.5 miles upstream of the Milltown Dam in a free flowing area of the river channel.

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 in the headpond at the Milltown Dam in Milltown (St. Stephen), New Brunswick and the second station is located in Forest City, Maine below the East Grand Lake, Forest City Dam.

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.

Figure 6: ECCC Milltown Dam Water Quality Monitoring Station, June 2019

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 water quality monitoring provides a continuous set of measurements using specialized instruments. Hourly measurements of key water quality parameters provide a clearer picture of daily, weekly, and seasonal fluctuations in water quality which can be associated with specific events like rainfall, snow melt, industrial discharges and stormwater overflows which might not be captured with regular grab sample monitoring.

3.2.1 Interpretation of Real-Time Monitoring Data

Milltown Station

This station, operated by Environment and Climate Change Canada, is located just above the Milltown Dam at a depth of 1.8 to 3.0 metres depending on head pond elevation. It was operational for all of 2019. Annual charts showing daily means, minimums and maximums from the Milltown station for each parameter as well as monthly summaries of the real-time data are presented in Appendix 5, Table 1 and Figure 1.

Temperature

Water temperature at the site increased gradually through the spring and summer until it reached its maximum of 27.2˚C on July 31st. Temperature slowly decreased in August and sharply declined on September 8th due to precipitation. August was the month with the highest mean temperature at 23.96˚C. The lowest temperatures recorded were all in January and the average was 0.11˚C. The daily mean water temperature stayed over 20˚C for 78 days, compared to 99 days in 2018. Water temperature was below 5˚C for 159 days in 2019, comparable to the 2015, 2017 and 2018 data. From 2014 to 2018, September had a higher mean temperature than June, contrary to past years (2007-2013) in which June had a higher mean temperature. Annual water temperature at this station in 2019 averaged at 10.03˚C.

Dissolved Oxygen

Dissolved oxygen readings followed a similar, but inverse, trend to water temperature, reaching the lowest concentration of 7.12 mg/L on August 1st, and a high of 14.53 mg/L on December 21st. May and November were the months with the greatest change in dissolved oxygen concentration, with mean daily ranges of 2.25 mg/L and 3.5 mg/L for May and November, respectively. The annual average concentration of dissolved oxygen was 11.28 mg/L in 2019 compared to 11.07 mg/L in 2018. No measurements were below the 6.5 mg/L minimum Canadian Council of Ministers of the Environment (CCME) Guideline for the Protection of Aquatic Life. The field measurements of dissolved oxygen taken with a newly calibrated sonde were similar to measurements from the deployed instrument.

pH

Most pH measurements in 2019 were within the CCME guideline range of 6.5-9.0 except for 8 days in April and 9 days in September, when pH was below 6.5. In total, there were only 19 days in which pH was below the guideline, in contrast to the 75 days recorded in

2018. Similar to 2018, summer in 2019 had a higher mean pH than in winter. This seems only to be the case for the year 2018 and 2019. The highest pH measurement (7.44 pH units) was recorded in August and the lowest (6.12 pH units) was recorded in September. Conductivity also dropped during the same period. The 2019 annual mean pH at this station was 6.81, which was slightly higher than the 6.7 annual mean of 2018.

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 20.8 and 106.6 µS/cm and averaged 51.6 µS/cm (Appendix 5). These values are similar to those of 2014-2018. Measurements of specific conductance reached their highest of 106.6 µS/cm on August 9th, and their lowest 20.8 µS/cm on December 17th.

August had by far, the highest monthly average specific conductance at 91.52 µS/cm, compared to September, which had the second highest monthly average of 64.1 µS/cm. Like pH, specific conductance tended to be higher in summer and lower in winter and during spring thaw. Ion concentration is usually higher in summer when rainfall is lowest. Although the dam controls stream discharge at this location, ion concentration can change with rainfall and/or spring melt/freshet conditions. The lowest monthly average specific conductance was measured from April to June, and is related to the spring thaw. The grab samples of specific conductance were very similar to the measurements from the deployed sonde.

Turbidity

Daily mean turbidity stayed below 10 NTU for almost 303 days of measurements although turbid events (spikes) occurred once or twice per month. Turbidity ranged from 0 to 3000 NTU (currently set as our maximum). Similar to previous years, the majority of elevated turbidity measurements occurred in December, with some also occured during spring freshet.

There were considerably fewer problems with real time monitoring of turbidity in 2019, compared to 2018. A common issue with turbidity sensors is that obstructions on the sensor (fouling) can compromise readings for long periods. The real time turbidity readings in Appendix 5, Figure 1 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 remain elevated until the sensor

is properly cleaned during sonde switch out. This observation is confirmed with the August grab samples when the sonde was switched to a clean one, thus the turbidity dropped markedly and returned to normal values (under 5 NTU). Figure 1 in Appendix 5 was created by cropping all the values above 250 NTU to improve the visibility of the spikes and to increase the visibility of the non-spike concentration occurrences.

Forest City Station

This station, operated by Environment and Climate Change Canada, is located immediately downstream of the East Grand Lake, Forest City Dam in Forest City, Maine. The real-time water quality station at Forest City was operational from February 14th, 2019, but data from late November to end of the year has not been included. Missing data prior to February 14th has been filled using a linear method with software AQUARIUS. Annual charts showing daily means for specific conductance and temperature, as well as monthly summaries of the real-time data from the Forest City station for each parameter are presented in Appendix 5.

Temperature

Water temperature at the site increased gradually through the spring and summer until it reached its maximum of 27.83°C on August 1st. Water temperatures above 20°C were recorded on 66 days between June and September, which is a similar frequency to 2016-2018. There were 171 days when water temperature was below 5°C, which is comparable to 2018.

Specific conductance

The highest specific conductance reading of 75.3 µS/cm was recorded on June 11th, while the lowest of 25.63 µS/cm was recorded on May 4th. A mean of 31.78 µS/cm was recorded for the year, comparable to mean values recorded from 2015 to 2018. Late May and June were marked with high conductance. There were a few spikes of specific conductance from July to September. October and November had a relatively stable and low specific conductance compared to the other months. The field measurements of specific conductance were similar to the measurements with in-situ real time instruments.

3.3 Daily Mean Water Temperature in Recent Years

Milltown Station Water Temperature 2007-2019

Daily mean water temperatures at Milltown were calculated for the time period between 2007 and 2019 and are presented in Figure 7. The number of days with water temperatures above 20˚C were also calculated for each year, based on daily mean. Those numbers are included in Figure 7 at the top of each annual data cycle. The greatest number of days with water temperature above 20˚C were 97 and 98 in 2017 and 2018, respectively. The summer of 2019 was much cooler, with the second lowest number of days above 20˚C (78 days), second only to 2009 with 67 days. Visual observation of the data (monthly means from 2007 to 2019) seems to indicate that June is getting colder and September, hotter (mean temperature of summer months). This does not apply to the year 2019, which June 2019 was a much colder month overall. High temperature occurrences of 25˚C are getting more common over the last few years (2015 to 2018).

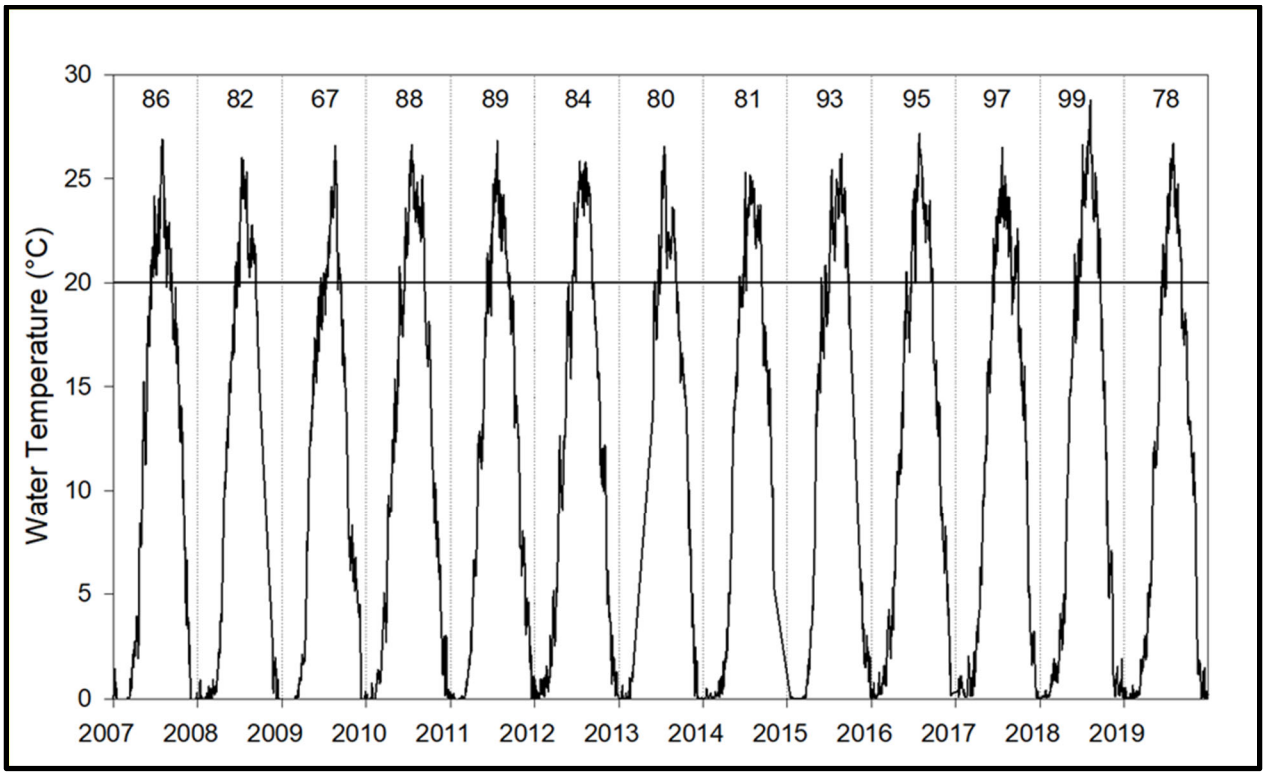


Figure 7: Mean daily water temperatures and number of days with water temperatures > 20˚C at Milltown between 2007 and 2019 (Note: sensor was not operational for spring 2012 and fall 2015).

Forest City Station Water Temperature 2009-2018

A daily mean of water temperature at Forest City was calculated for the time period between 2007 and 2019 (Figure 8). 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 2017 and 2018 at Forest City. For 2019, it was a relatively cold year with 66 days over 20˚C. This is comparable to 2007 and 2008, each of which had 64 days over 20˚C (Figure 8).

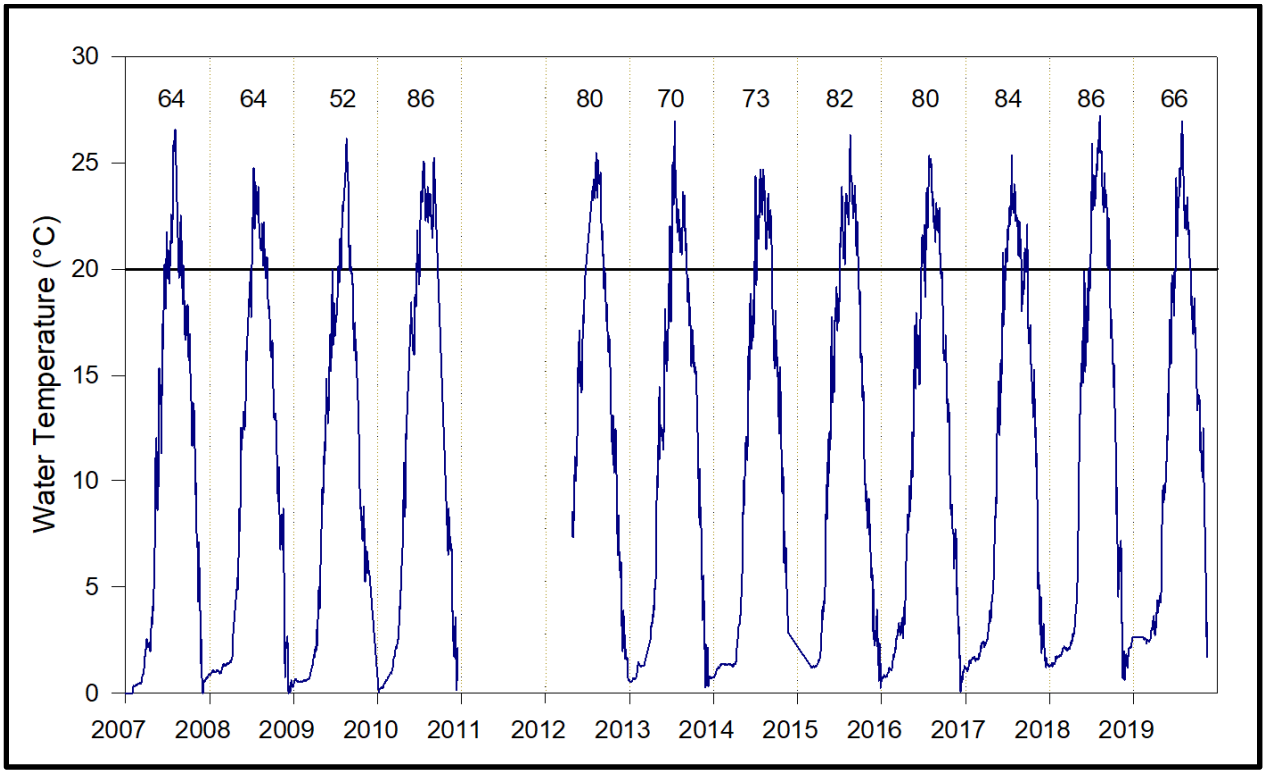


Figure 8: Mean daily water temperatures and number of days with water temperatures > 20°C at Forest City between 2007 and 2019 (Note: sensor was not operational for 2011 to spring 2012, and fall 2015).

3.2.3 Interpretation of Grab Samples Results

Six grab samples were collected in 2019 at the Milltown station and six 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. The 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 freshwater 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 four out of six samples in 2019. 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 7.66 to 12.3 mg/L, the calculated complexed aluminum concentrations made up a large proportion of the measured total aluminum (> 75%).

- Three of the six samples at Milltown showed total iron values that exceeded the CCME guideline value. Exceedances for this parameter are fairly common at the Milltown site, with several samples exceeding guidelines in any given year. Iron is naturally common in surface waters due to its abundance in the earth's crust. 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).

- In 2019, two samples had cadmium concentrations that were at the calculated CCME cadmium guideline (0.04 µg/L). This guideline has been exceeded in the past (e.g. 2016), although caution should be used as the guideline value is within 10 times the laboratory detection limit for cadmium.

The CCME guidelines for cadmium, copper, nickel and lead, and the British Columbia Ministry of Environment (BC MOE) guideline for zinc are based on formulae that use water hardness to determine guideline concentration and which also have a minimum base values. Based on the range of water hardness at the Milltown station (7.5 – 15 mg/L), we used the minimum values stated in the CCME and BC MOE guidelines for these metals (Appendix 5).

- The sample taken on February 14th, 2019 showed elevated concentrations of several metals, with aluminum, copper, iron, and zinc all exceeding their respective guidelines. Lab turbidity in this sample was high but not abnormal (4.1 NTU), and conductivity values were similar to the other samples in that year. Snowfall was recorded on February 13th at the St. Stephen weather station, which may increase streamflow and raise turbidity levels, which can be associated with elevated total metals concentrations. However the automated station at Milltown did not record any drastic changes in pH, conductivity, or turbidity. It is unclear what caused these elevated concentrations, they may be related to municipal or industrial wastewater discharges.

- Total phosphorus was up to five times higher at Milltown than at Forest City, and two of six measurements slightly exceeded the Ontario Ministry of the Environment (OMOE, 1994) phosphorus guideline of 0.03 mg/L. Both exceedances occurred in the summer months (June and August). Similarly, nitrate was also higher at Milltown than at Forest City, although concentrations were well below the CCME guideline. The differences between the two sites suggest that sources such as municipal and industrial wastewater and inputs from major tributaries are likely contributing to nutrient loads. Measurement of nutrients (nitrogen and phosphorus) at Milltown may also be influenced by marine derived nutrients from migrating alewife. Increased nutrients could result in an increase in algal production in the lower reaches of the river and the estuary.

- pH values were not measured outside the 6.5 to 9 range recommended by the CCME, except for the field blank (highlighted in Table 3, Appendix 5).

St. Croix River at Forest City, ME

Results for samples taken at Forest City are shown in Appendix 5, along with applicable guideline for the protection of freshwater 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 in grab samples exceeded the applicable guidelines in 2019. The field blank had a pH of 5.48 (highlighted in Table 4, Appendix 5).

Water Quality Index

The CCME water quality index (WQI) is a useful tool to assess water quality at regularly visited monitoring sites. 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 dampen 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.

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

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 freshwater aquatic

life and thus, the WQI scores will reflect this intended water use only. WQI scores 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 (2017-2019) as well as during the entire ten year period (2009-2019), with no guideline exceedances.

At Milltown, scores were very consistent from 2007 to 2015 – varying between 82.5 and 88.2, and remained in the “good” category. The WQI score dipped to 76.7, or “fair”, in 2016 due to several exceedances of total phosphorus, turbidity, iron, and zinc. Scores in 2017 and 2018 were again “good”, with scores of 88.2 and 87.6. The score in 2019 decreased to 76.3, bringing the site into the “fair” category once again. Several exceedances in phosphorus (in June and August samples) and iron (in February, August, November samples), and a single exceedances in copper and zinc in the February sample contributed to the lower WQI score for 2019. Increased levels of zinc, phosphorus, and iron between the two stations on the St. Croix River are likely indicative of wastewater discharge from municipal and industrial sources. Measurement of nutrients (nitrogen and phosphorus) at Milltown may also be influenced by marine derived nutrients from migrating alewife.

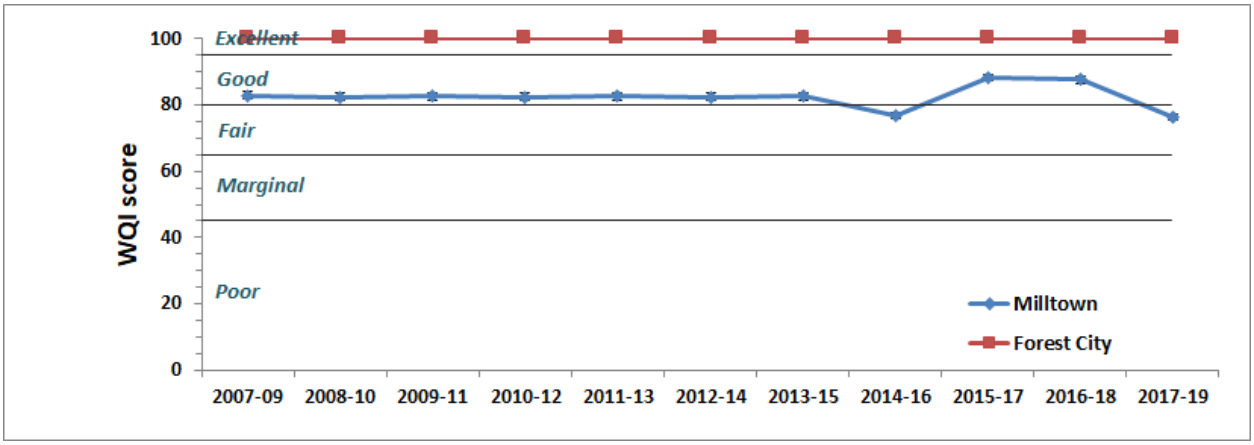


Figure 9: Water Quality Index scores, 2007 to 2019

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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 (Department) indicated there were no Sanitary Sewer Overflow (SSO) events in 2019. The Town of Baileyville has completed several I/I removal projects as part of a 3-phased approach, which have successfully removed excess flows from the collection system and wastewater treatment facility. There were no reports of numeric limitation violations in 2019. The Department's most recent compliance inspection was completed on January 22, 2020. This inspection was focused on the laboratory and self-monitoring requirements. Some minor deficiencies were identified, and corrective actions are being implemented by wastewater treatment facility staff. Department staff will follow up on the status of the corrective actions to ensure they are completed by the assigned deadlines.

