International Niagara Board of Control

One Hundred Fortieth Semi-Annual Progress Report to the International Joint Commission

Covering the Period September 1, 2022 through February 28, 2023

Executive Summary

The level of Lake Erie began the reporting period with a September mean level at 27 cm (10.6 inches) above its 1918–2020 period-of-record long-term average level for the month. The level of Lake Erie remained above average on a monthly basis throughout the remainder of the reporting period. Water levels did recede over the course of the reporting period and the February mean water level was 35 cm (13.8 inches) above average (Section 2). While still well above average monthly levels, this is a reduction of 6 cm from the previous year when the February 2022 mean level was 41 cm (16.1 inches) above average.

The level of the Chippawa–Grass Island Pool (CGIP) is regulated under the International Niagara Board of Control's 1993 directive. The Power Entities—Ontario Power Generation (OPG) and the New York Power Authority (NYPA)—were able to comply with the board's directive during the reporting period (Section 3).

Gauges were operating normally during most of the reporting period to provide flow measurements over Niagara Falls. There were a few outages due to communications failures (Section 4).

During this reporting period, flow over Niagara Falls did not fall below the minimum Treaty requirements (Section 5).

During the period September 2022 through February 2023, the flow at Queenston averaged 6,254 m^3/s (220,860 cfs), which is 576 m^3/s (20,340 cfs) above the 1900-2021 average of 5,678 m^3/s (200,520 cfs). Monthly values ranged between 6,119 m^3/s (216,090 cfs) and 6,366 m^3/s (224,810 cfs) (Section 7).

Discharge measurements are regularly scheduled in the Niagara River and Welland Canal as part of a program to verify the gauge ratings used to determine flow in these channels for water management purposes. There were no regularly scheduled discharge measurements completed this reporting period. (Section 8).

Installation of the Lake Erie-Niagara River Ice Boom for the 2022-2023 ice season was initiated on December 16 and completed on December 21, 2022. NYPA requested authority to install a smaller ice boom of 21 spans as opposed to the typical 22 span ice boom this ice season due to safety concerns on the Canadian side of the ice boom. Sedimentation and/ or lower water levels have caused reduced draft in that area causing concern for grounding of the installation barge. A Supplemental Order of Approval for installation of a 21-span ice boom was issued by the IJC on December 20, 2022. Monitoring of conditions during the ice season and the performance of the 21-span ice boom is to be conducted by the Power Entities and INCW for discussion with the board. (Section 10).

The board held a virtual public webinar in August of 2022 with coordination from the two other International Great Lakes Boards. This webinar had good participation and the board will look to schedule another webinar-style meeting for the summer of 2023 (Section 12).

Table of Contents

List of Tables

List of Figures

Enclosures

<u>INTERNET SITES</u>

International Joint Commission
https://www.ijc.org/enInternati
onal Niagara Board of Control
English: https://ijc.org/en/nbc
French: https://ijc.org/fr/ccrn

Lake Erie-Niagara River Ice Boom
https://iceboom.nypa.gov/

INTERNATIONAL NIAGARA BOARD OF CONTROL

Cincinnati, Ohio
Burlington, Ontario

March 22, 2023

International Joint Commission
Washington, D.C.
Ottawa, Ontario

Commissioners:

1. General

The International Niagara Board of Control (the board) was established by the International Joint Commission (IJC) in 1953. The board provides advice to the IJC on matters related to the IJC's responsibilities for water levels and flows in the Niagara River. The board's main duties are to ensure the operation of the Chippawa-Grass Island Pool (CGIP) upstream of Niagara Falls within the limits of the board's 1993 directive and provide oversight of the operation of the Lake Erie-Niagara River Ice Boom at the outlet of Lake Erie. The board also collaborates with the International Niagara Committee (INC), a body created by the 1950 Niagara Treaty to determine the amount of water available for Niagara Falls and hydroelectric power generation.

The board is required to submit written reports to the IJC at its semi-annual meetings in the spring and fall of each year. In accordance with this requirement, the board herewith submits its One Hundred Fortieth Semi-Annual Progress Report, covering the reporting period September 1, 2022 to February 28, 2023.

All elevations in this report are referenced to the International Great Lakes Datum 1985 (IGLD 1985). Values provided are expressed in metric units, with approximate customary units (in parentheses) for information purposes only. Monthly Lake Erie water levels are based on a network of four gauges to better represent the average level of the lake.

2. Basin Conditions

The level of Lake Erie was above average throughout the reporting period. It began the reporting period with a September mean level at 27 cm (10.6 inches) above its 1918–2021 period-of-record long-term average level for the month. Between September and February, the monthly mean lake level on average lost 10 cm (4.0 inches), which is less than the average lake declines of 18 cm (7.4 inches) during this period. Lake Erie levels ended the reporting period with February mean water level 35 cm (13.8 inches) above average. Recorded monthly water levels for the period September 2022 through February 2023 are shown in Table 1 and depicted graphically in Figure 1. The following paragraphs provide more detail on the main factors that led to the water level changes observed on Lake Erie during the reporting period.

Table 1: Monthly average Lake Erie water levels based on a network of four water level gauges and the International Great Lakes Datum (1985).