Calais: The City of Calais Wastewater Treatment Facility (Facility) permit compliance reporting to the Department noted one weekly average Total Suspended Solids (TSS) loading violation, one bacteria violation, and one Sanitary Sewer Overflow (SSO) event in 2019. The TSS violation was due to high flows during rain and rain/snow melt events. The bacteria violation was due to a solids build-up in the chlorine contact tank. The SSO event was due to root intrusion in clay pipe. The Facility is part of the Department'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. A CSO Master Plan for the next 5-years has been submitted and is under review by the Department. The Department's most recent inspection was on June 18th. 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 2020.

Woodland Pulp: In 2019 the Woodland Pulp Mill (Mill) in Baileyville reported one exceedance related to wastewater discharge permit numeric limitations. There was a pH exceedance of 4.8 on a limit of 5.0 at outfall 003A on June 27th due to a caustic pump failure. The pump was repaired and there have been no further problems.

Three discharge to water events were reported in 2019. The three events occurred on June 16th, July 1st, and December 2nd.

On June 16th, a parent roll of tissue paper fell and broke a valve on the firefighting water system. An estimated 900 gallons of firefighting water (filtered river water) drained to outfall 002. The Mill addressed the procedure for handling tissue rolls to prevent similar incidents. The Department monitored the Mill for additional violations.

On July 1st, there was a spill of about 1800 gallons of tissue fiber and water from a hydro-pulper to the Mill floors which drained to outfall 002. The Mill made changes to the hydro-pulper and the hydro-pulper control system and built containment to prevent future spills from draining to the collection system for outfall 002. A Letter of Warning (LOW) was issued by the Department.

On December 2nd, a contractor working for the Mill pumped an estimated 2,000 to 3,000 gallons of a mix of secondary treated wastewater and stormwater to a forested area. Some of the wastewater went to wetlands which drain to Wapskahegan Brook and the St. Croix River. The Mill will initiate training for contractors to prevent similar discharges from occurring. A Notice of Violation (NOV) was issued by the Department.

The Mill completed work on efforts to pursue site specific water quality criteria in 2018 and submitted a final report to the Department in 2019. It is the Department's intent to integrate these new criteria into any evaluation of reasonable potential, or establishment of permit limits for toxic criteria, as part of the renewal process for Woodland Pulp LLC's pending MEPDES/WDL. The Department issued an Administrative Consent Agreement to the Mill on June 11th for violations occurring between 2013 and February 2019. Department staff conducted compliance inspections at the Mill on March 7th, July 11th, July 31st and September 5th, and inspections at 2 of the Mill's dams on July 11th.

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. Two wastewater bypass events were reported in July 2019, as a result of a power outage and an equipment malfunction that has since been rectified.

St. Stephen: The wastewater lagoon system along Dennis Stream continues to meet the effluent requirements of the Province of New Brunswick. Three wastewater bypass events were reported in 2019. Two events occurred due to a power outage that took place in June and August. The third event was a result of a force main break in October, however, the wastewater from this event did not reach any surface waters. The Town

pumped the sewage through to the lagoon and minimized the impacts.

Champlain Industrial Park: The extended aeration facility treats the domestic wastewater of its employees as well as the industrial inputs from the industrial park.
The effluent currently meets the limits set in the Approval to Operate, except for three suspended solids exceedance in June, November and December. A wastewater bypass event was reported in 2019, due to maintenance work. The facility will continue improving effluent quality and plan to upgrade the current system to a two-cell lagoon system.

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 purchased this property, and received an Approval to Operate containing an effluent monitoring program. The owner's consultant (a hired third party) has completed testing on a regular basis per Approval requirements.

5.0 FISHERIES

5.1 Anadromous Fisheries

Anadromous fish have been counted at the research trap at the Milltown Dam fishway since 1981. 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 all inbound fish, but notably Atlantic salmon and herring including river herring (alewives or gaspereau) and blueback herring. Beginning in 2007 and continuing to the present, the counting facility was operational from May - July and primarily focused on documenting the annual river herring run.

As in prior years, in 2019 the St. Croix International Waterway Commission (SCIWC) operated the Milltown research trap and collected relevant data, under agreements, licenses and partnerships with Canadian Department of Fisheries & Oceans, NB Power, U.S. Fish & Wildlife Service, the International Join Commission , Atlantic Salmon Federation, Maine Department of Marine Resources, and Sipayik Environmental Department. These partnerships were essential to the successful completion of the fish count process.

On April 15th, the staff at NB Power prepared and activated the Milltown fishway and the research trap was activated on May 1st , allowing staff of the SCIWC to enter the facility and collect the fish passage data. The fish count was conducted from May 1st – July 21st, at which time it was presumed the river herring run had ended and the research trap was lifted out of the fishway. The fish run is considered to end when there are three consecutive days with no fish in the fish trap. NB Power continues to operate the fishway until mid-November, as required by federal agreement, but with no further fish observed and counted.

Figure 10: Milltown Research Trap Clicker Counting (Photo credit: SCIWC)

In 2018, NB Power purchased and installed the Gas Infusion System (GIS), and in 2019 the GIS was operated throughout the season. The maintenance, operation, and security of the GIS was conducted by the staff of NB Power. The goal of the GIS is to supersaturate the water with oxygen, and to see if this supersaturated water would help in attracting river herring up the fish ladder. The hydroelectric turbine adjacent to the fishway was turned off during the fish run, from 8 am AST to 8 pm AST, to prevent turbulence which could confuse the fish during their migration upriver.

During the start of the monitoring season, spring river flows exceeded 10,000 cubic feet per second (cfs) and hit a peak of 13,100 on May 1st. River flows greater than 5000 cfs impact the effective operation of the fishway. River flows remained above 5000 cfs until May 10th, when the flow dropped to 4070 cfs.

The fish count was conducted using two methods: hand counting and clicker counting. Until the run increased to several thousand a day, all fish entering the research trap were individually hand netted and counted to ensure a complete record before they were released upstream. When the number of fish reached 5000 or more per day, the trap was left open and fish entering the research trap were counted using clickers as they passed over a white board installed in the fish way. This method of counting was conducted in 10 minute intervals, every 30 minutes, and the total number of fish was extrapolated by multiplying the 10 minute count by 3 and results recorded.

A total of 486,500 river herring were recorded at the Milltown trap in 2019, a large increase from the 270,659 recorded in 2018 and the 157,750 river herring counted in 2017. The ten-year average is 110,575 (2009 – 2019). See Table 3.

Table 3
Counts of inbound fish at the Milltown fishway research trap,
St. Croix River, 2019

River herring: alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*)	480,500
American shad (Alosa sapidissima)	29
American eel (*Anguilla rostrata*)	4
White sucker (*Catostomus commersonii)*	43
Smallmouth bass *(Micropterus dolomieu)*	6
Brook trout *(Salvelinus fontinalis)*	5
Pumpkinseed sunfish (*Lepomis gibbosus)*	1
Fallfish (*Semotilus corporalis)*	1

Another anadromous species (American shad) and a catadromous species (American eel) were also recorded. In 2019, five freshwater fish species were recorded in small numbers; freshwater species are assumed to have passed over the dam spillway or through open gates and returned up the fish ladder after encountering brackish water.

Fish species and numbers counted in 2019 are presented in Table 3. In addition to the counting operation, 100 river herring and three American shad were sampled by SCIWC staff for the purpose of scale aging by Maine Department of Marine Resources. Most scales were taken from live samples. Results indicated that more than half of the fish sampled were blueback herring. Repeat spawning rates and age structure were on the low side compared to adjacent commercial and non-commercial runs.

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 (ECCC) sampled Oak Bay and the lower St. Croix River marine water quality stations on five occasions from June 13 to October 28, 2019. 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.

In 2019, bacterial densities within the conditionally managed portions of Oak Bay ranged from <2 to 33 MPN FC per 100 mL. Densities within the Restricted areas ranged from <2 to 140 MPN FC per 100 mL. Sampling occurred under rainfall conditions ranging from dry to 39 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 rainfall accumulations of 39 mm rainfall on July 13, 2019. This water quality recovery time is consistent with that observed in 2018, three days following a 42 mm rainfall event in mid-August. Water quality remains satisfactory within the approved portions of the lower St. Croix River estuary.

A comparison of 2019 bacterial results with those for 2014 to 2018 (n = 30) does not signal any departure from the norm. Notwithstanding background bacterial density fluctuations at individual sampling stations in response to environmental conditions, water quality within the survey area is relatively stable overall. The survey data also indicate 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, in 2019 there was one small cove in Perry, Maine upgraded to “Approved” due to elimination of a potential pollution point source and water quality meeting acceptable standards. 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 projects 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 2019, 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 Fish Passage Efficiency and Harvest Management Outcomes for Alewife on the St. Croix River

In 2019, the IWI program supported completion of an on-line tool (model) to explore alewife passage efficiency at dams and harvest management scenarios through comparison of population results. Scenarios can be compared for the St. Croix River or for a user created river. The Project was led by U.S. Geological Survey and University of Maine (in collaboration with Fisheries and Oceans Canada).

A tutorial video, an introduction video with background information, and a technical document on the modeling tool are provided at the link below.

The tool, tutorials, and technical document can be accessed at:
https://umainezlab.shinyapps.io/alewifepopmodel/

6.3 Fish Passage Study Grand Falls and Woodland Dam

The St. Croix River has significant potential to improve sea-run fisheries resources, including supporting runs of over 20 million river herring, thousands of American eels, and other species. Current fish passage constraints at the Milltown, Woodland, and Grand Falls dams limit fish production into the more productive upper reaches of the watershed. However, there is a willingness and interest from dam owners, NGOs, state and federal partners, and tribes to evaluate ways to make improvements to fish passage at these locations.

The IWI study is exploring a range of upstream and downstream fish passage improvements on the St. Croix River at Woodland and Grand Falls dams. Limnotech was contracted to preform the study, and is working with a Technical Advisory group made up of resource agencies in the US and Canada and the Peskotomuhkati/ Passamaquoddy. The draft report will be provided to the Board for review in May 2020.

7.0 OTHER ITEMS TO REPORT

7.1 Environment and Climate Change Canada Water Quality Trend Analysis Study

At the request of the Board, Environment and Climate Change Canada (ECCC) conducted a trend analysis on water quality grab samples collected in the upper watershed, below the Forest City Dam, and in the lower watershed, above Milltown Dam. The objective of this study was to use long-term water quality data from the ECCC Forest City and Milltown Stations to determine whether there has been trends in water quality parameters. Analysis was conducted for most parameters over a 12 year period from 2007 to 2018, and for select metal parameters over a seven year period from 2011 to 2018. Metal data prior to 2011 was not included in the analysis due to a change in testing methodology. The trend analysis was presented to the Board at the December 2019 meeting, and the final report will be provided to the Board and IJC in 2020.

7.2 Environment and Climate Change Canada Biomonitoring in the St. Croix Watershed

The Canadian Aquatic Biomonitoring Network (CABIN) program[3] 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

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

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.

To date, there have been six CABIN sites sampled by ECCC in the St. Croix watershed between 2010 and 2019. Four of the sites were originally selected with the purpose of being incorporated into the Atlantic RCA model, but can also help to provide some insight into the status of the St. Croix River. After some discussions in 2018 about including biomonitoring data in the IJC report, ECCC added two new sites in the sampling plan with the intention of gathering baseline biomonitoring data for the St. Croix in locations that will complement the long-term water quality grab samples that have also been collected by ECCC. More data collection is required to gain a full understanding of the condition of the St. Croix River and its tributaries.

A draft report on biomontoring has been prepared by ECCC for the St. Croix River and will be provided for Board and IJC review in 2020.

7.3 St. Croix International Waterway Commission Water Quality Monitoring Project

In 2019, the St. Croix International Waterway Commission (SCIWC) received funding from the New Brunswick Environmental Trust Fund (ETF) to continue water quality monitoring in the St. Croix Watershed, and from the Atlantic Water Network (AWN) to upload the water quality dataset to a regional open access data sharing hub. The AWN also loaned and calibrated the equipment utilized for the project.

Sampling was conducted following the Province of NB Department of Environment and Local Government "Guidelines for River Sample Collection and Lab Submissions for Watershed Groups in NB". Measurements of pH, conductivity, temperature, dissolved oxygen (DO), total dissolved solids (TDS) and salinity were made at the sites using a Professional Plus series YSI borrowed from Atlantic Water Network's equipment bank.

Water samples from the sites were also submitted to RPC lab in Fredericton for analysis of surface water chemistry, surface water metals, total suspended solids, and E. coli. In 2017, 35 samples were collected, 20 in 2018, and 43 samples were collected in 2019 from the pre-designated sample site list. The collection period in 2019 was increased to June to October. The dataset is available to the public and results are posted on-line at: www.atlanticdatastream.ca.

7.4 St. Croix International Waterway Commission Assessment of Alewife and Blueback Herring Spawning Migration at Moosehorn National Wildlife Refuge in Maine

The United States Fisheries & Wildlife Services (USFWS) contracted the SCIWC to assist with assessing the movement of migratory fish on the Magurrewoc Stream, located in Moosehorn National Wildlife Refuge. The Magurrewoc is a tributary stream that discharges to the St. Croix River just upstream of Calais, Maine, and provides potential habitat for fish passing above Milltown Dam. The USFWS, in the last few years, has completed two culvert redesign-construction projects in the refuge to improve fish passage, along the Magurrewock between the St. Croix River and Vose Pond.

The SCIWC assisted with pit-tagging and monitoring upstream and downstream (post-spawning) movements of river herring within the Magurrewock. In 2019, 465 river herring were tagged and released between the dates of May 31st and June 7th. Of the 465 fish tagged in 2019, the team recorded 199 incidents of fish passing the through the tracking antenna (42.8%). Study findings will be available in 2020.

7.5 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, Fish and Wildlife Services, Bureau of Indian Affairs, National Atmospheric and Oceanic Administration - National Marine Fisheries, Department of Agriculture), Fisheries and Oceans Canada, the International St. Croix River Watershed Board, Global Affairs Canada, and the U.S. 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.

7.6 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, Waweig, Magaguadavic and Letang rivers in New Brunswick, and to support restoration of key migratory fish species, including Alewife, Atlantic and Shortnose Sturgeon, Striped Bass, Atlantic Salmon, and American Eel, to their native spawning ground. In 2019, a portion of the funding provided to the Peskotomuhkati, Skutikwas used to contract Dillon Consulting Limited for work on the St. Croix River. A draft report is expected to be submitted to DFO in spring 2020.

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 LLC 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 Pulp LLC 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.

Woodland Pulp also submitted a request to FERC in July 2017 to determine whether or not the project was jurisdictional if the project was owned by the State of Maine. In December 2017, FERC denied the petition. Woodland Pulp LLC subsequently filed a

request for a rehearing on the decision, and in February 2018 FERC granted a request for rehearing.

On August 28, 201, FERC held a technical meeting to gather new technical information concerning the following three items: (1) whether there are alternative modes of project operation that could demonstrably lower the project's impact on downstream generation; (2) whether there are methods for implementing license requirements in an economically efficient manner; and (3) whether there are decommissioning plans that would meet the needs of stakeholders.

The Transcript of the meeting is available at:
https://elibrary.ferc.gov/idmws/docket_search.asp
Search on Docket P-2660

At the meeting, the Commissioner of the Maine Department of Inland Fish and Wildlife indicated that the State of Maine was no longer interested in taking over the dam, but is committed to working towards a solution to find an owner of the dam.

In October 2019, the Governor of Maine and the Premier of New Brunswick sent a letter to FERC proposing that an independent third party take over ownership of the dam, and that Maine would lead efforts, in cooperation with New Brunswick to develop an acceptable operational plan for the three gates (two in the U.S. and one in Canada).

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

7.8 Proposed Milltown Generating Station Decommissioning

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

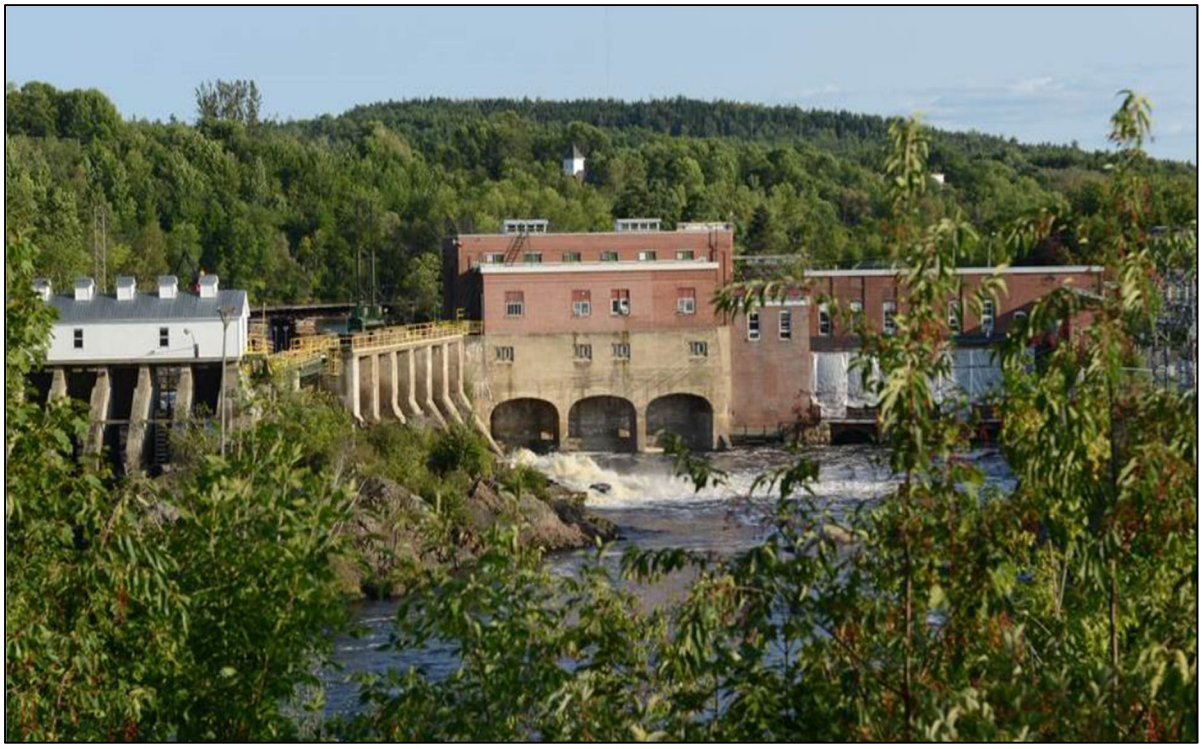

Figure 11: Milltown Generation Station (Photo Source: NB Power, Presentation to Board December, 4 2019)

The Milltown Generating Station and dam is owned by New Brunswick Power (NB Power). It was originally built in the late 1800s, with a number of modifications made in the early to mid-1900s. Currently, only four of the seven turbines are operational at the facility, and existing upstream and downstream fish passage systems are inefficient.

In 2018, NB Power communicated potential interest in upgrading the Milltown facility with new technologies and a new fish passage system. However, following a thorough engineering and cost evaluation of the existing station and the infrastructure required to support these new technologies, it was determined that the refurbishment was not an economically viable option. Further, based on ongoing costs to maintain the facility and investments needed to meet new upstream and downstream fish passage systems requirements by Fisheries and Oceans Canada, it was determined that extending the life of the station was not financially feasible and that the Milltown Generating Station

should therefore be decommissioned and the section of the river, known historically as Salmon Falls, be restored.

NB Power is preparing a Milltown Decommissioning Project and Salmon Falls Restoration project to register under the New Brunswick Environmental Impact Assessment Regulation. NB Power has also been engaging with different Canadian and American regulatory agencies and commissions, including the IJC and the Board, to better understand the regulatory requirements for this proposed project. In addition, they have started First Nations consultation and public engagement which will continue throughout the life of the project.

NB power plans to register the Environmental Impact Assessment with New Brunswick Department of Environment and Local Government in spring 2020.

The proposed NB Power timelines, pending project approvals and regulatory permitting, indicate the decommissioning process would begin in winter 2020-2021 (10 to 16 month duration) with completion anticipated in summer 2021. Construction activities would be scheduled to avoid impact to the upstream alewife run occurring from May to July. Additional details of project design, restoration, and monitoring activities will be available in the EIA.

7.9 U.S. Geological Survey (USGS) Tide Gauge Station

The USGS established a tide gage station at the international bridge in Calais, Maine in October 2015. Water level data collected at the tide gage will be used to document trends over time and to 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. Tide information from 2019 is illustrated in Figure 12. The link to the real time data site is available at: http://waterdata.usgs.gov/me/nwis/uv/?site_no=01021060&PARAmeter_cd=00065,00060

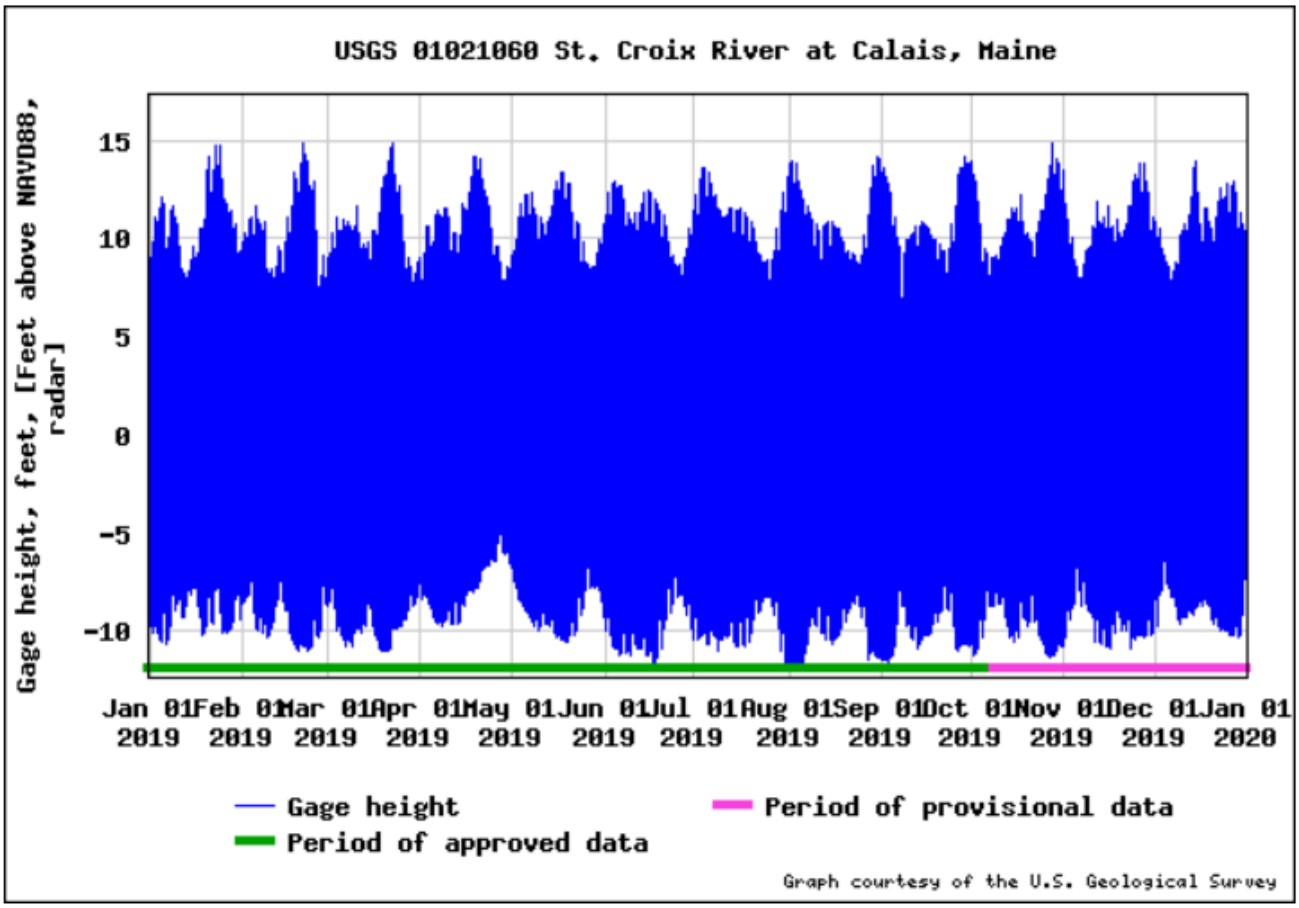

Figure 12: USGS Tide Gage Reading in 2019

ACKNOWLEDGEMENTS

The International St. Croix River Watershed Board gratefully acknowledges the valuable input and efforts in support of this report provided by the following groups/individuals and without whom the preparation of this report would not be possible.

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Sam	Ouellette	Environment and Climate Change Canada
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Bernard	Richard	Environment and Climate Change Canada
Liang	Zhu	Environment and Climate Change Canada
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Erica	Stuart	Fisheries and Oceans Canada
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Sean	Ledwin	Maine Department of Marine Resources
Donald	Fox	New Brunswick Department of Environment and Local Government
Tim	Leblanc	New Brunswick Department of Environment and Local Government
Joyce	Wang	New Brunswick Department of Environment and Local Government
John	Morrow	New Brunswick Department of Transportation and Infrastructure
Elizabeth	Hyslop	St. Croix International Waterway Commission
Rebecca	Goreham	St. Croix International Waterway Commission
Tim	Devlin	Town of St. Stephen

Barbara	Blumeris	U.S. Army Corps of Engineers
Nicholas	Stasulius	U.S. Geological Survey
Joseph	Zydlewski	University of Maine at Orono, U.S. Geological Survey ME Cooperative Fish & Wildlife Research Unit
Betsy	Barber	University of Maine at Orono
Edward	Arsenault	Village of McAdam

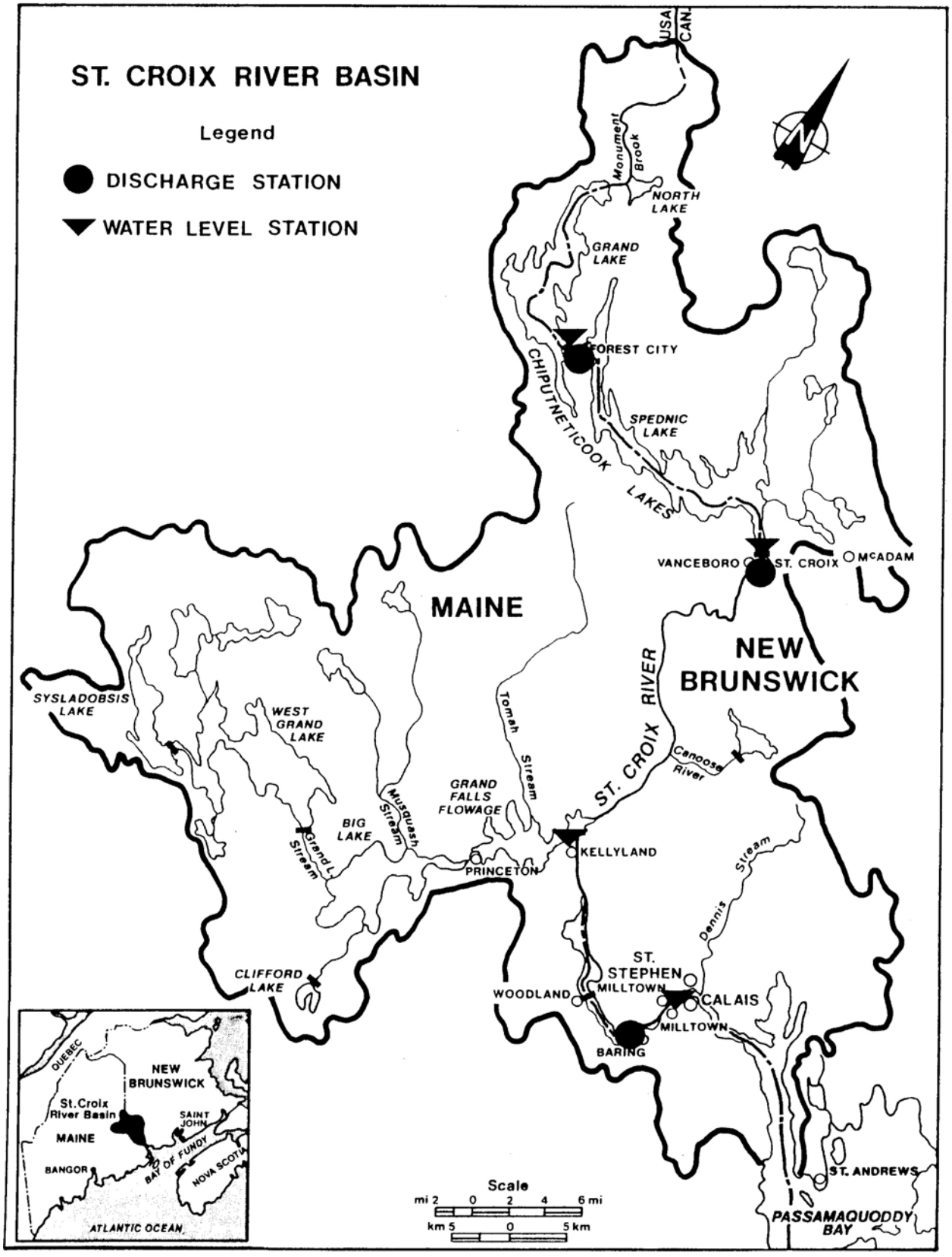
APPENDIX 1

SUMMARY - ORDERS OF APPROVAL & BASIN MAP

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 2019

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 2019

Board members met with New Brunswick Power Corporation officials on 5 June 2019 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 5 June 2019 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
Robert Philips	IJC Senior Advisor, Canadian Section
Susan Daniel	IJC Senior Advisor, 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
Don Fox	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	New Brunswick Power
Bethanie Parker	New Brunswick Power
Colin (Scott) Beal	Woodland Pulp LLC
Kevin Dean	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 (5 June 2019) View of Dam from downstream

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

Vanceboro Dam (5 June 2019) 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 Woodland Pulp LLC conduct periodic dam safety inspections at the site.

Grand Falls Dam (5 June 2019) View of Spillway at Dam

Milltown Dam: New Brunswick Power 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 (5 June 2019) View of Dam Powerhouse and Fishway Entrance from Downstream

APPENDIX 3

WATER LEVELS AND FLOWS

GRAND LAKE AT FOREST CITY
DAILY MEAN WATER LEVEL IN METERS FOR 2019

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	132.011	132.180	132.001	131.923	132.482	132.341	132.369	132.171	132.147	131.716	131.615	131.840	1
2	132.014	132.173	131.989	131.957	132.450	132.334	132.368	132.161	132.137	131.705	131.625	131.839	2
3	132.017	132.164	131.977	131.997	132.430	132.333	132.373	132.153	132.139	131.681	131.633	131.857	3
4	132.018	132.154	131.976	132.029	132.414	132.334	132.368	132.150	132.122	131.666	131.637	131.860	4
5	132.020	132.143	131.968	132.046	132.400	132.327	132.360	132.137	132.120	131.644	131.642	131.860	5
6	132.021	132.133	131.956	132.066	132.383	132.334	132.357	132.122	132.102	131.620	131.667	131.860	6
7	132.020	132.123	131.945	132.082	132.369	132.332	132.359	132.112	132.103	131.621	131.670	131.859	7
8	132.019	132.115	131.933	132.100	132.366	132.333	132.344	132.151	132.096	131.621	131.688	131.854	8
9	132.029	132.101	131.918	132.124	132.351	132.324	132.332	132.187	132.077	131.606	131.683	131.857	9
10	132.032	132.089	131.905	132.141	132.346	132.318	132.317	132.188	132.058	131.595	131.681	131.900	10
11	132.034	132.075	131.892	132.149	132.360	132.319	132.296	132.187	132.051	131.582	131.685	131.937	11
12	132.033	132.061	131.876	132.158	132.353	132.327	132.288	132.184	132.047	131.570	131.702	131.961	12
13	132.032	132.078	131.860	132.171	132.344	132.320	132.287	132.183	132.024	131.556	131.708	131.974	13
14	132.030	132.079	131.844	132.195	132.341	132.325	132.281	132.177	131.991	131.541	131.698	132.008	14
15	132.028	132.078	131.831	132.266	132.345	132.325	132.276	132.172	131.974	131.539	131.700	132.067	15
16	132.026	132.082	131.824	132.329	132.337	132.325	132.260	132.167	131.953	131.531	131.702	132.101	16
17	132.025	132.076	131.814	132.373	132.332	132.325	132.250	132.162	131.932	131.539	131.694	132.119	17
18	132.024	132.070	131.804	132.402	132.334	132.318	132.240	132.170	131.908	131.549	131.696	132.136	18
19	132.024	132.063	131.796	132.437	132.332	132.311	132.224	132.168	131.883	131.546	131.718	132.146	19
20	132.039	132.056	131.788	132.480	132.347	132.310	132.217	132.167	131.862	131.538	131.727	132.150	20
21	132.055	132.055	131.779	132.511	132.370	132.343	132.227	132.160	131.843	131.536	131.736	132.151	21
22	132.052	132.051	131.786	132.529	132.375	132.341	132.228	132.175	131.819	131.532	131.739	132.153	22
23	132.051	132.045	131.807	132.546	132.369	132.335	132.219	132.180	131.801	131.545	131.755	132.154	23
24	132.076	132.042	131.812	132.551	132.384	132.323	132.211	132.172	131.816	131.556	131.763	132.153	24
25	132.134	132.045	131.818	132.549	132.383	132.312	132.204	132.162	131.810	131.560	131.802	132.152	25
26	132.150	132.033	131.823	132.532	132.389	132.315	132.196	132.157	131.790	131.563	131.806	132.149	26
27	132.162	132.024	131.828	132.534	132.391	132.318	132.188	132.151	131.788	131.563	131.812	132.148	27
28	132.176	132.013	131.831	132.543	132.381	132.324	132.179	132.141	131.771	131.572	131.837	132.152	28
29	132.180		131.843	132.531	132.367	132.332	132.178	132.165	131.762	131.573	131.852	132.150	29
30	132.186		131.852	132.510	132.351	132.361	132.172	132.168	131.738	131.576	131.852	132.149	30
31	132.185		131.869		132.346		132.168	132.161		131.583		132.160	31
MEAN	132.061	132.086	131.869	132.292	132.372	132.327	132.269	132.163	131.955	131.585	131.718	132.028	MEAN
MAX	132.186	132.180	132.001	132.551	132.482	132.361	132.373	132.188	132.147	131.716	131.852	132.160	MAX
MIN	132.011	132.013	131.779	131.923	132.332	132.310	132.168	132.112	131.738	131.531	131.615	131.839	MIN

SUMMARY FOR THE YEAR 2019
Mean water level, 131.850 m
Maximum daily water level, 132.551 m On 2019-04-21
Minimum daily water level, 131.531 m On 2019-10-16