	Meters			Feet		
Month	Recorded* 2022-2023	Average 1918-2021	Departure	Recorded* 2022-2023	Average 1918-2021	Departure
September	174.46	174.19	0.27	572.23	571.49	0.74
October	174.32	174.09	0.24	571.77	571.16	0.71
November	174.25	174.02	0.23	571.54	570.93	0.61
December	174.20	174.02	0.19	571.38	570.90	0.48
January	174.28	174.02	0.26	571.64	570.93	0.71
February	174.36	174.02	0.35	571.90	570.90	1.00

* Provisional

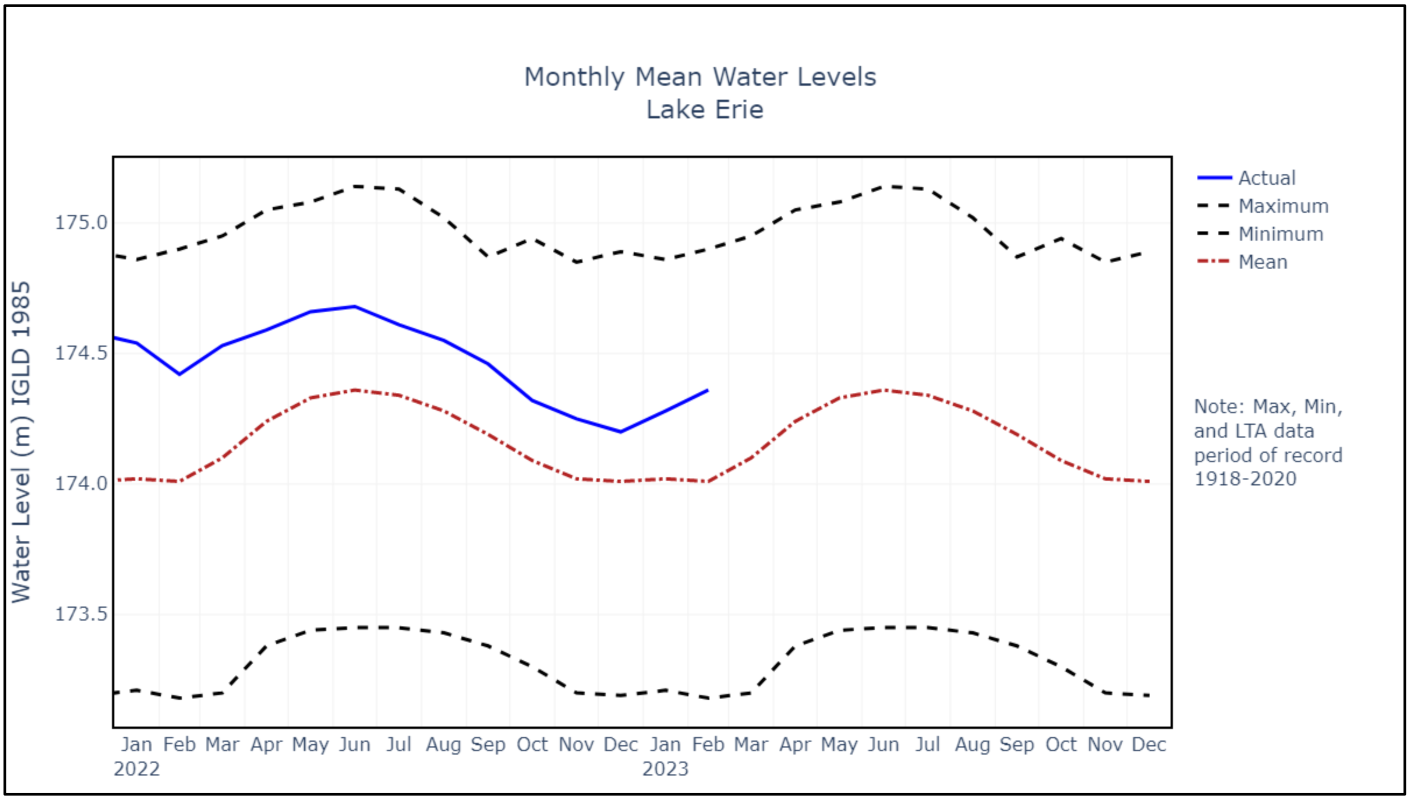


Figure 1: Lake Erie mean monthly and, long-term maximum, minimum and average water levels.

Lake Erie receives water from its local drainage basin and from upstream lakes. The water supplied to a lake from its local drainage basin is referred to as its net basin supply (NBS). A lake's NBS is the sum of the amount of water the lake receives from precipitation falling directly on its surface and runoff (including snow melt) from its surrounding land area, minus the amount of water that evaporates from its surface. The sum of Lake Erie's NBS and the inflow from Lake Michigan–Huron via the St. Clair-Detroit Rivers system is its net total supply (NTS).

Precipitation is a major contributor to NBS, both directly on the lake and through runoff due to rain and snowmelt. Recent precipitation data and departures from the long-term average are shown in Table 2 and depicted graphically in Figure 2. Overall, precipitation on the Lake Erie basin was lower than average forthe reporting period, with the basin receiving 33.4 cm (13.1 inches) of precipitation from September 2022 through February 2023, which is approximately 19% below average for the period. Precipitation was below average for the months of September, October, November, and December and above average for January and February.