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 2019

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	3.00	14.0	10.7	4.24	37.1	6.85	7.24	2.50	6.73	13.51	3.03	2.67	1
2	3.00	14.0	10.6	4.35	31.6	6.08	7.25	2.49	7.15	13.32	3.01	4.19	2
3	3.01	14.0	10.5	4.42	25.1	4.78	7.85	2.49	8.50	12.96	3.03	4.22	3
4	3.01	13.9	10.5	4.45	22.2	4.62	8.30	2.49	9.42	12.74	3.03	4.23	4
5	3.02	13.9	10.5	4.49	19.3	5.28	8.28	2.47	9.90	12.35	3.06	4.23	5
6	3.00	13.8	10.4	4.55	18.5	5.30	8.26	2.46	12.55	11.91	3.07	4.23	6
7	3.00	13.8	10.4	4.57	15.7	4.23	8.24	2.45	14.95	11.94	3.07	4.22	7
8	3.03	13.7	11.7	4.64	13.8	3.44	8.19	2.50	14.82	12.00	3.09	4.23	8
9	3.04	13.6	13.0	4.69	11.4	3.25	8.14	2.53	15.98	11.79	3.09	4.25	9
10	3.03	13.5	13.0	4.70	9.86	3.06	8.09	2.52	16.67	11.69	3.09	4.33	10
11	3.03	13.4	13.3	4.71	9.86	3.06	8.06	2.52	17.34	11.49	3.10	4.38	11
12	3.03	11.3	13.7	4.74	9.81	3.06	8.04	2.52	18.48	11.30	3.13	4.44	12
13	3.04	7.88	13.6	4.77	9.79	3.06	8.01	2.52	18.85	11.09	3.13	4.48	13
14	3.04	7.12	13.4	4.82	9.74	3.06	7.99	2.52	18.66	8.76	3.12	4.59	14
15	3.03	7.15	12.8	4.98	9.73	2.81	7.94	2.54	18.35	3.89	3.12	4.67	15
16	3.04	7.13	11.9	5.04	8.86	2.69	7.91	2.54	17.94	2.90	3.09	4.71	16
17	3.04	7.12	11.8	9.96	7.09	2.68	7.88	2.56	15.04	2.92	3.10	4.78	17
18	3.05	7.12	11.8	17.4	5.99	2.68	7.83	2.56	17.04	2.91	3.11	4.80	18
19	3.04	7.08	10.5	24.0	5.21	2.67	6.81	2.54	16.64	2.88	3.14	4.80	19
20	3.08	7.08	9.60	34.7	4.51	2.67	5.77	2.52	16.30	2.87	3.16	4.81	20
21	3.08	7.10	9.58	38.5	5.28	3.48	5.79	2.52	15.93	2.86	3.16	4.84	21
22	3.08	7.08	8.68	38.9	7.82	4.78	5.00	2.53	15.49	2.87	3.19	4.84	22
23	3.10	7.07	7.44	39.0	8.89	4.75	4.29	2.53	15.14	2.89	3.19	4.85	23
24	4.25	7.10	7.49	39.2	9.77	3.87	3.49	2.51	15.39	2.90	3.21	4.82	24
25	6.72	8.05	7.53	39.1	11.4	2.79	2.57	2.51	15.23	2.91	3.25	4.83	25
26	8.03	8.95	6.94	38.8	12.8	2.63	2.56	2.51	14.87	2.91	3.27	4.83	26
27	8.09	9.76	6.57	38.8	14.7	2.64	2.55	3.35	14.84	2.92	3.29	4.85	27
28	9.16	10.7	6.04	38.9	15.8	2.63	2.54	4.53	14.47	2.94	3.33	4.85	28
29	10.4		4.64	38.5	17.7	2.64	2.53	4.89	14.26	2.94	3.34	4.84	29
30	12.4		4.14	37.9	13.2	4.99	2.51	5.83	13.86	2.94	3.30	4.87	30
31	14.1		4.20		9.08		2.50	6.77		2.97		4.89	31
TOTAL	143	286	307	548	412	111	192	91	441	217	94	141	TOTAL
MEAN	4.61	10.2	9.90	18.3	13.3	3.68	6.21	2.93	14.7	7.01	3.14	4.53	MEAN
MAX	14.1	14.0	13.7	39.2	37.1	6.85	8.30	6.77	18.9	13.5	3.34	4.89	MAX
MIN	3.00	7.07	4.14	4.24	4.51	2.63	2.50	2.45	6.73	2.86	3.01	2.67	MIN
DAM3	12300	24700	26500	47300	35600	9600	16600	7800	38100	18800	8100	12100	DAM3

SUMMARY FOR THE YEAR 2019
Total discharge 257500 DAM
Mean discharge, 8.21 m^3/s
Maximum daily discharge, 39.2 m^3/s On 2019-04-24
Minimum daily discharge, 2.45 m^3/s On 2019-08-07

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

TABLE II

SPEDNIC LAKE AT ST. CROIX
DAILY MEAN WATER LEVEL IN METERS FOR 2019

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	117.081	116.653	116.407	116.399	117.239	117.211	117.186	116.892	116.482	116.209	116.193	116.688	1
2	117.067	116.650	116.403	116.481	117.230	117.188	117.184	116.872	116.463	116.219	116.209	116.694	2
3	117.044	116.646	116.397	116.572	117.218	117.179	117.188	116.853	116.458	116.207	116.225	116.719	3
4	117.022	116.636	116.402	116.641	117.207	117.180	117.186	116.844	116.432	116.206	116.239	116.730	4
5	117.000	116.624	116.402	116.688	117.189	117.161	117.181	116.822	116.431	116.200	116.246	116.739	5
6	116.980	116.616	116.397	116.730	117.164	117.160	117.178	116.793	116.403	116.177	116.294	116.747	6
7	116.958	116.603	116.391	116.769	117.148	117.157	117.185	116.773	116.412	116.185	116.299	116.754	7
8	116.926	116.592	116.383	116.809	117.154	117.153	117.171	116.765	116.432	116.207	116.338	116.757	8
9	116.913	116.583	116.375	116.856	117.126	117.137	117.160	116.789	116.421	116.206	116.342	116.768	9
10	116.893	116.567	116.363	116.892	117.116	117.123	117.142	116.779	116.421	116.203	116.346	116.831	10
11	116.868	116.553	116.361	116.918	117.157	117.124	117.118	116.771	116.434	116.195	116.360	116.901	11
12	116.841	116.537	116.351	116.940	117.151	117.148	117.113	116.752	116.461	116.193	116.383	116.949	12
13	116.813	116.545	116.333	116.969	117.142	117.128	117.117	116.740	116.464	116.192	116.416	116.977	13
14	116.785	116.535	116.303	117.020	117.149	117.140	117.111	116.723	116.449	116.179	116.394	117.017	14
15	116.755	116.515	116.271	117.121	117.166	117.148	117.108	116.707	116.439	116.180	116.408	117.099	15
16	116.724	116.510	116.253	117.250	117.167	117.149	117.087	116.686	116.418	116.154	116.427	117.146	16
17	116.697	116.495	116.228	117.314	117.161	117.153	117.076	116.668	116.385	116.140	116.410	117.159	17
18	116.663	116.480	116.202	117.342	117.170	117.144	117.069	116.663	116.353	116.163	116.413	117.160	18
19	116.639	116.467	116.176	117.381	117.167	117.135	117.051	116.650	116.322	116.151	116.440	117.149	19
20	116.630	116.455	116.145	117.453	117.180	117.134	117.043	116.642	116.295	116.123	116.456	117.131	20
21	116.624	116.452	116.113	117.550	117.217	117.164	117.051	116.620	116.269	116.110	116.473	117.116	21
22	116.596	116.449	116.107	117.587	117.225	117.168	117.058	116.629	116.233	116.094	116.482	117.099	22
23	116.565	116.439	116.132	117.581	117.215	117.159	117.042	116.626	116.205	116.098	116.523	117.081	23
24	116.557	116.429	116.135	117.547	117.225	117.138	117.028	116.603	116.232	116.122	116.510	117.064	24
25	116.602	116.436	116.157	117.499	117.239	117.119	117.010	116.583	116.239	116.129	116.567	117.039	25
26	116.613	116.430	116.178	117.426	117.245	117.118	116.989	116.568	116.215	116.126	116.582	117.014	26
27	116.623	116.421	116.195	117.353	117.263	117.122	116.967	116.554	116.233	116.116	116.603	116.985	27
28	116.639	116.414	116.204	117.322	117.259	117.128	116.944	116.529	116.224	116.121	116.651	116.967	28
29	116.646		116.235	117.294	117.248	117.140	116.929	116.529	116.238	116.124	116.702	116.942	29
30	116.650		116.262	117.249	117.236	117.171	116.912	116.518	116.223	116.128	116.712	116.926	30
31	116.655		116.294		117.230		116.897	116.507		116.135		116.923	31
MEAN	116.776	116.526	116.276	117.098	117.194	117.149	117.080	116.692	116.356	116.161	116.421	116.944	MEAN
MAX	117.081	116.653	116.407	117.587	117.263	117.211	117.188	116.892	116.482	116.219	116.712	117.160	MAX
MIN	116.557	116.414	116.107	116.399	117.116	117.118	116.897	116.507	116.205	116.094	116.193	116.688	MIN

SUMMARY FOR THE YEAR 2019
Mean water level, 116.170 m
Maximum daily water level, 117.587 m On 2019-04-22
Minimum daily water level, 116.094 m On 2019-10-22

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 2019

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	37.9	41.6	22.7 E	11.0 E	102	37.9	25.2	16.1	21.8	25.5	11.2	11.2 E	1
2	37.9	41.6 E	22.6	10.1 E	85.8	33.7	21.9	16.1	21.8	23.2	10.1	11.2	2
3	37.7	41.9 E	22.4	10.4 E	80.1	28.3	22.2	16.0	23.0	23.2	10.1	11.2	3
4	37.7	41.9 E	22.5	11.0	75.3	24.0	22.2	16.0	24.4	23.1	10.1	11.3	4
5	37.4	41.9 E	22.6	11.1	71.6	23.9	22.2	15.9	26.0	23.1	10.2	11.3	5
6	37.4	41.9	22.7	11.2	67.1	23.9	22.2	15.8	27.0	23.0	10.3	11.3	6
7	37.4	42.5	22.8	11.3	55.8	21.6	22.2	15.7	27.2	23.0	10.3	11.4	7
8	37.1	43.0	24.8	11.4	50.1	19.1	22.1	16.4	27.3	23.2	10.4	11.4	8
9	36.8	43.0	27.4	11.4	43.0	16.5	21.8	17.1	25.2	23.1	10.4	11.3	9
10	36.8	42.5	27.3	11.5	34.0	11.5	21.7	17.0	20.3	23.1	10.4	14.1	10
11	36.8	41.9	29.7	11.4	28.6	8.50	21.7	17.0	18.3	23.1	10.4	17.5	11
12	36.8	37.7	31.4	11.6	28.6	7.50	20.4	16.9	15.6	23.0	10.5	19.1	12
13	36.5	34.3	36.2	11.6	28.6	7.50	21.0	16.8	22.8	23.1	10.6	23.6	13
14	36.5	34.0	43.9	11.8	28.6	7.60	21.0	16.8	35.7	23.0	10.5	28.3	14
15	36.0	34.3	46.4	16.4	28.6	7.60	20.9	16.7	41.3	23.0	10.5	45.6	15
16	35.7	32.8	46.7	34.8	28.6	7.60	20.8	16.7	43.0	22.9	10.6	57.5	16
17	35.7	31.7	46.2	56.9	25.5	7.60	20.8	16.6	45.0	22.9	10.5	57.5	17
18	35.4	31.7	46.7	75.9	22.9	7.10	20.8	16.6	44.7	23.0	10.5	57.5	18
19	35.4	27.6 E	46.4	90.9	22.8	6.70	20.0	16.5	44.5	22.9	10.6	57.2	19
20	35.4	22.8 E	47.0	112	22.9	6.70	20.3	16.5	44.2	22.8	10.6	51.8	20
21	35.1	22.6 E	45.3	139	24.5	13.4	20.4	16.4	43.9	20.8	10.7	43.6	21
22	35.1	22.6 E	40.2	167	28.6	18.8	20.4	16.5	43.6	19.6	10.7	43.6	22
23	35.1	22.6 E	36.0	181	30.0	19.3	20.4	16.5	43.3	19.7	10.8	43.6	23
24	35.4	22.6	32.3	185	31.7	15.9	20.3	16.3	39.9	19.7	10.8	43.3	24
25	36.8	22.6	24.0	184	33.7	11.3	20.2	16.3	42.8	19.7	10.9	43.0	25
26	38.8	22.7	21.2	186	35.4	9.10	20.0	16.2	38.8	19.7	11.0	43.0	26
27	38.5	22.6	21.8	193	39.6	9.10	20.0	17.9	30.9	19.7	11.0	42.8	27
28	38.5	22.6 E	18.9	182	43.3	9.10	19.9	20.6	28.6	17.4	11.1	42.8	28
29	39.9		13.4	161	45.9	9.20	18.0	21.9	28.6	13.9	11.3	37.7	29
30	41.6		11.4	138	44.2	16.7	16.2	22.0	28.6	13.0	11.3 E	30.9	30
31	41.9		11.4 E		40.5		16.1	22.0		13.0		30.9	31
TOTAL	1151	987	934	2259	1328	447	643	532	968	659	318	977	TOTAL
MEAN	37.1	34.0	30.1	75.3	42.8	14.9	20.8	17.2	32.3	21.3	10.6	31.5	MEAN
MAX	41.9	55.5	47.0	193	102	37.9	25.2	22.0	45.0	25.5	11.3	57.5	MAX
MIN	35.1	22.6	11.4	10.1	22.8	6.70	16.1	15.7	15.6	13.0	10.1	11.2	MIN
DAM3	99400	85300	80700	195200	114700	38600	55600	45900	83600	57000	27500	84400	DAM3

SUMMARY FOR THE YEAR 2019
Total discharge 967900 DAM
Mean discharge, 30.7 m^3/s
Maximum daily discharge, 193 m^3/s On 2019-04-27
Minimum daily discharge, 6.70 m^3/s On 2019-06-19

NOTE: DATA ARE SUPPLIED BY THE UNITED STATES GEOLOGICAL SURVEY AND ARE PROVISIONAL
E - ESTIMATE

TABLE IV

GRAND FALLS FLOWAGE AT GRAND FALLS
DAILY MEAN WATER LEVEL IN METERS FOR 2019

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
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 2019
Mean water level, 61.788 m
Maximum daily water level, 62.042 m On 2019-04-29
Minimum daily water level, 61.406 m On 2019-02-28

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 2019

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	81.3	108E	55.0E	216	368	116	81.0	36.2	49.0	75.3	90.3	55.5	1
2	82.7E	107E	54.4E	239	314	104	99.4	33.4	48.7	60.9	110	87.2	2
3	78.2	104E	54.4	237	253	85.2	112	31.7	43.9	62.6	79.9	80.1	3
4	64.0	104	51.0	219	235	68.5	116	30.6	40.8	59.7	71.9	76.2	4
5	65.4	103	51.3	186	219	62.6	94.3	29.4	41.9	59.7	73.9	77.0	5
6	66.5	103	52.1E	171	193	58.3	105	29.4	42.5	60.0	96.8	73.6	6
7	64. E	101	49.8E	152	187	58.6	114	29.2	55.8	72.5	93.2	70.5	7
8	63.1	101	52.4E	148	165	61.4	78.2	28.9	58.9	90.9	95.4	68.0	8
9	64.0	103E	53.2E	146	134	53.2	59.7	29.2	45.9	83.5	98.3	86.1	9
10	68.2	99.1E	54.1E	133	120	43.9	60.0	39.4	39.1	81.3	91.2	134	10
11	66.3E	96.0E	54.9E	123	132	44.2	59.2	32.8	36.5	82.1	75.3	170	11
12	64.0E	94.3E	54.7	113	130	47.3	71.1	29.4	36.0	81.8	77.0	210	12
13	62.9E	95.4	54.1	110	120	46.2	68.8	29.2	34.5	81.3	77.3	201	13
14	62.9E	90.6	53.5	138	120	45.3	66.8	28.1	33.7	80.4	72.8	208	14
15	69.4	88.9E	57.5	186	116	44.5	66.0	27.9	37.7	80.1	65.4	232	15
16	72.5E	90.3	64.3	259	103	37.7	62.6	27.8	60.6	77.0	64.3	245	16
17	68.2E	89.2	64.6	286	102	30.3	58.6	27.3	45.0	76.2	71.6	247	17
18	70.8E	87.2	64.0	283	94.0	30.0	56.6	29.2	53.8	81.0	62.3	245	18
19	73.3E	82.7E	63.4	294	90.9	29.2	54.9	28.3	61.7	77.3	66.5	198	19
20	71.9E	81.6E	65.4	311	94.0	29.7	50.1	27.8	64.6	64.6	77.0	156	20
21	76.7E	81.0	68.8	374	103	54.9	46.7	27.0	58.0	69.7	75.0	140	21
22	76.2E	73.6	111	416	103	55.2	47.3	27.5	56.9	63.4	68.8	129	22
23	75.9E	74.2	149	416	94.6	53.5	47.0	28.3	59.7	50.7	85.2	125	23
24	86.1	76.5	141	413	110	47.6	47.3	27.8	56.6	67.1	102	125	24
25	104	76.7	139	413	133	35.7	45.3	27.9	57.8	77.6	106	118	25
26	92.3	69.1E	125	399	132	35.7	44.2	29.2	65.4	54.7	103	108E	26
27	90.6	66.5E	119	402	141	47.6	43.6	32.6	81.6	49.3	99.4	104E	27
28	93.2E	58.9E	111	428	146	63.1	43.9	50.1	88.1	53.8	107	104	28
29	98.8E		107	433	142	62.0	50.1	62.0	89.5	65.7	106	96.3	29
30	105E		110	411	137	66.5	43.6	54.1	86.6	81.0	97.7	85.0	30
31	108E		119		128		41.1	50.7		77.9		88.3	31
TOTAL	2387	2764	2424	8057	4659	1618	2035	1022	1631	2199	2560	4142	TOTAL
MEAN	77.0	95.3	78.2	269	150	53.9	65.6	33.0	54.4	70.9	85.3	133.6	MEAN
MAX	108	259	149	433	368	116	116	62.0	89.5	90.9	110	247	MAX
MIN	62.9	58.9	49.8	110	90.9	29.2	41.1	27.0	33.7	49.3	62.3	55.5	MIN
DAM3	206300	238800	209500	696100	402600	139800	175800	88300	140900	190000	221200	357900	DAM3

SUMMARY FOR THE YEAR 2019

Total discharge 3044900 DAM

Mean discharge, 96.7 m^3/s

Maximum daily discharge, 433 m^3/s On 2019-04-29

Minimum daily discharge, 27.0 m^3/s On 2019-08-21

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

E - ESTIMATE

TABLE VI

ST. CROIX RIVER AT MILLTOWN DAM
DAILY MEAN WATER LEVEL IN METERS FOR 2019

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	13.724	13.738	13.712	14.005	13.785	13.734	13.724	13.679	13.729	13.777	13.856	13.549	1
2	13.725	13.716	13.711	13.997	13.777	13.729	13.712	13.677	13.723	13.766	13.890	13.576	2
3	13.714	13.714	13.713	13.998	13.771	13.729	13.694	13.672	13.720	13.776	13.839	13.563	3
4	13.718	13.714	13.713	13.989	13.766	13.712	13.705	13.671	13.715	13.759	13.837	13.562	4
5	13.723	13.717	13.712	13.996	13.765	13.731	13.710	13.671	13.721	13.774	13.820	13.564	5
6	13.720	13.724	13.713	13.981	13.762	13.725	13.709	13.671	13.750	13.781	13.819	13.573	6
7	13.729	13.722	13.713	13.980	13.760	13.724	13.712	13.674	13.756	13.778	13.824	13.579	7
8	13.718	13.720	13.713	13.999	13.758	13.729	13.706	13.671	13.743	13.782	13.828	13.586	8
9	13.729	13.722	13.715	13.986	13.757	13.724	13.705	13.671	13.758	13.786	13.841	13.580	9
10	13.724	13.731	13.714	13.984	13.754	13.715	13.708	13.682	13.759	13.780	13.836	13.573	10
11	13.716	13.799	13.715	13.986	13.754	13.699	13.710	13.683	13.737	13.778	13.841	13.590	11
12	13.726	13.841	13.715	13.987	13.755	13.712	13.690	13.675	13.746	13.773	13.825	13.612	12
13	13.724	13.767	13.714	13.992	13.753	13.718	13.694	13.677	13.761	13.786	13.834	13.604	13
14	13.718	13.725	13.715	14.002	13.754	13.718	13.704	13.679	13.753	13.797	13.776	13.588	14
15	13.731	13.719	13.716	13.971	13.754	13.724	13.706	13.682	13.740	13.790	13.747	13.582	15
16	13.714	13.719	13.719	14.016	13.753	13.720	13.706	13.680	13.754	13.845	13.801	13.607	16
17	13.731	13.722	13.718	14.014	13.750	13.711	13.704	13.684	13.760	13.873	13.817	13.605	17
18	13.746	13.720	13.840	14.008	13.750	13.703	13.703	13.667	13.774	13.879	13.799	13.600	18
19	13.738	13.719	13.899	14.011	13.752	13.708	13.678	13.659	13.778	13.886	13.813	13.601	19
20	13.750	13.716	13.897	14.038	13.754	13.705	13.686	13.678	13.766	13.879	13.820	13.611	20
21	13.710	13.719	13.898	14.044	13.751	13.637	13.686	13.678	13.765	13.871	13.813	13.609	21
22	13.712	13.716	13.911	14.043	13.748	13.658	13.694	13.671	13.758	13.816	13.783	13.589	22
23	13.714	13.723	13.901	14.043	13.743	13.688	13.777	13.625	13.743	13.805	13.819	13.586	23
24	13.721	13.720	13.833	14.036	13.745	13.709	13.715	13.692	13.743	13.810	13.837	13.588	24
25	13.726	13.719	13.549	14.036	13.742	13.705	13.705	13.694	13.758	13.887	13.722	13.598	25
26	13.720	13.717	13.788	14.025	13.742	13.699	13.696	13.688	13.762	13.868	13.569	13.605	26
27	13.720	13.775	13.810	13.977	13.745	13.692	13.689	13.681	13.779	13.833	13.571	13.585	27
28	13.724	13.749	13.912	13.867	13.742	13.679	13.686	13.690	13.790	13.804	13.568	13.588	28
29	13.729		13.991	13.728	13.739	13.713	13.686	13.694	13.789	13.848	13.576	13.591	29
30	13.718		13.991	13.791	13.738	13.716	13.670	13.703	13.795	13.842	13.580	13.588	30
31	13.720		14.038		13.735		13.676	13.714		13.860		13.575	31
MEAN	13.724	13.732	13.787	13.984	13.753	13.709	13.701	13.678	13.754	13.816	13.777	13.587	MEAN
MAX	13.750	13.841	14.038	14.044	13.785	13.734	13.777	13.714	13.795	13.887	13.890	13.612	MAX
MIN	13.710	13.714	13.549	13.728	13.735	13.637	13.670	13.625	13.715	13.759	13.568	13.549	MIN