Table 2: Monthly average precipitation on the Lake Erie basin.

	Centimeters				Inches			
Month	Recorded* 2022-2023	Average 1900-2017	Departure		Recorded* 2022-2023	Average 1900-2017	Departure	Departure (in percent)
September	5.57	8.20	-2.63		2.19	3.23	-1.04	-32
October	3.72	7.20	-3.48		1.46	2.83	-1.37	-48
November	4.55	7.30	-2.75		1.79	2.87	-1.08	-38
December	4.62	6.80	-2.18		1.82	2.68	-0.86	-32
January	7.33	6.30	1.03		2.89	2.48	0.41	16
February	7.58	5.30	2.28		2.98	2.09	0.89	43

* Provisional

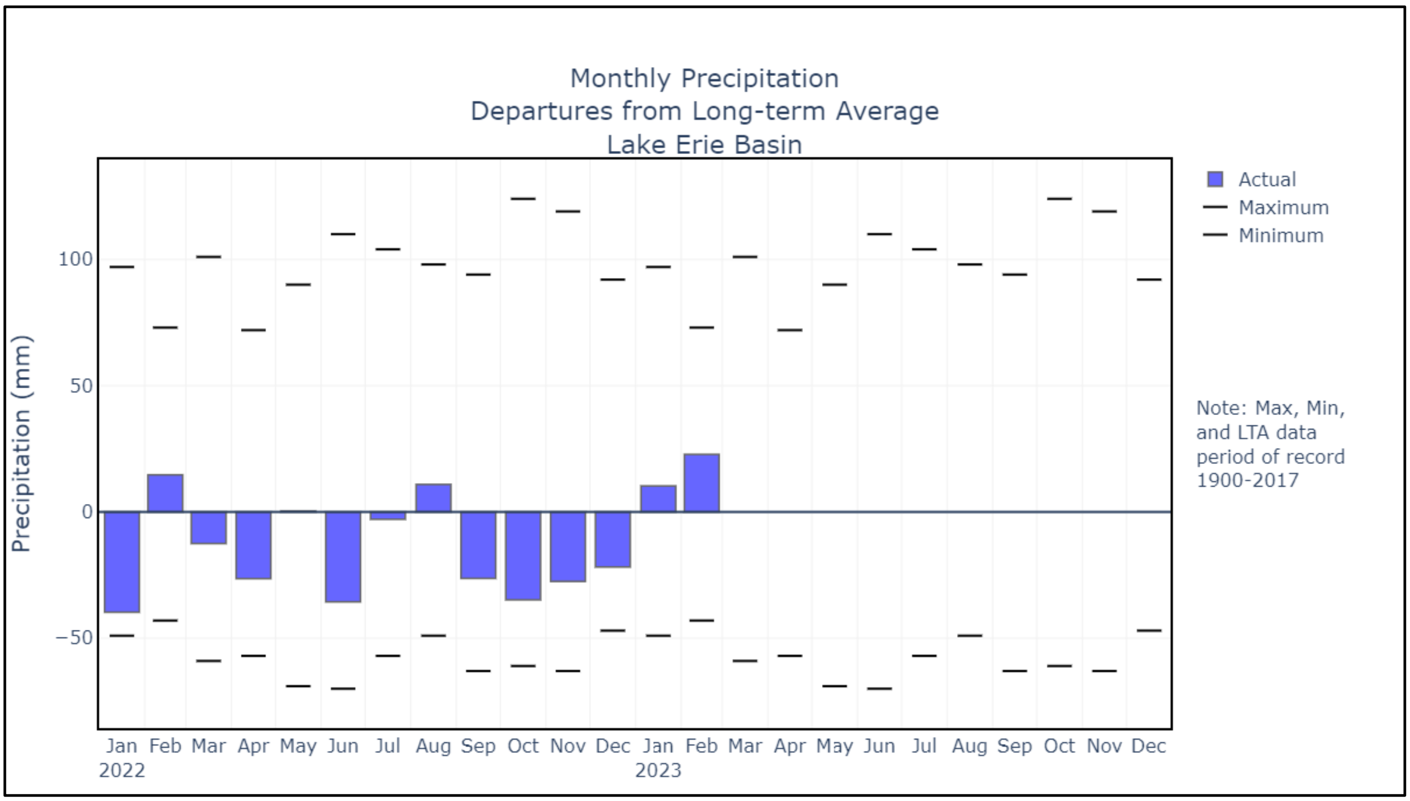


Figure 2: Monthly actual, maximum and minimum precipitation departures from the long-term average on Lake Erie basin.

The recent NBS to Lake Erie is shown relative to average on a monthly basis in Figure 3.

A negative NBS value indicates that more water left the lake during the month due to evaporation than entered it through precipitation and runoff. On Lake Erie, average NBS was negative from September through November. For the remainder of the reporting period, the lake's NBS was above average in December, January and February.