SUMMARY FOR THE YEAR 2019
Mean water level, 13.750 m
Maximum daily water level, 14.044 m On 2019-04-21
Minimum daily water level, 13.549 m On 2019-03-25

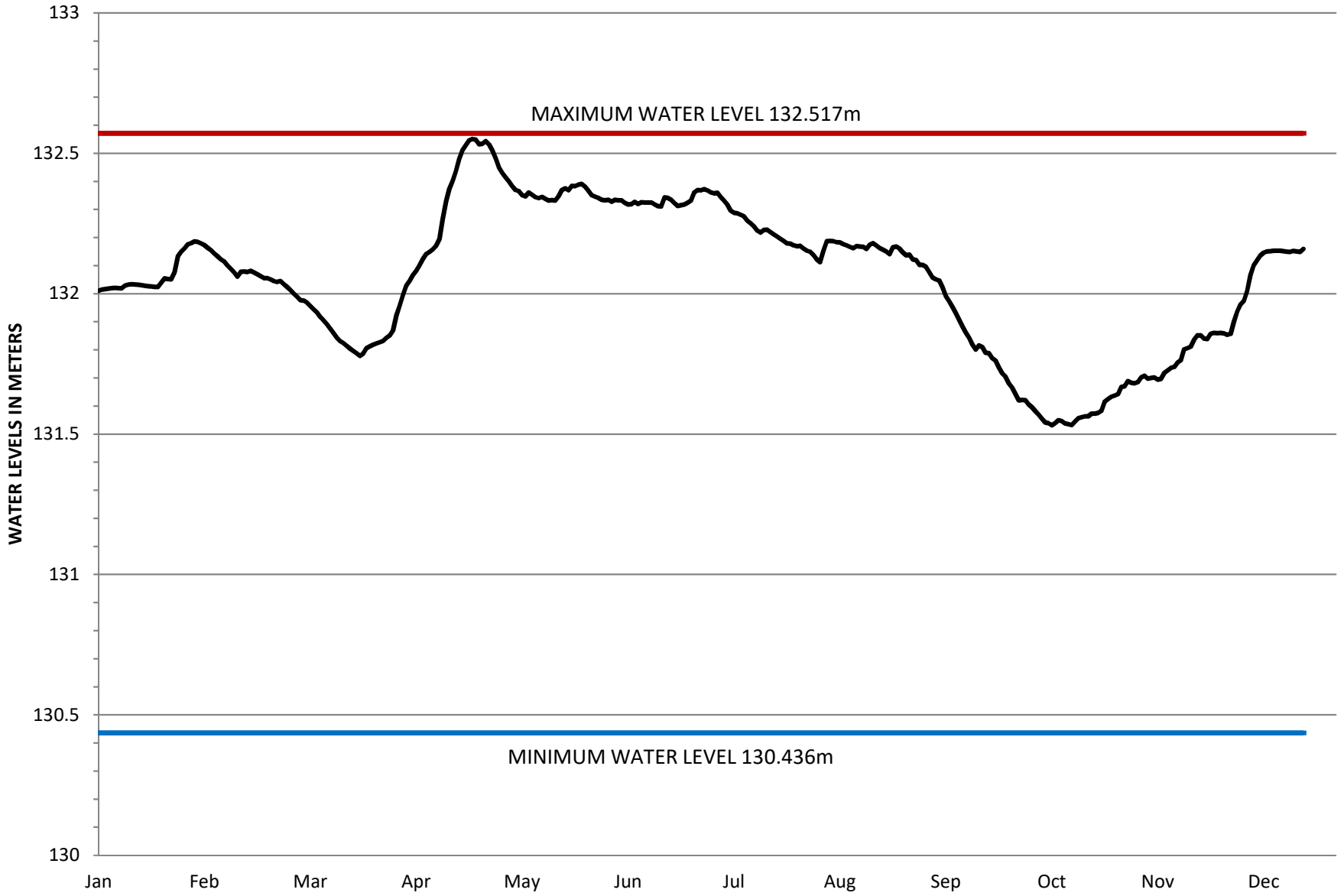
NOTES: WATER LEVELS ARE IN METERS AND ARE REFERENCED TO GEODETIC SURVEY OF CANADA DATUM. THE WATER LEVEL DATA ARE PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT CANADA IN COOPERATION WITH NEW BRUNSWICK POWER.

APPENDIX 4

HYDROGRAPHS

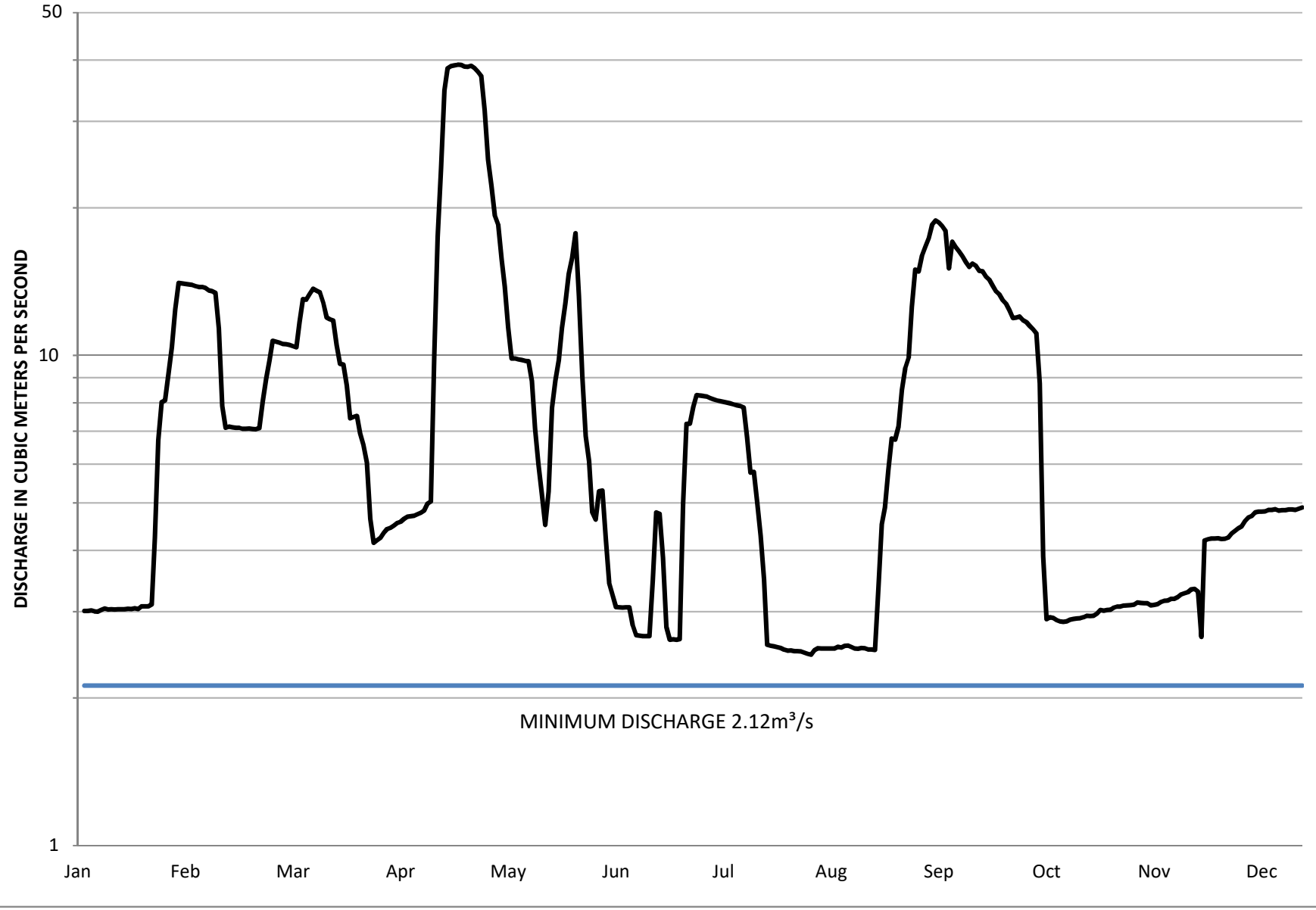
YEAR: 2019 STATION ID: 01AR009 - GRAND LAKE AT FOREST CITY

FIGURE I



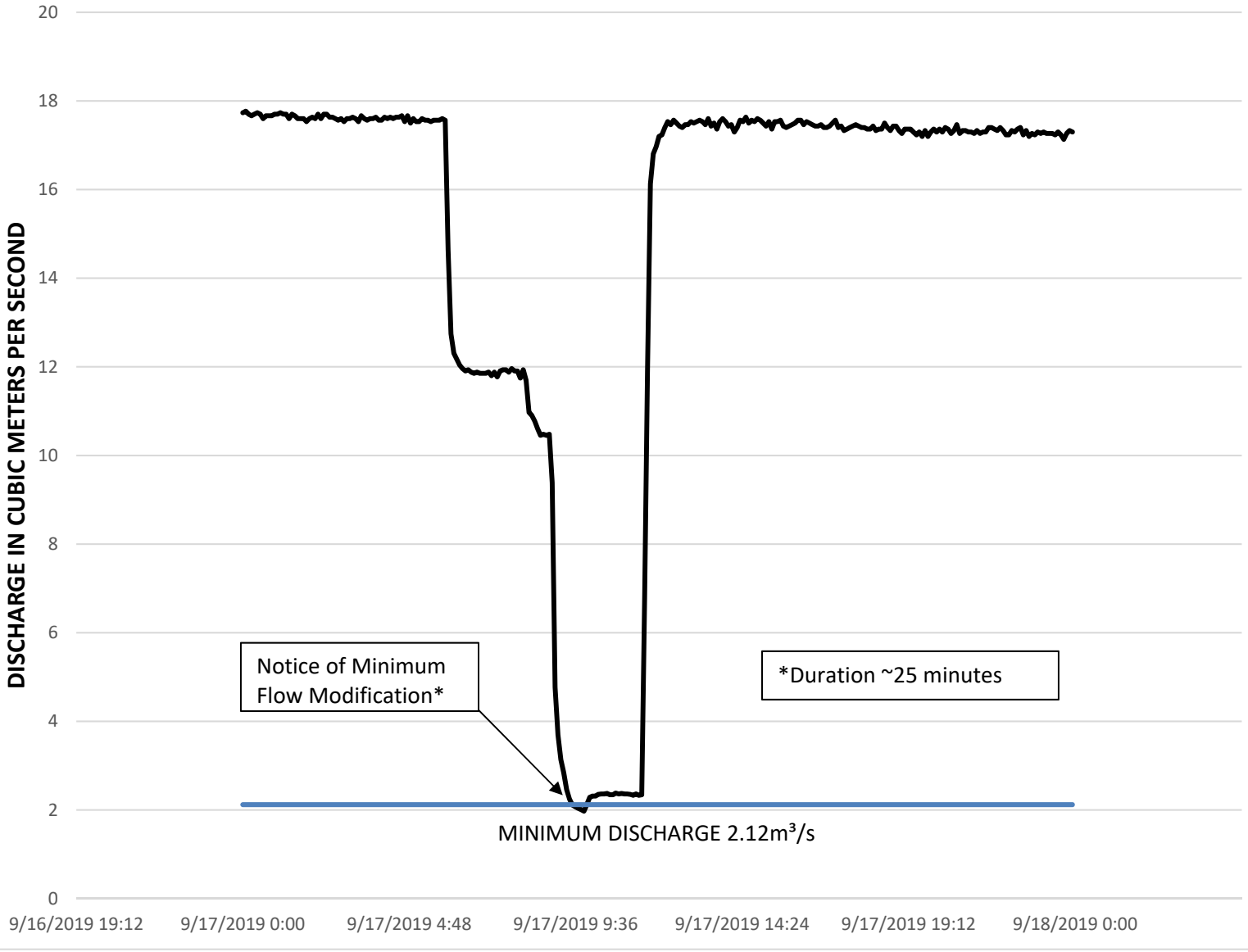
YEAR: 2019 STATION ID: 01AR011 - FOREST CITY STREAM BELOW FOREST CITY DAM

FIGURE II



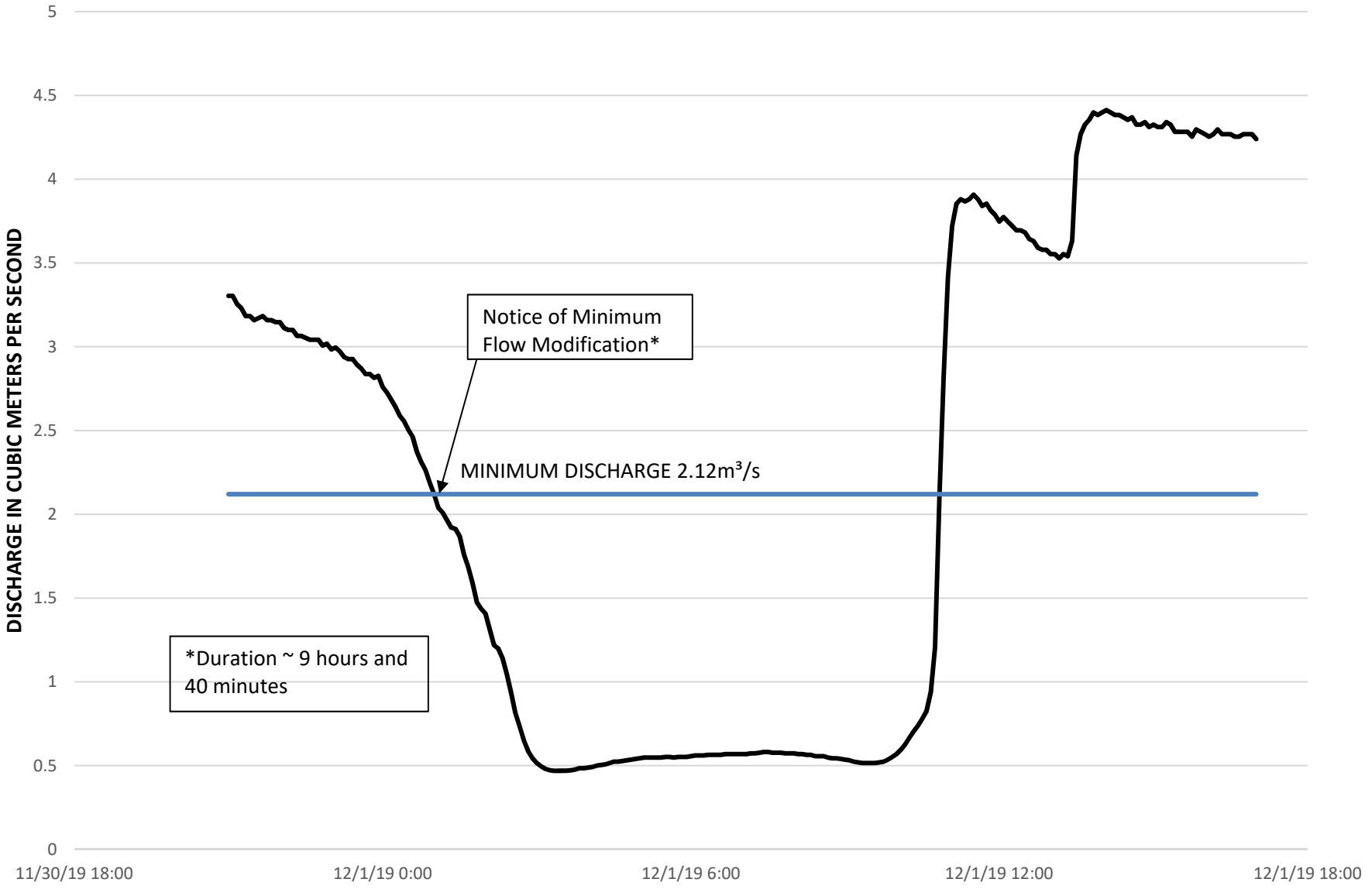
YEAR: 2019 STATION ID: 01AR011 - FOREST CITY STREAM BELOW FOREST CITY DAM
INSTANTANEOUS VALUES