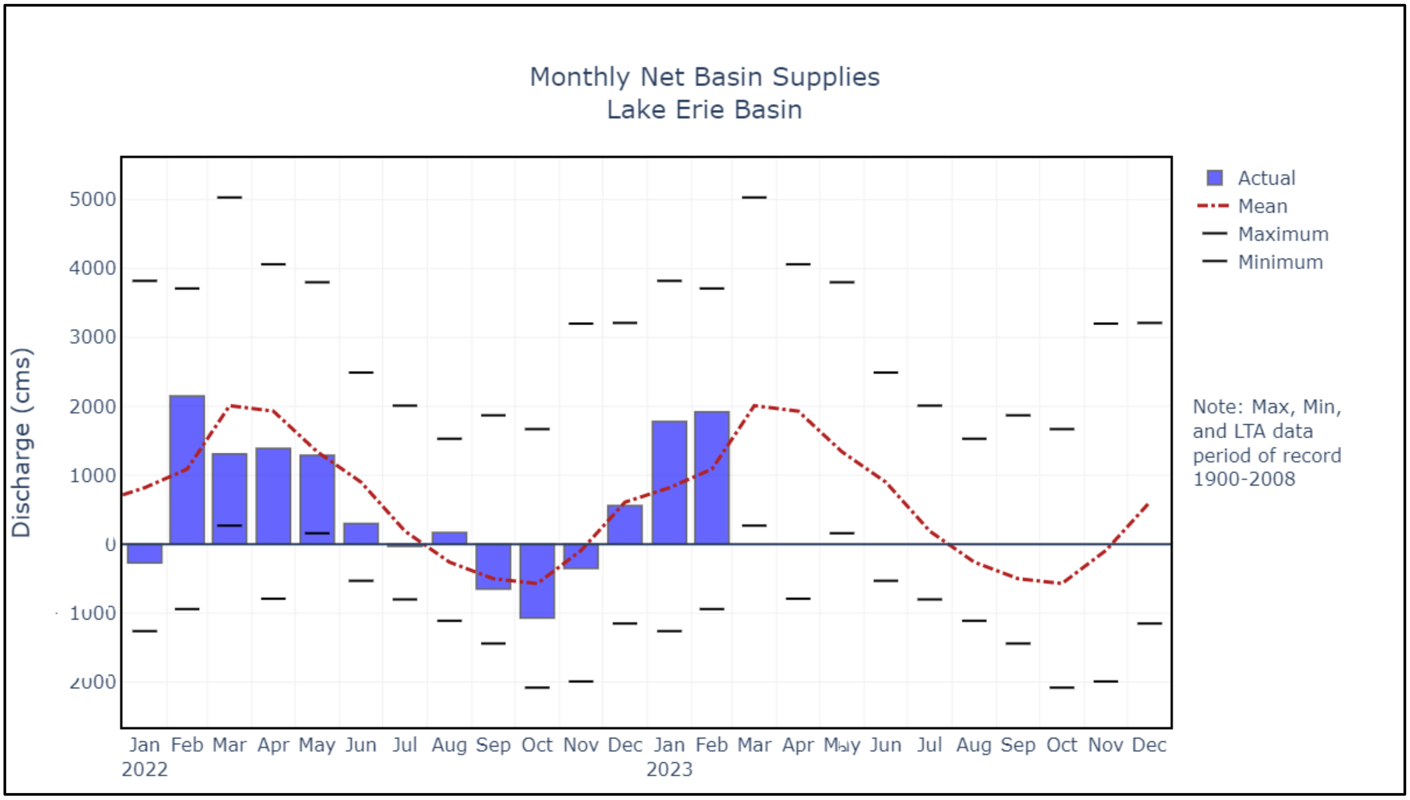


Figure 3: Mean monthly and long-term maximum, minimum and average net basin supplies on Lake Erie basin.

Inflow via the Detroit River is the major portion of Lake Erie's NTS, and is greatly influenced by the level of Lake Michigan–Huron. Continuing the trend from last reporting period, the level of Lake Michigan–Huron has continued to move closer to the long-term average and down from the high levels observed over the years 2019-2021. The monthly mean water level on Lake Michigan–Huron and the monthly mean flow in the Detroit River are provided in Figures 4 and 5, respectively.

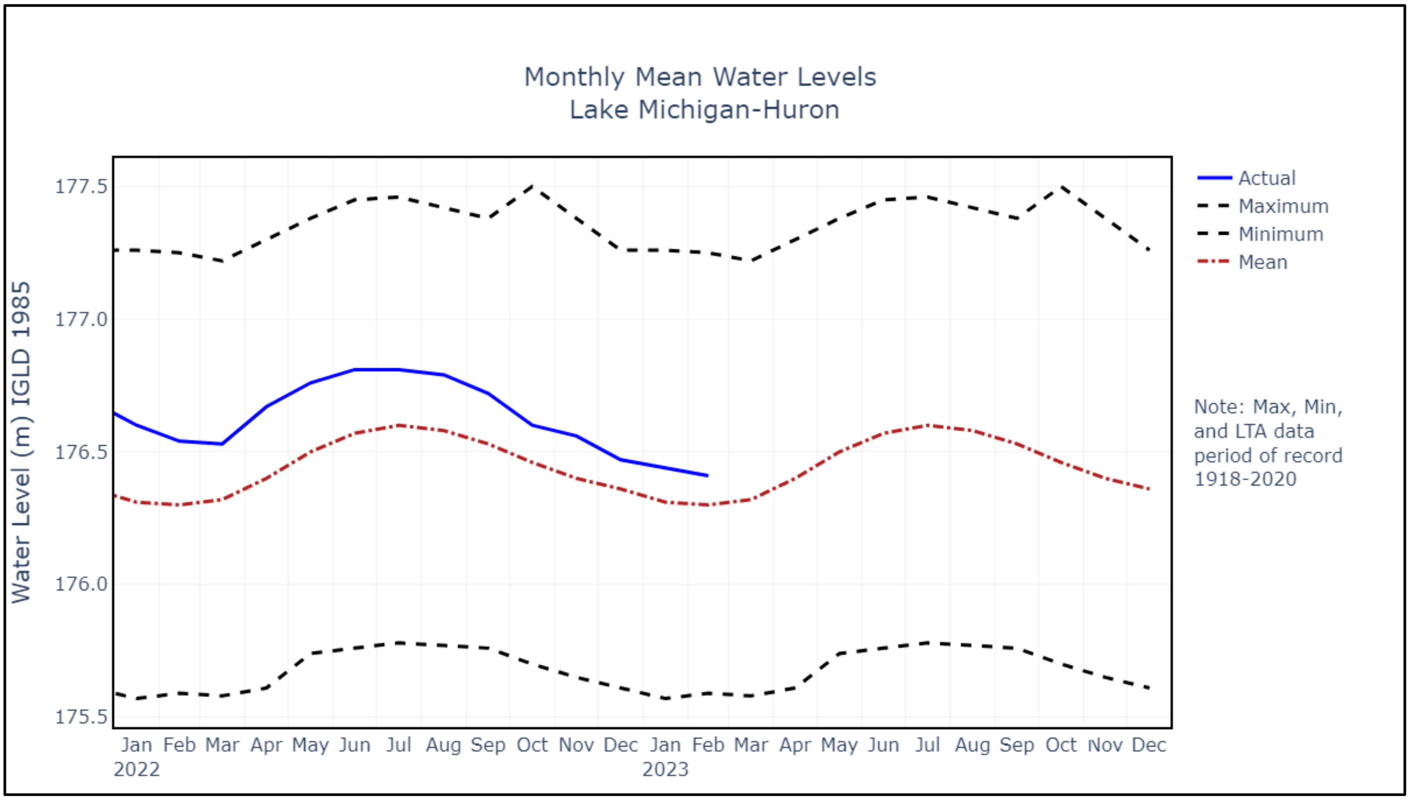


Figure 4: Lake Michigan-Huron mean monthly, and long-term maximum, minimum and average water levels.

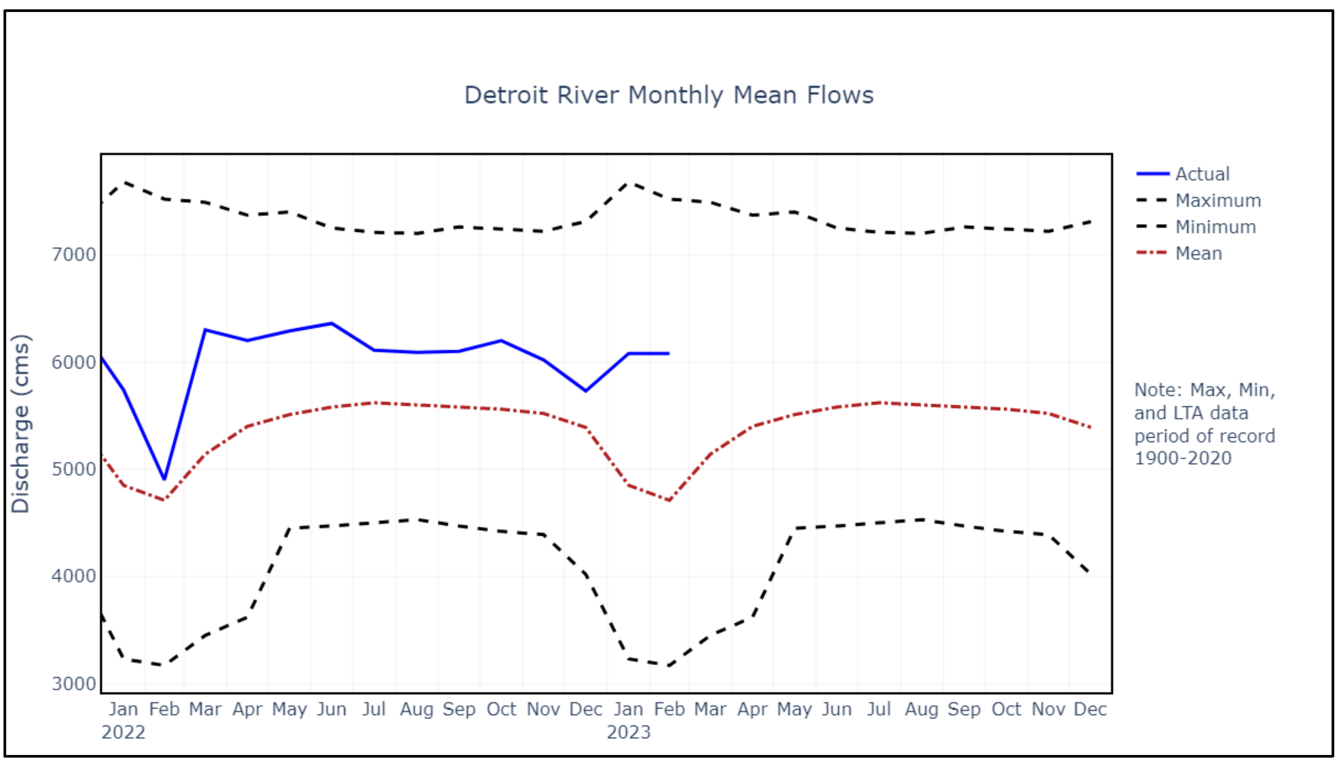


Figure 5: Detroit River mean monthly and long-term average flows.