FIGURE II-I



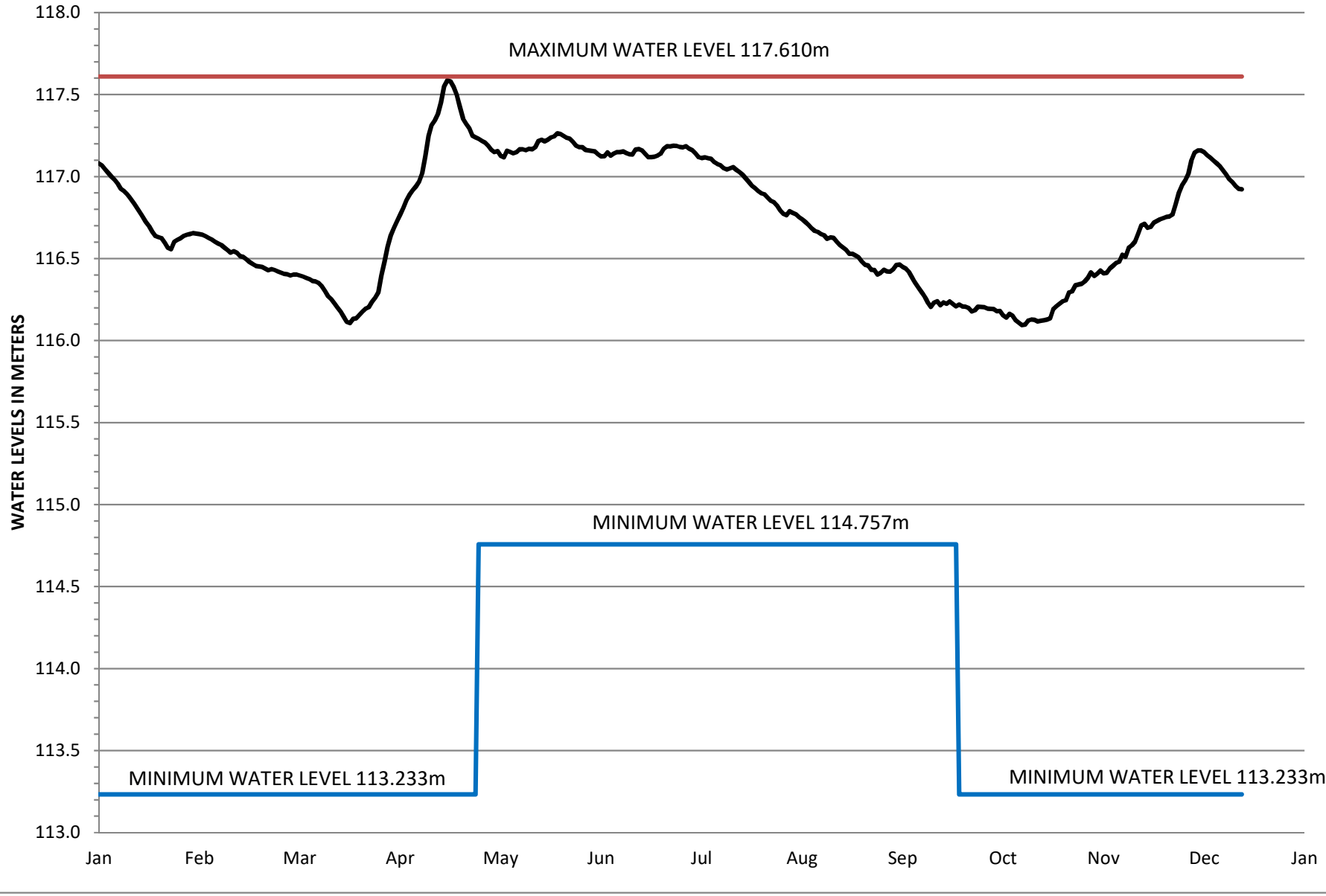
YEAR: 2019 STATION ID: 01AR011 - FOREST CITY STREAM BELOW FOREST CITY DAM
INSTANTANEOUS VALUES

FIGURE II-II



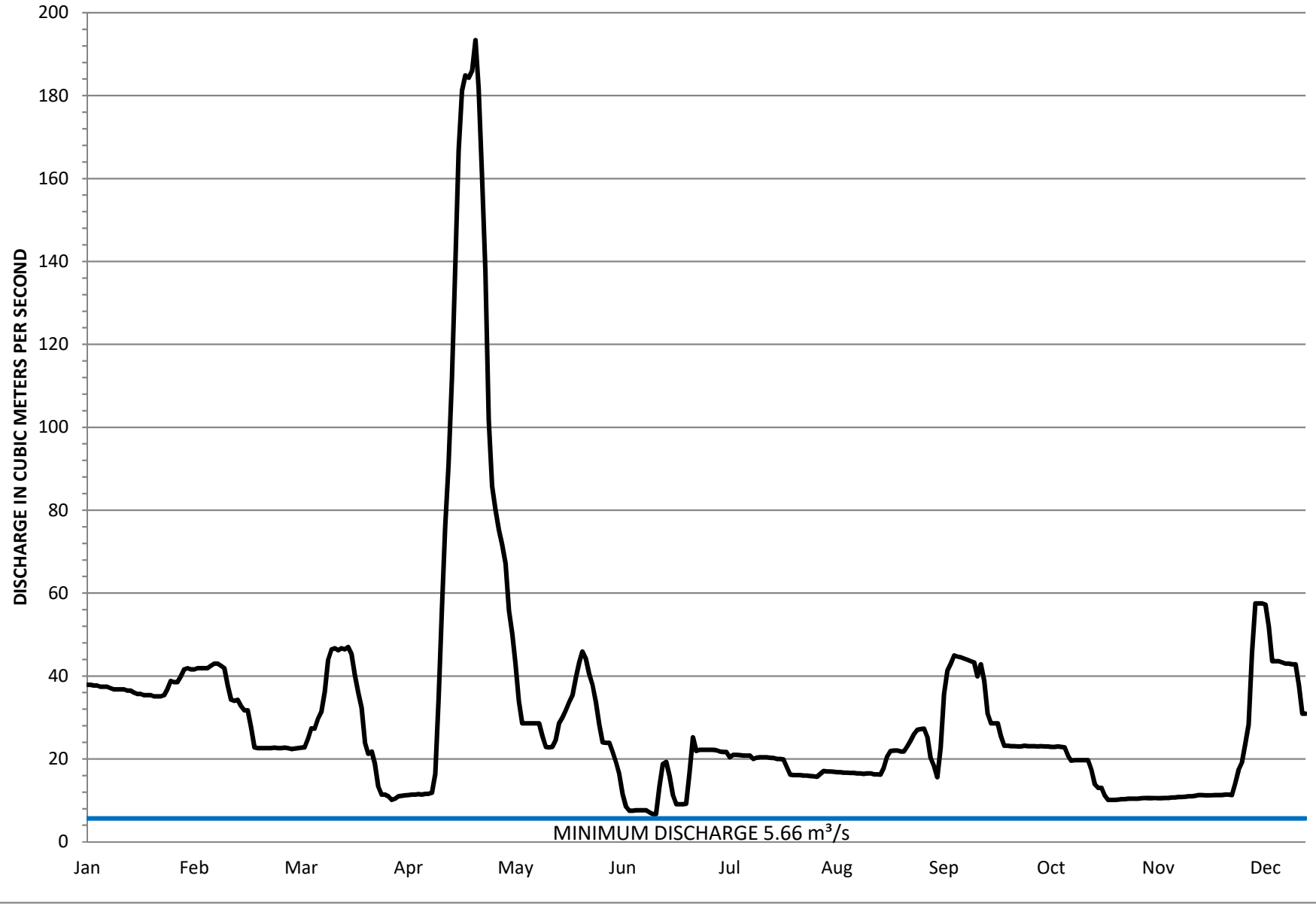
YEAR: 2019 STATION ID: 01AR010 - SPEDNIC LAKE AT ST. CROIX

FIGURE III



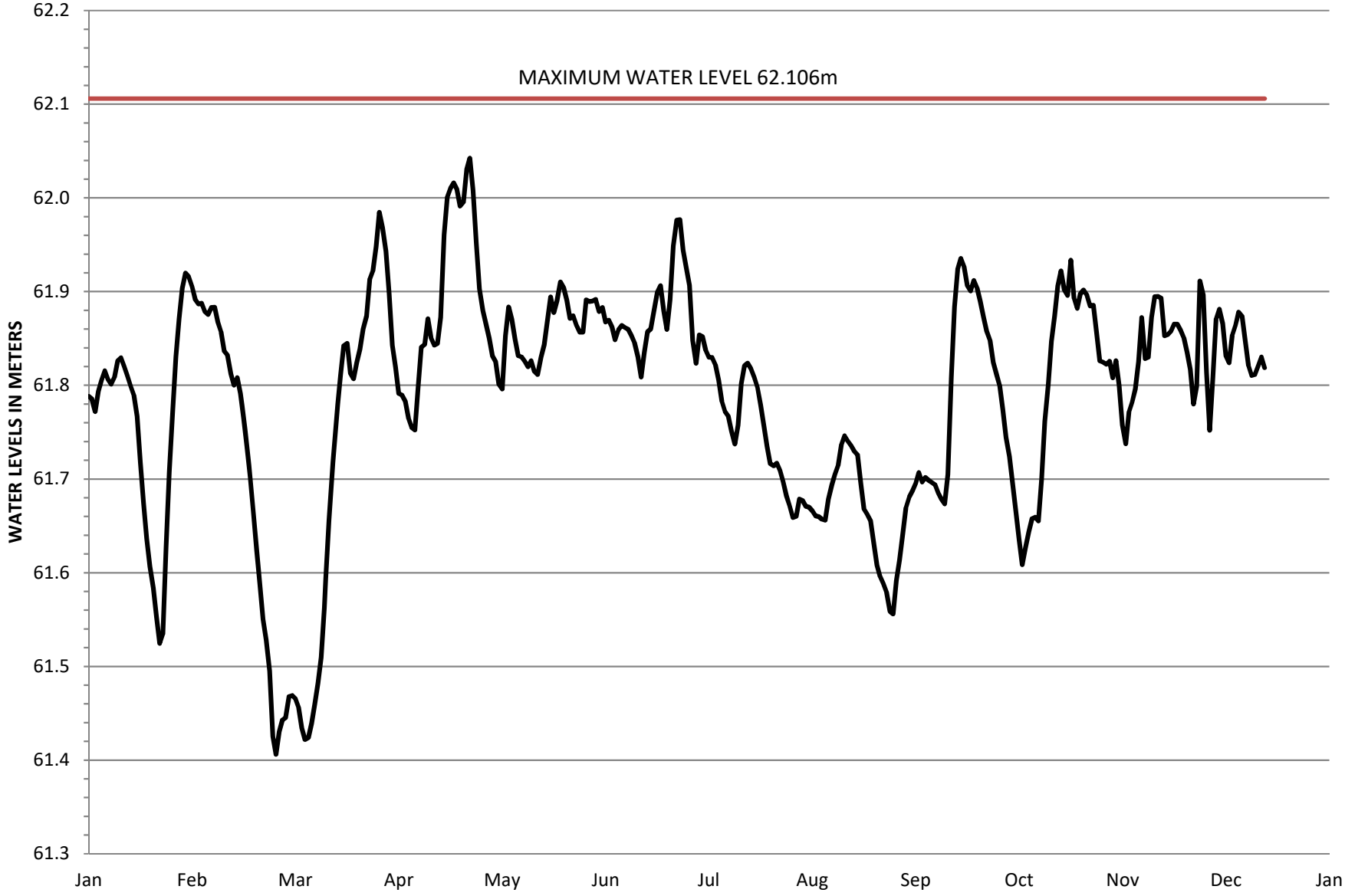
YEAR: 2019 STATION ID: 01AR004 - ST. CROIX RIVER AT VANCEBORO

FIGURE IV



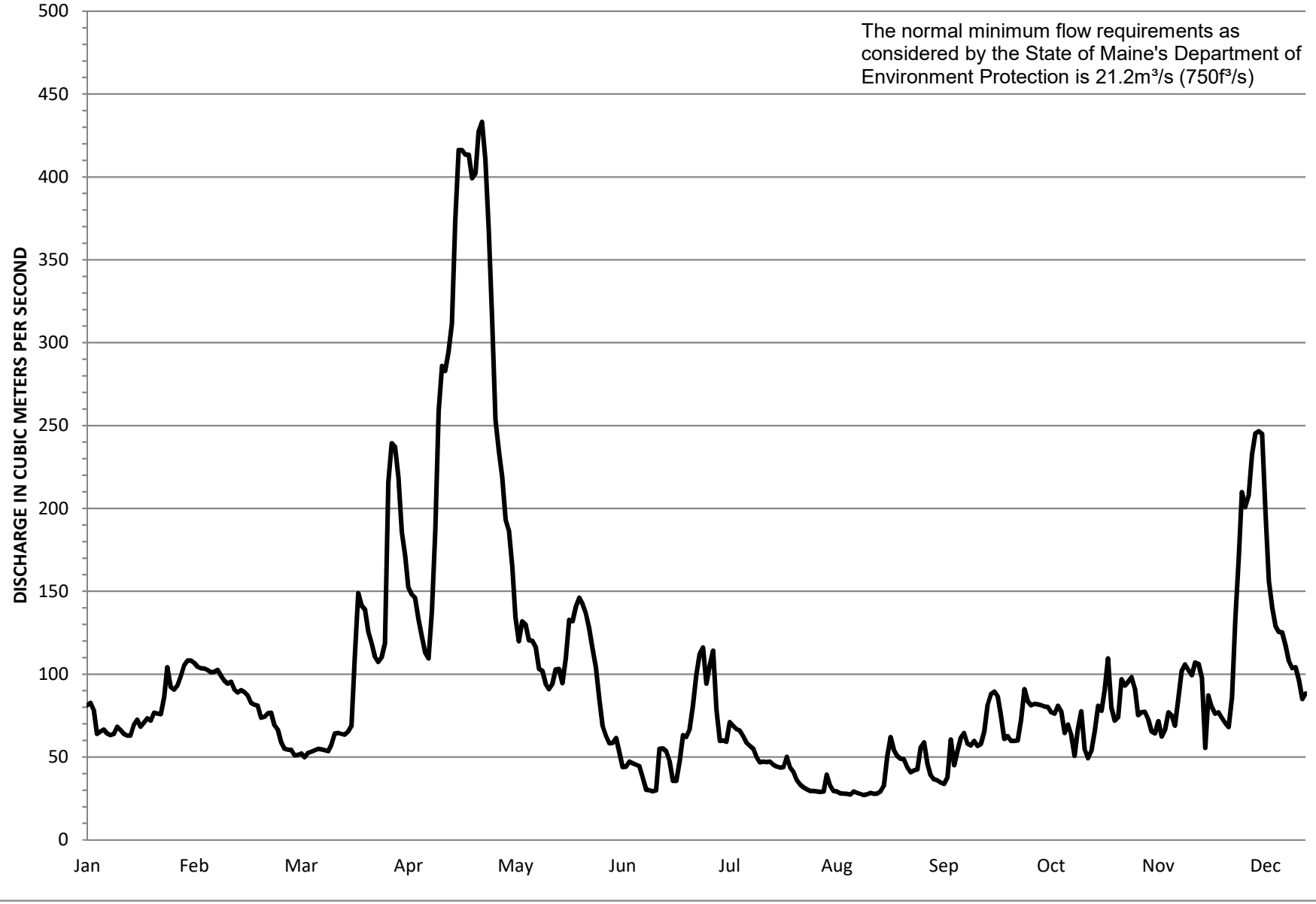
YEAR: 2019 STATION ID: 01AR013 - GRAND FALLS FLOWAGE AT GRAND FALLS

FIGURE V



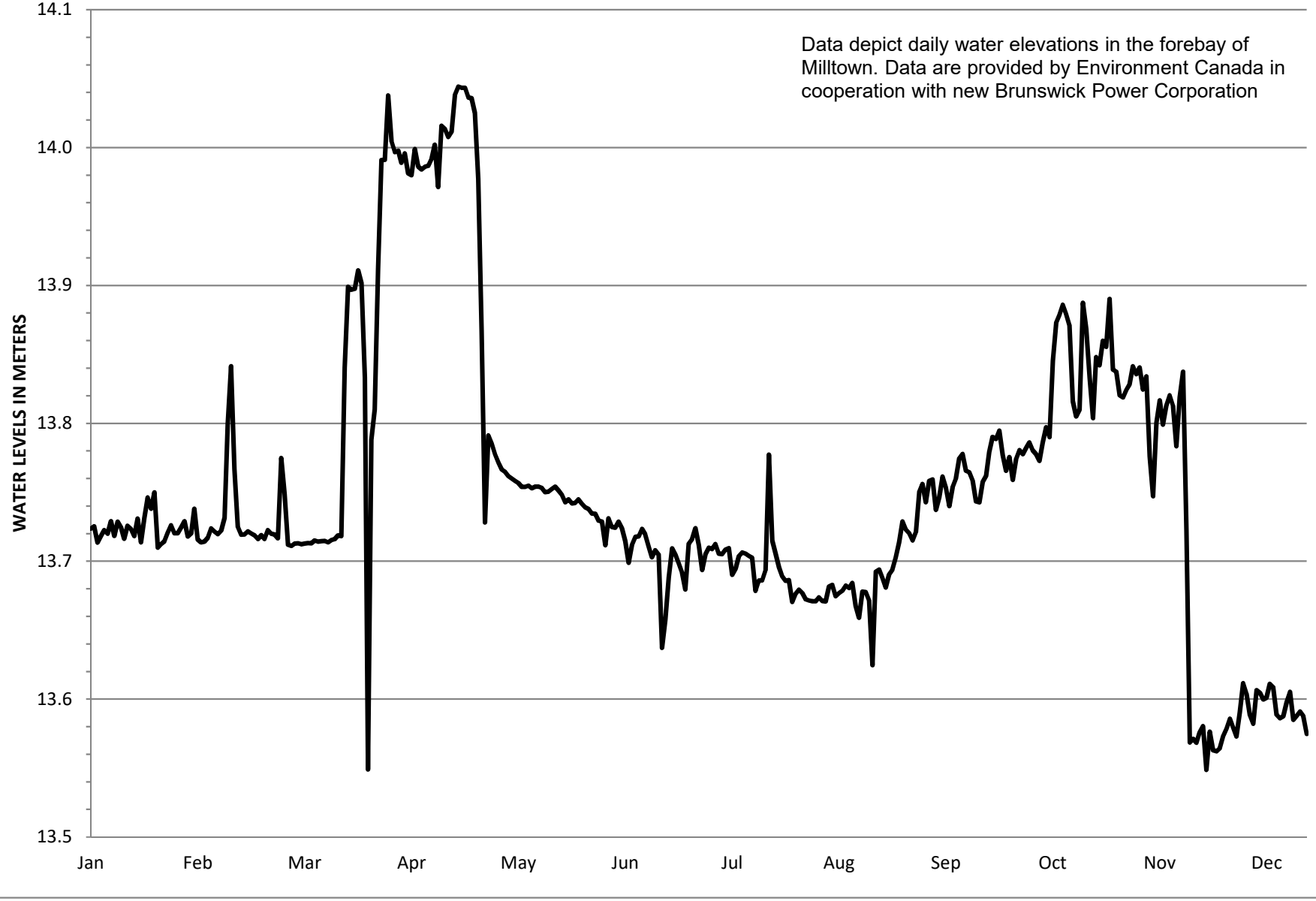
YEAR: 2019 STATION ID: 01AR005 - ST. CROIX RIVER AT BARING MAINE

FIGURE VI



YEAR: 2019 STATION ID: 01AR014 - ST. CROIX RIVER AT MILLTOWN DAM

FIGURE VII

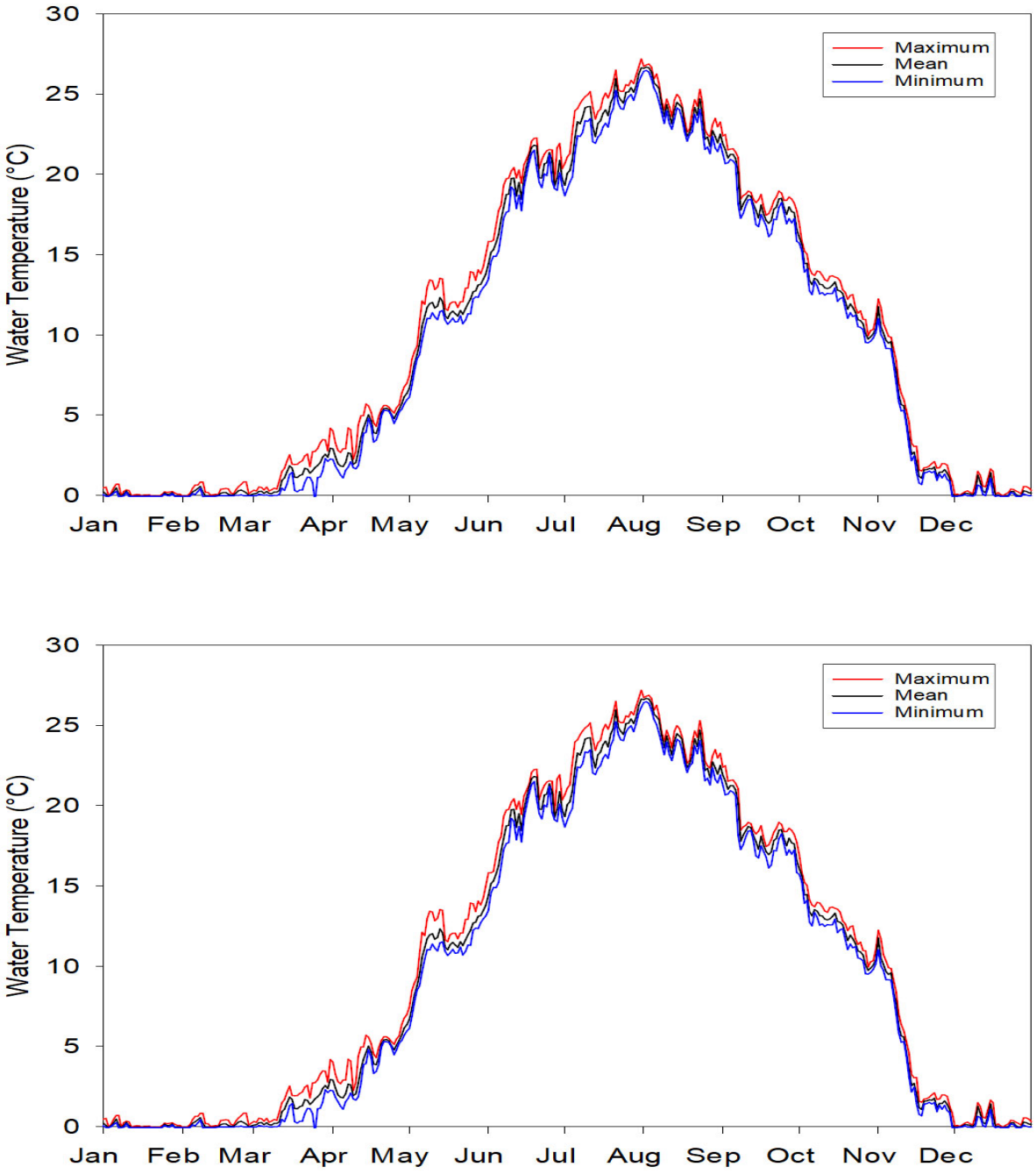


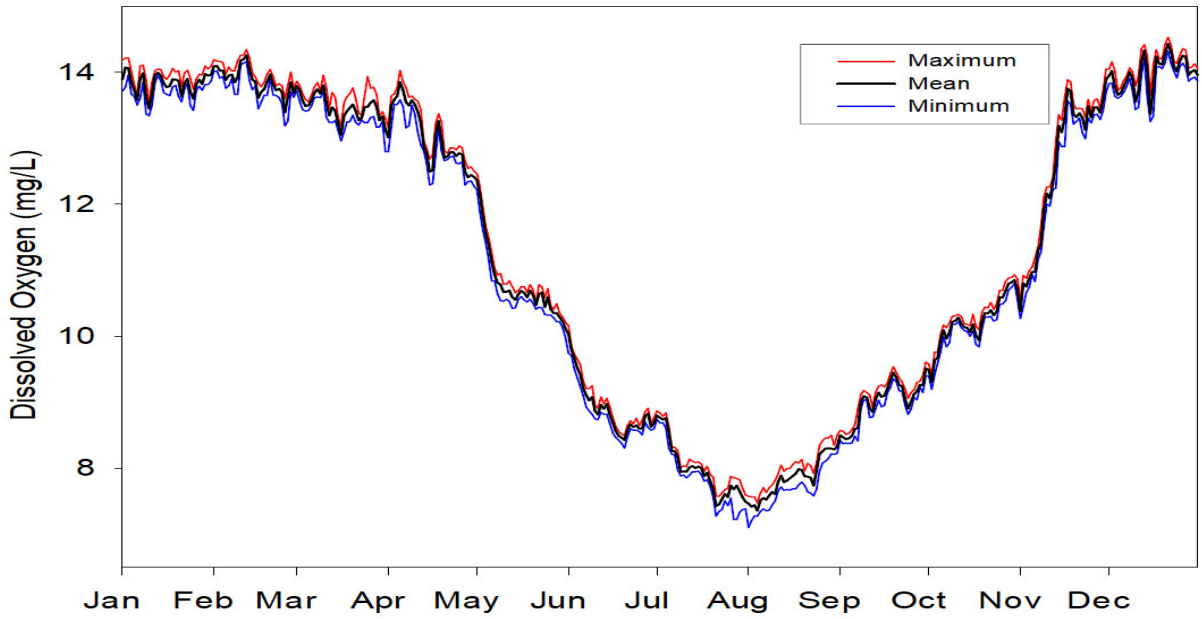
APPENDIX 5

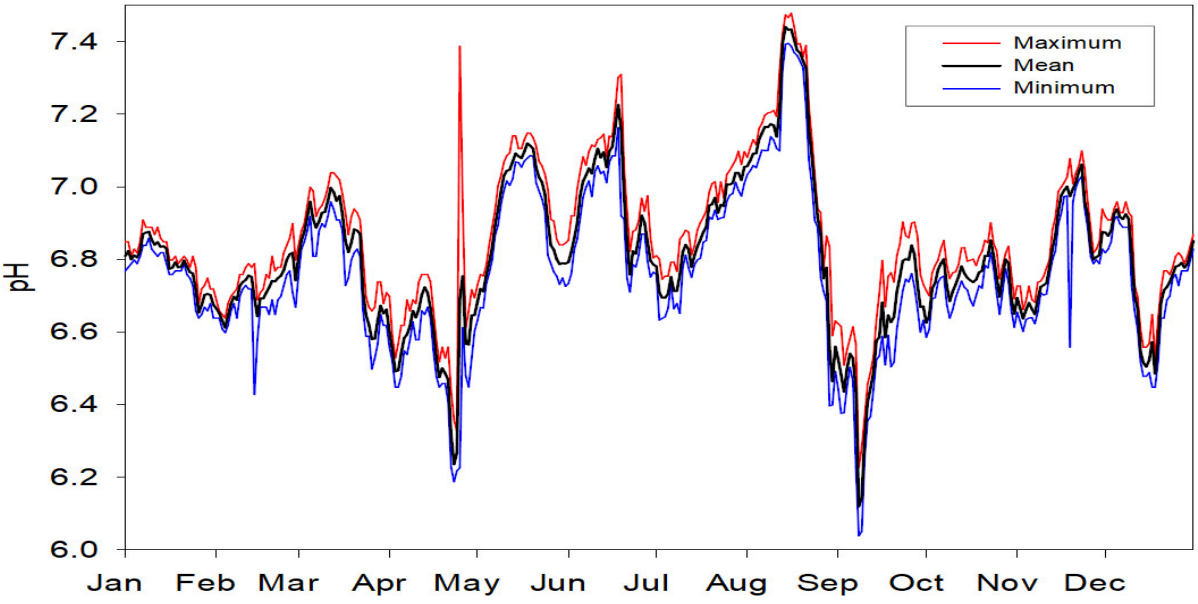
WATER QUALITY DATA

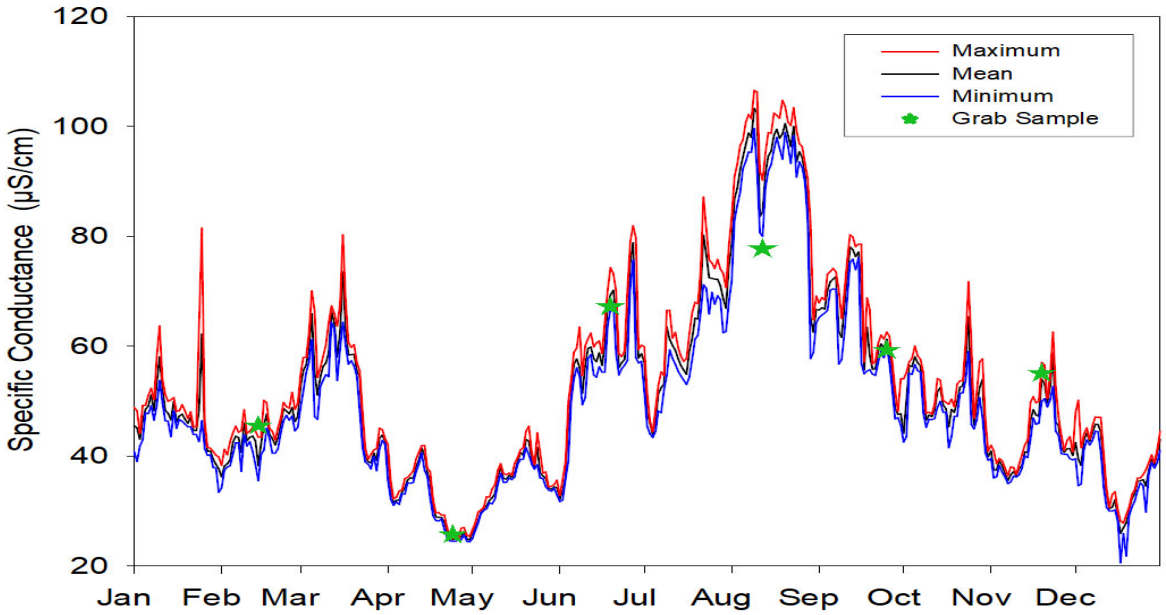
Milltown Station, Real Times Data (operated by Environment and Climate Change Canada)

Figure 1: Daily mean, maximum and minimum temperature, dissolved oxygen, pH, specific conductance, and turbidity on the St. Croix River at Milltown, NB, 2019. Grab Samples measurements (green stars) are also shown on the real time graphs.




Maximum
Mean
Minimum
Dissolved Oxygen (mg/L)
14
12
10
8
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Maximum
Mean
Minimum
pH
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Specific Conductance (µS/cm)
120
100
80
60
40
20
Maximum
Mean
Minimum
Grab Sample
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

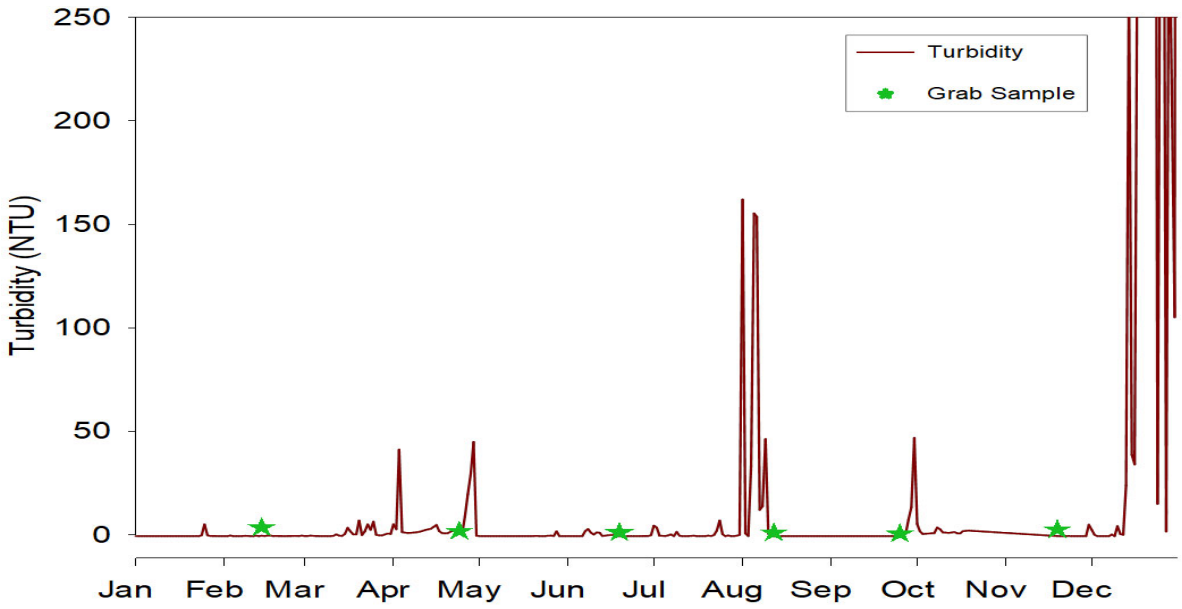

Turbidity (NTU)
250
200
150
100
50
0
Turbidity
Grab Sample
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Table 1: Monthly mean, maximum and minimum temperature, dissolved oxygen, pH, specific conductance, and turbidity on the St. Croix River at Milltown, NB, 2019.

St. Croix River at Milltown, NB - 2019

Temperature °C

	January	February	March	April	May	June	July	August	September	October	November	December
Min	0.00	0.00	-0.29	1.15	6.18	13.51	18.70	21.31	15.87	9.55	0.01	0.01
Max	0.76	0.91	4.24	7.03	15.04	22.29	27.20	26.89	22.51	16.94	12.28	1.72
Mean	0.11	0.19	1.23	4.02	11.36	19.20	23.80	23.96	18.63	12.46	4.36	0.29

Dissolved Oxygen (mg/L)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	13.35	13.20	12.80	12.28	9.98	8.32	7.24	7.12	8.38	9.21	10.28	13.26
Max	14.22	14.35	13.96	14.03	12.47	10.17	8.88	8.51	9.62	10.94	14.05	14.53
Mean	13.84	13.89	13.48	13.04	10.80	8.93	7.98	7.86	9.01	10.22	12.56	14.00

pH (pH units)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	6.64	6.43	6.50	6.19	6.63	6.71	6.63	6.40	6.04	6.59	6.56	6.45
Max	6.91	6.90	7.04	7.39	7.15	7.31	7.10	7.48	6.90	6.90	7.10	6.96
Mean	6.79	6.72	6.83	6.57	6.94	6.97	6.87	7.11	6.58	6.75	6.83	6.75

Specific Conductance (µS/cm)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	33.60	34.40	37.51	24.60	25.20	31.90	43.55	57.89	45.79	39.41	35.18	20.80
Max	81.60	51.75	80.38	42.35	45.60	82.00	87.22	106.60	80.38	71.86	62.70	50.30
Mean	47.10	43.74	53.88	31.78	35.54	57.83	61.91	91.52	64.08	50.98	43.10	36.91

Turbidity (NTU)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.13	1.00	0.00	0.00
Max	5.71	0.30	7.50	45.40	2.33	5.04	162.32	162.32	47.37	5.83	5.51	3000.00
Mean	0.21	0.07	1.40	6.76	0.09	0.55	3.37	27.82	15.39	2.05	0.70	575.50

Forest City Station, Real Times Data (operated by Environment and Climate Change Canada)

Figure 2: Daily mean, maximum and minimum temperature and specific conductance on the St. Croix River at Forest City, NB, 2019. Grab samples for specific conductance (green stars) are also shown on the real time graphs.

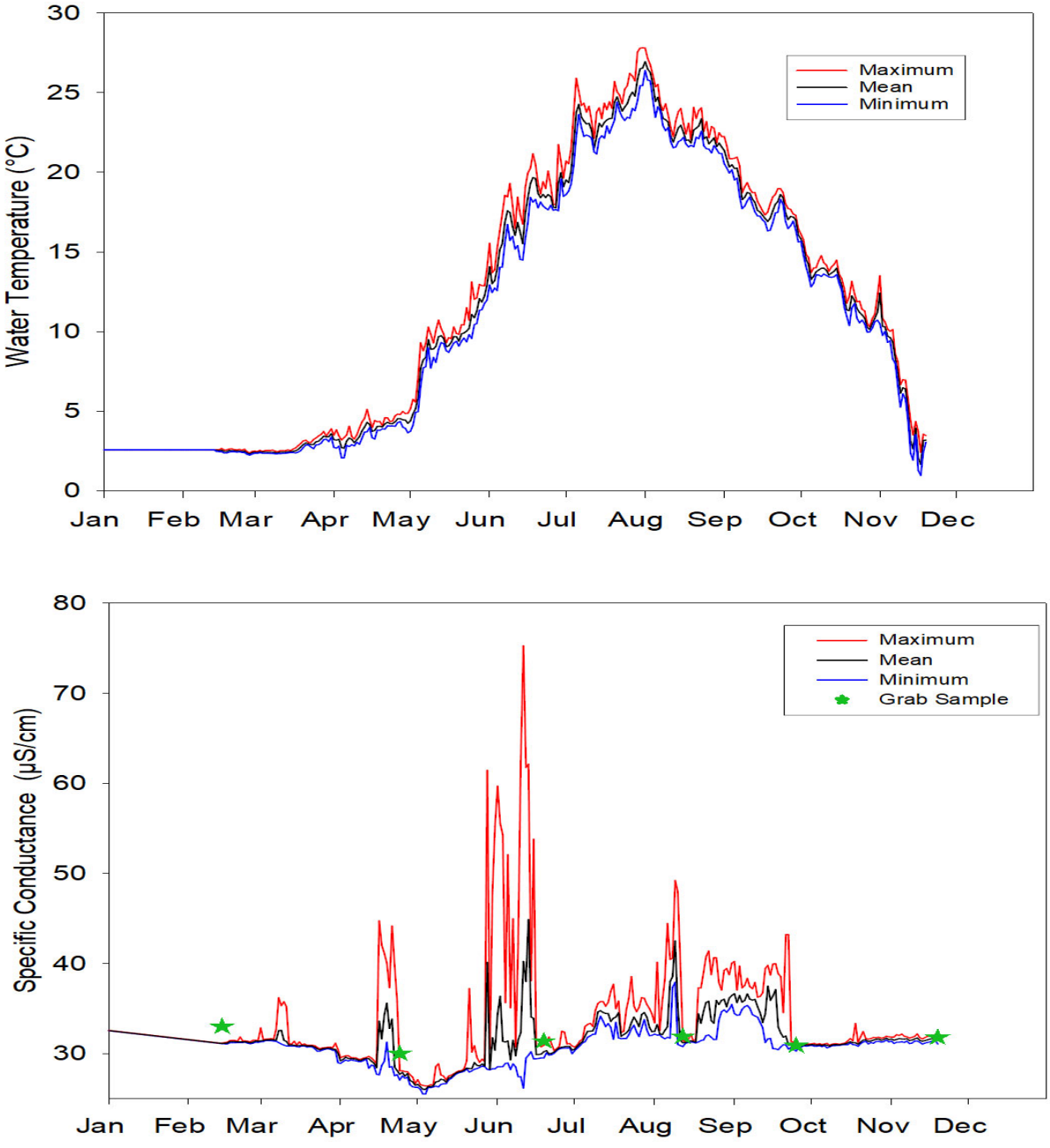


Table 2: Monthly mean, maximum and minimum temperature and specific conductance on the St. Croix River at Forest City, NB, 2019.