High inflows from Lake Michigan–Huron via the Detroit River combined with Lake Erie's NBS, resulted in above-average NTS throughout the reporting period. The recent NTS to Lake Erie is depicted relative to average in Figure 6.

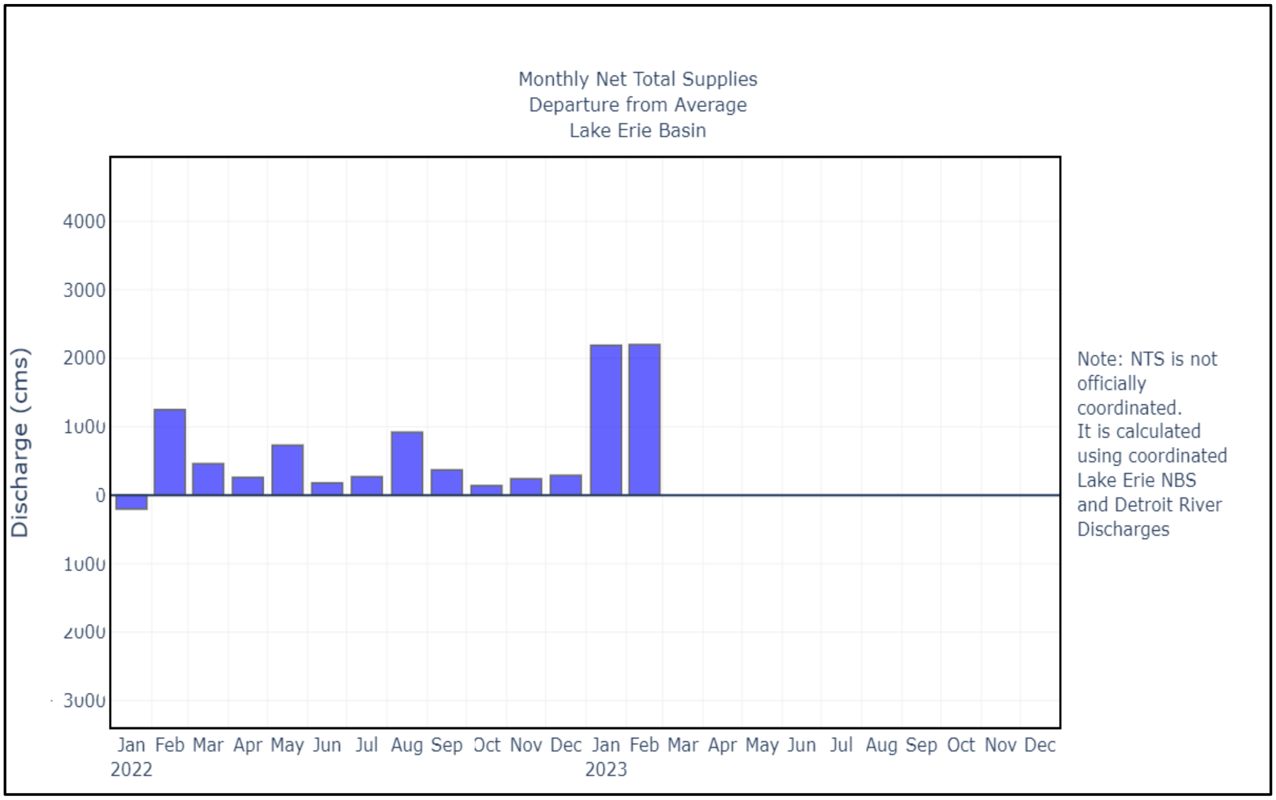


Figure 6: Lake Erie basin monthly net total supplies difference from the long-term average.

Lake Erie discharges water to Lake Ontario through the Niagara River and the Welland Canal. The portion of Lake Erie outflow that is diverted through the Welland Canal is relatively small, about 4 to 5% of the total Lake Erie outflow, and is used for navigation purposes through the canal and generation of electricity at Ontario Power Generation's (OPG's) DeCew hydroelectric plants. Most of the outflow from Lake Erie occurs through the Niagara River and depends on the level of the lake at its outlet. Generally speaking, above-average lake levels result in above-average outflow, and below-average lake levels lead to below-average outflow. Flow in the river is also influenced by ice during the winter and aquatic plant growth during the summer, both of which can reduce the flow. Additionally, seasonal trends in prevailing winds typically raise levels at the eastern end of

Lake Erie relative to levels at the western end and the lake's average level. Recent monthly outflow via the Niagara River is graphically depicted in Figure 7. The lake's above-average water level conditions from September 2022 through February 2023 resulted in Niagara River flow at Buffalo also being above average during those months. Flows ranged from 7,410 m^3/s (261,700 cfs) to 5,680 m^3/s (200,600 cfs) (Figure 7) due to above average levels on Lake Erie.