St. Croix River at Forest City, NB - 2019

Temperature °C

	January	February	March	April	May	June	July	August	September	October	November	December
Min	2.63	2.30	2.38	2.12	3.80	12.49	18.63	21.20	15.66	10.01	1.03	
Max	2.63	2.72	3.95	5.16	13.98	21.77	27.83	27.82	22.27	16.17	13.54	
Mean	2.63	2.58	2.78	3.84	9.35	17.28	23.45	23.12	18.36	12.74	6.49	

Specific Conductance (µS/cm)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	31.67	31.18	29.11	26.38	25.64	26.29	30.45	30.89	30.38	30.75	31.16	
Max	32.68	31.95	36.30	44.83	61.51	75.30	38.64	49.29	43.29	33.45	32.30	
Mean	32.18	31.42	31.15	29.74	28.27	32.28	33.22	34.34	34.00	31.32	31.68	

Table 3: Results of grab samples collected at St. Croix River at Milltown in 2019

St. Croix River at Milltown (NB01AR0021)										
Analyte	**Units**	**Guideline[2]**	**Feb 14**	**Apr 24**	**Apr 24**	**Apr 24**	**Jun 19**	**Aug 12**	**Sep 25**	**Nov 19**
					RepT	FB				
Alkalinity, total $CaCO_3$	mg/L		9.22	4.8	4.8	<1	13.2	15.2	13.1	11.4
Aluminum (total) [1]	µg/L	100	153	150	147	<1.5	150	88.4	69.9	182
Antimony (total) [1]	µg/L		0.09	0.04	0.03	<0.02	0.1	0.04	0.04	0.04
Arsenic (total) [1]	µg/L	5	0.46	0.29	0.29	<0.02	0.56	0.9	0.49	0.46
Barium (total) [1]	µg/L		6.6	3.7	3.7	<0.1	8.5	8.6	7.4	4.5
Beryllium (total) [1]	µg/L		0.016	0.014	0.013	<0.005	0.011	0.009	0.007	0.015
Boron (total) [1]	µg/L		3	2	2	<1	4	5	3.3	4
Cadmium (total) [1]	µg/L	0.04[3]	0.04	0.02	0.01	<0.01	0.04	0.03	0.02	0.02
Calcium (total) [1]	mg/L		3.59	2.31	2.34	<0.01	4.85	4.86	4.47	3.78
Carbon, total organic	mg/L		8.01	7.66	7.72	<0.25	8.73	9.67	7.92	12.3
Chloride	mg/L	120	4.1	2.2	2.2	<0.2	6.9	6.7	5.4	4.3
Chromium (total) [1]	µg/L	8.9	0.62	0.24	0.22	<0.02	0.54	0.16	0.139	0.29
Cobalt (total) [1]	µg/L		0.09	0.09	0.09	<0.02	0.08	0.05	0.04	0.08
Colour, apparent	Colour units		86	79	80	<5	84	86	61	127
Conductivity	µS/cm		45.7	25.9	25.2	0.7	67.3	77.8	59.4	55.2
Copper (total) [1]	µg/L	2[3]	2.7	0.5	0.4	<0.1	1.4	0.4	0.41	0.45
Hardness (calculated)	mg/L		11.5	7.6	7.7		14.9	15.1	13.8	12.4
Iron (total) [1]	µg/L	300	1810	209	206	<0.5	238	313	158	316
Lead (total) [1]	µg/L	1[3]	1.42	0.23	0.21	<0.03	1.95	0.14	0.1	0.16
Magnesium (total) [1]	mg/L		0.612	0.434	0.435	<0.001	0.655	0.7	0.626	0.713
Manganese (total) [1]	µg/L	73	46.2	35.5	33.7	<0.2	58.5	59.5	48.5	29.8
Molybdenum (total) [1]	µg/L		0.18	0.06	0.06	<0.02	0.12	0.17	<0.15	<0.15
Nickel (total) [1]	µg/L	25[3]	0.94	0.39	0.33	<0.05	0.36	0.36	0.277	0.48
Nitrate as N	mg/L	2.9	0.04	<0.03	<0.03	<0.03	0.05	0.09	0.06	0.03
Nitrogen, total	mg/L		0.38	0.32	0.32	<0.02	0.43	0.52	0.4	0.4
pH	pH	6.5 - 9.0	6.96	6.83	6.84	5.47	7.34	7.26	7.31	7.16
Phosphorus, total	mg/L	0.03[4]	0.02	0.016	0.016	<0.002	0.033	0.032	0.02	0.018
Potassium (total) [1]	mg/L		0.61	0.36	0.36	<0.05	0.87	1.9	0.85	0.79
Selenium (total) [1]	µg/L	1	0.06	0.05	0.04	<0.03	0.04	0.07	0.066	0.06
Silver (total) [1]	µg/L	0.1	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.003	0.005
Sodium (total) [1]	mg/L		4.49	2.14	2.12	<0.02	8.02	9.1	7.02	6.23
Strontium (total) [1]	µg/L		18.7	11.4	11.2	<0.15	22.2	24.9	20.7	18.8
Sulphate	mg/L		3.9	1.9	1.9	<0.2	6.3	8.6	5.1	5.2
Thallium (total) [1]	µg/L	0.8	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.006	<0.02
Tin (total) [1]	µg/L		0.07	0.02	<0.02	<0.02	0.02	<0.02	0.01	<0.01
Turbidity	NTU	15	4.1	2.4	2.4	<0.1	1.7	1.6	1.1	3.1
Uranium (total) [1]	µg/L		0.088	0.077	0.075	<0.005	0.073	0.076	0.072	0.076
Vanadium (total) [1]	µg/L		0.38	0.33	0.31	<0.02	0.34	0.33	0.268	0.344
Zinc (total) [1]	µg/L	33[3]	55.1	6.9	2.6	<0.2	5.7	3.1	1.85	1.79

Notes:

µg/L - microgram per litre; mg/L - milligrams per litre; $CaCO_3$ - calcium carbonate; µS/cm - microSiemens per centimetre; NTU - nephelometric turbidity units; RepT – temporal replicate sample; FB – field blank

Highlighted cells indicates exceedances.

[1]Measured as total recoverable.

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

[3]Calculated guideline value, CCME and BC MOE.

[4]OMOE, 1994.

Table 4: Results of grab samples collected at St. Croix River at Forest City in 2019

St. Croix River at Forest City (NB01AR0151)										
Analyte	**Units**	**Guideline[2]**	**Feb 14**	**Apr 24**	**Jun 19**	**Aug 12**	**Aug 12**	**Aug 12**	**Sep 25**	**Nov 19**
							RepT	FB		
Alkalinity, total $CaCO_3$	mg/L		11.1	10.1	10.3	10.2	10.2	<1	10.5	10.6
Aluminum (total)[1]	µg/L	100	9.1	16.4	17	14.8	15.2	<1.5	12.8	8.9
Antimony (total)[1]	µg/L		0.03	0.03	0.03	0.03	0.03	<0.02	0.03	0.03
Arsenic (total)[1]	µg/L	5	0.25	0.21	0.23	0.24	0.24	<0.02	0.229	0.21
Barium (total)[1]	µg/L		1.8	1.5	1.8	1.8	1.7	<0.1	1.9	1.7
Beryllium (total)[1]	µg/L		<0.005	0.005	<0.005	<0.005	<0.005	<0.005	0.004	0.003
Boron (total)[1]	µg/L		3	2	2	2	2	<1	2.3	4
Cadmium (total)[1]	µg/L	0.04[3]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005
Calcium (total)[1]	mg/L		4.07	3.98	4.18	4	3.99	<0.01	4.49	4.07
Carbon, total organic	mg/L		3.47	3.37	3.88	4.28	4.2	<0.25	3.76	3.29
Chloride	mg/L	120	1.7	1.6	1.8	1.8	1.8	<0.2	1.8	1.7
Chromium (total)[1]	µg/L	8.9	0.06	0.05	0.06	0.11	0.06	<0.02	0.055	0.05
Cobalt (total)[1]	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01
Colour, apparent	Colour units		13	14	16	17	17	<5	15	13
Conductivity	µS/cm		33.1	30.1	31.5	32	32.4	0.9	31	31.9
Copper (total)[1]	µg/L	2[3]	0.3	0.3	0.3	0.2	0.2	<0.1	0.28	0.2
Hardness (calculated)	mg/L		12.6	12.2	12.7	12.1	12.2		13.6	12.5
Iron (total)[1]	µg/L	300	23.5	18.4	15.9	18.6	19.1	<0.5	14.1	16.3
Lead (total)[1]	µg/L	1[3]	0.06	<0.03	<0.03	<0.03	<0.03	<0.03	0.02	<0.01
Magnesium (total)[1]	mg/L		0.573	0.538	0.542	0.512	0.527	<0.001	0.573	0.546
Manganese (total)[1]	µg/L	73	5.1	4.2	3.5	5.6	5.7	<0.2	5.3	5.7
Molybdenum (total)[1]	µg/L		0.06	0.07	0.05	0.05	0.05	<0.02	<0.15	<0.15
Nickel (total)[1]	µg/L	25[3]	0.12	0.13	0.15	0.13	0.14	<0.05	0.133	0.12
Nitrate as N	mg/L	2.9	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.02
Nitrogen, total	mg/L		0.16	0.18	0.19	0.2	0.023	<0.02	0.18	0.17
pH	pH	6.5 - 9.0	7.22	7.23	7.35	7.3	7.26	5.48	7.32	7.29
Phosphorus, total	mg/L	0.03[4]	0.004	0.005	0.007	0.005	0.005	<0.002	0.006	0.005
Potassium (total)[1]	mg/L		0.29	0.26	0.23	0.25	0.26	<0.05	0.23	0.24
Selenium (total)[1]	µg/L	1	0.05	0.04	0.04	0.04	0.04	<0.03	0.053	0.042
Silver (total)[1]	µg/L	0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	0.002
Sodium (total)[1]	mg/L		1.5	1.34	1.42	1.41	1.41	<0.02	1.65	1.52
Strontium (total)[1]	µg/L		23	20.7	22.6	22.3	22.5	<0.15	21.3	21.8
Sulphate	mg/L		1.6	1.6	1.5	1.5	1.5	<0.2	1.6	1.6
Thallium (total)[1]	µg/L	0.8	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.006	<0.006
Tin (total)[1]	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01
Turbidity	NTU	15	0.4	0.4	0.4	0.5	0.5	<0.1	0.5	0.7
Uranium (total)[1]	µg/L		0.021	0.025	0.024	0.023	0.023	<0.005	0.024	0.021
Vanadium (total)[1]	µg/L		0.05	0.05	0.05	0.07	0.07	<0.02	0.066	0.06
Zinc (total)[1]	µg/L	33[3]	1	4.1	0.9	<0.2	0.2	<0.2	0.17	0.23

Notes:

µg/L - microgram per litre; mg/L - milligrams per litre; $CaCO_3$ - calcium carbonate; µS/cm - microSiemens per centimetre; NTU - nephelometric turbidity units; RepT – temporal replicate sample; FB – field blank

Highlighted cells indicates exceedances.

[1]Measured as total recoverable.

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

[3]Calculated guideline value, CCME and BC MOE

[4]OMOE, 1994.

APPENDIX 6

MILLTOWN FISH DATA

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

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

(bold = 7-day peak)

YEARS >>>	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Apr 14 - Apr 29	--	--	--	--	--	--	--	--	--	--
Apr 30 - May 2	--	0	0	0	0	5,460	0	0	0	0
May 3 - May 9	--	0	0	0	0	16,410	9,400	24,410	0	29,690
May 10 - May 16	7,510	32,160	16,970	6,000	0	75,150	171,500	468,750	0	305,370
May 17 - May 23	47,450	64,120	**44,050**	40,300	70,000	429,400	559,500	760,280	200,610	319,380
May 24 - May 30	47,770	**74,800**	33,760	**67,100**	**149,890**	**772,800**	**674,700**	**764,990**	**464,390**	**411,090**
May 31 - Jun 6	**48,310**	56,930	20,770	26,200	96,740	628,300	645,300	370,750	424,550	141,490
Jun 7 - Jun 13	16,000	4,610	35,650	13,300	26,900	57,200	480,400	187,800	63,940	132,030
Jun 14 - Jun 20	1,760	250	620	0	21,040	0	83,900	13,770	11,370	0
Jun 21 - Jun 27	790	210	0	0	1,060	0	0	0	0	0
Jun 28 - Jul 4	30	20	0	0	3,270	0	0	0	0	0
Jul 5 - Jul 11	0	1	130	0	0	0	0	0	0	0
Jul 12 - Jul 18	0	1	0	0	0	0	0	0	0	0
Jul 19 - Jul 25	0	0	2	0	0	0	0	0	0	0
Jul 26 - later			0	0	0	0	0	0	0	0
Escapement	169,620	233,102	151,952	152,900	368,900	1,984,720	2,624,700	2,590,750	1,164,860	1,339,050
Harvest	0	0	0	0	0	0	0	0	0	192,200
Total	**169,620**	**233,102**	**151,952**	**152,900**	**368,900**	**1,984,720**	**2,624,700**	**2,590,750**	**1,164,860**	**1,531,250**

YEARS >>>	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Apr 14 - Apr 29	--	--	--	--	--	--	--	--	--	--
Apr 30 - May 2	0	0	0	0	0	0	0	0	0	0
May 3 - May 9	170	0	0	0	0	2,814	0	0	0	**3,966**
May 10 - May 16	14,740	8,910	0	0	5,898	11,178	0	**77,394**	195	142
May 17 - May 23	133,820	**74,120**	12,000	94,304	**109,388**	202,188	**122,478**	25,705	5,933	2,011
May 24 - May 30	**154,560**	45,520	**146,600**	99,150	99,847	188,538	93,000	71,534	**13,615**	377
May 31 - Jun 6	51,110	24,780	102,800	**125,900**	50,946	**231,870**	4,091	2,684	5,476	2,067
Jun 7 - Jun 13	4,010	50,420	2,260	15,400	0	9,390	5,951	0	108	6
Jun 14 - Jun 20	0	0	26,060	0	0	0	0	0	0	0
Jun 21 - Jun 27	0	0	0	0	0	0	0	0	0	0
Jun 28 - Jul 4	0	0	0	0	0	0	0	0	0	0
Jul 5 - Jul 11	0	0	0	0	0	0	0	0	0	0
Jul 12 - Jul 18	0	0	0	0	0	0	0	0	0	0
Jul 19 - Jul 25	0	0	0	0	0	0	0	0	0	0
Jul 26 - later	0	0	0	0	0	0	1	0	0	0
Escapement	358,410	203,750	289,720	334,754	266,079	645,978	225,521	177,317	25,327	8,569
Harvest	228,500	0	8,000	15,400	8,000	0	0	0	0	0

Total	586,910	203,750	297,720	350,154	274,079	645,978	225,521	177,317	25,327	8,569

YEARS >>>	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Apr 14 - Apr 29	--	--	--	--	--	--	--	--	--	--
Apr 30 - May 2	0	0	0	0	0	0	--	--	--	--
May 3 - May 9	0	2	0	0	0	18	0	0	0	0
May 10 - May 16	160	6	3	0	0	577	0	4	1	9,748
May 17 - May 23	505	23	603	0	2	3,111	0	33	12	**17,731**
May 24 - May 30	**2,625**	325	2,115	0	20	**3,155**	2	119	3,740	17,008
May 31 - Jun 6	1,735	**494**	**3,163**	0	5,277	2,540	0	**11,797**	42	8,520
Jun 7 - Jun 13	123	35	999	**951**	**6,220**	1,096	**1,225**	61	2	4,700
Jun 14 - Jun 20	54	15	1,018	108	113	1,227	66	23	**6,627**	1,126
Jun 21 - Jun 27	0	0	0	79	0	105	1	221	26	255
Jun 28 - Jul 4	0	0	--	150	--	--	--	3	0	45
Jul 5 - Jul 11	0	0	--	11	--	--	--	--	--	9
Jul 12 - Jul 18	0	0	--	0	--	--	--	--	--	3
Jul 19 - Jul 25	0	0	--	0	--	--	--	--	--	--
Jul 26 - later	0	0	--	0	--	--	--	--	--	--
Escapement	5,202	900	7,901	1,299	11,632	11,829	1,294	12,261	10,450	59,145
Harvest	0	0	0	0	0	0	0	0	0	0
Total	**5,202**	**900**	**7,901**	**1,299**	**11,632**	**11,829**	**1,294**	**12,261**	**10,450**	**59,145**

YEARS >>>	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apr 14 - Apr 29	--	--	--	--	--	0	--	0		
Apr 30 - May 2	--	--	--	--	0	0	0	0	--	
May 3 - May 9	0	993	342	0	0	0	0	5	60	
May 10 - May 16	1,657	343	362	7	16	125	369	13,028	417	
May 17 - May 23	**13,053**	**22,260**	178	16	126	269	29,946	43,260	13	
May 24 - May 30	1,227	11,190	**10,542**	29	**32,637**	**14,304**	**44,110**	**130,538**	63,941	
May 31 - Jun 6	7,750	1,175	5,107	**19,971**	16,875	12,781	42,406	43,657	252,631	
Jun 7 - Jun 13	1,387	197	37	6,775	27,150	3,038	27,681	29,292	129,387	
Jun 14 - Jun 20	50	10	83	95	11,871	2,000	8,790	7,804	34,221	
Jun 21 - Jun 27	10	0	23	143	3,817	471	3,787	2,163	4,220	
Jun 28 - Jul 4	7	--	3	267	816	27	571	821	809	
Jul 5 - Jul 11	1	--	--	9	161	1	69	86	743	
Jul 12 - Jul 18	--	--	--	--	34	--	21	5	58	
Jul 19 - Jul 25	--	--	--	--	--	--	0	0	0	
Jul 26 - later	--	--	--	--	--	--	--	--		
Escapement	25,142	36,168	16,677	27,312	93,503	33,016	157,750	270,659	486,500	0
Harvest	0	0	0	0	0	0	0	0	0	0
Total	**25,142**	**36,168**	**16,677**	**27,312**	**93,503**	**33,016**	**157,750**	**270,659**	**486,500**	**0**

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

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

Note 3. **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 4. **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 5. **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.