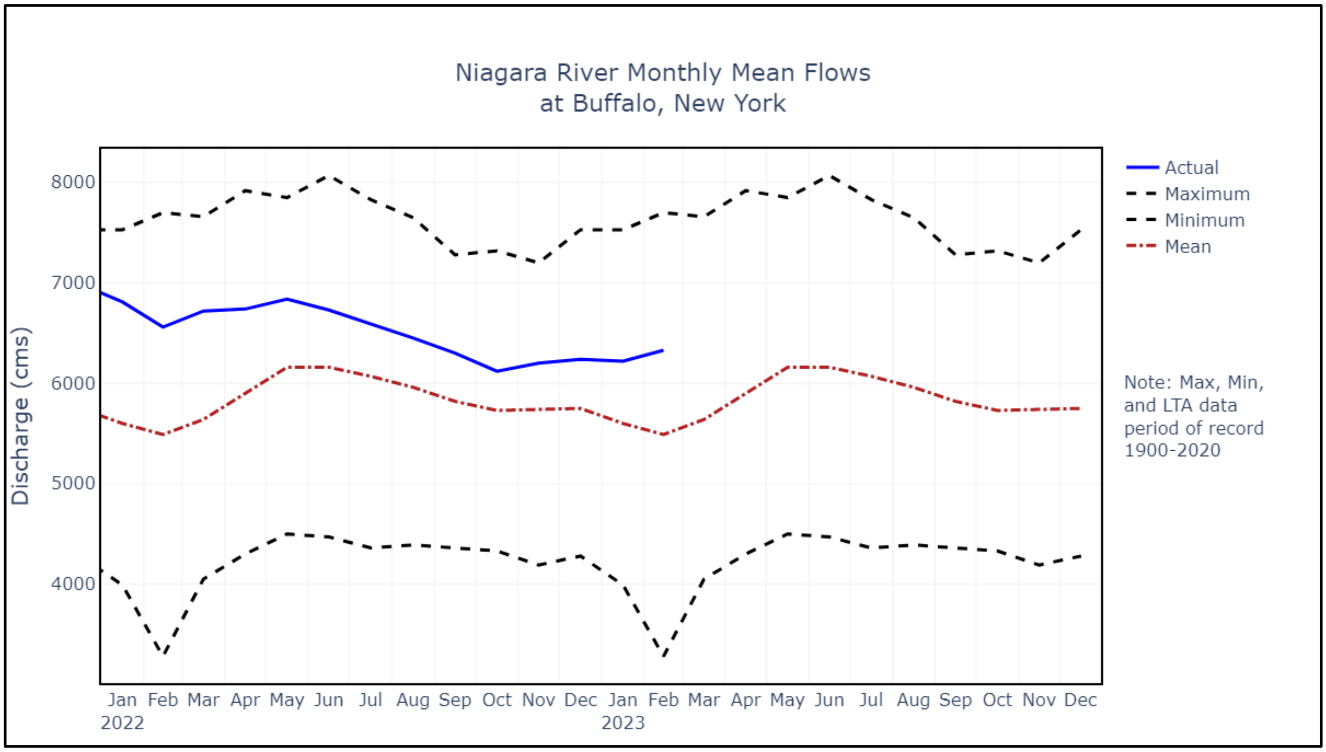


Figure 7: Niagara River mean monthly and long-term average flows at Buffalo, New York.

The six-month water level forecast prepared at the beginning of March by the U.S. Army Corps of Engineers (USACE) and Environment and Climate Change Canada (ECCC) indicates that Lake Erie water levels will likely remain above average throughout the spring and summer. This forecast is made using historical water supplies and current lake levels, and it should be noted that the accuracy of this prediction is limited and actual conditions could vary from the prediction.

3. Operation and Maintenance of the International Niagara Control Works

Water levels in the CGIP are regulated in accordance with the board's 1993 directive (revised 2017). The directive requires that the Power Entities– OPG and the New York Power Authority (NYPA)–operate the International Niagara Control Works (INCW) to ensure the maintenance of an operational long-term average CGIP level of 171.16 m (561.55 feet) to reduce adverse high or low water levels in the CGIP. The Directive also establishes tolerances for the CGIP's level as measured at the Material Dock gauge.

The accumulated deviation of the CGIP's level from March 1, 1973, through February 28, 2023, was -0.07 meter-months below the long-term operational average elevation. The accumulated deviation was within the maximum permissible accumulated deviation of ±0.91 metre-months for this reporting period.

Tolerances for regulation of the CGIP were suspended on a number of occasions for ice, and abnormally high flows during the reporting period. Ice suspensions occurred on February 4, 10-11 (3 days). Suspensions for abnormally high flows occurred on November 30- December 1 and December 23-25 (5 days).

Tolerances were also suspended for emergency or rescues on September 24-25 (2 days), October 30-31 (2 days), November 16-17 (2 days), and February 21 (1 day).

The locations of the water level gauges on the Niagara River are shown in Enclosure 1. Recorded daily Material Dock water levels covering the reporting period are shown in Figure 8.

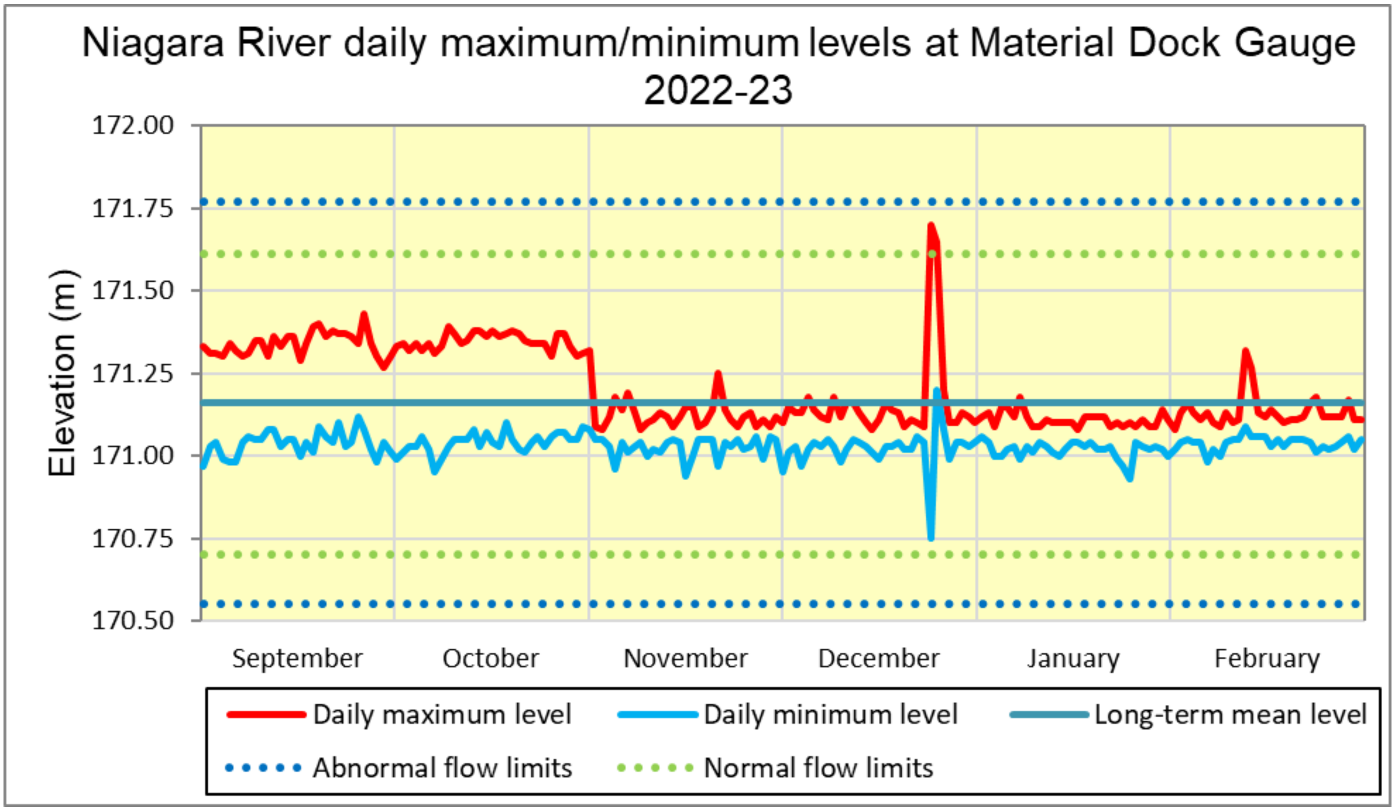


Figure 8: Niagara River daily maximum and minimum water levels at Material Dock gauge from September 2022 through February 2023.

4. Gauging Stations

The Fort Erie, Material Dock and Ashland Avenue gauges (as shown in Enclosure 1) are used to determine flows in the Niagara River, monitor the CGIP levels and monitor the flow over Niagara Falls. The Buffalo, Slater's Point, and U. S. National Oceanic and Atmospheric Administration (NOAA) Ashland Avenue gauges are used as alternatives in the event of primary gauge failure. The Slater's Point and Material Dock gauges are owned and operated by the Power Entities. NOAA and the Power Entities own and operate water level gauges at the Ashland Avenue location. All gauges required for the operation of the INCW were in service during this reporting period, with the following exceptions. The Frenchman's Creek gauge was out from October 9, 2022, at 9:13 AM to October 16, 2022, at 9:00 PM due to a communications failure.

5. Flow over Niagara Falls

The International Niagara Treaty of 1950 sets minimum limits on the flow of water over Niagara Falls. During the tourist season (April-October) daytime hours, the required minimum Niagara Falls flow is 2,832 cubic metres per second (m^3/s) (100,000 cubic feet per second (cfs)). At night and at all times during the non-tourist season months (November-March), the required minimum Falls flow is 1,416 m^3/s (50,000 cfs). Appropriate operation of the INCW, in conjunction with power diversion operations, maintains sufficient flow over the Falls to meet the requirements of the 1950 Niagara Treaty. During this reporting period, there were no flow violations and flows over Niagara Falls did not fall below the minimum Treaty requirements. The recorded daily flow over Niagara Falls, covering the period September 2022 through February 2023, is shown in Figure 9.

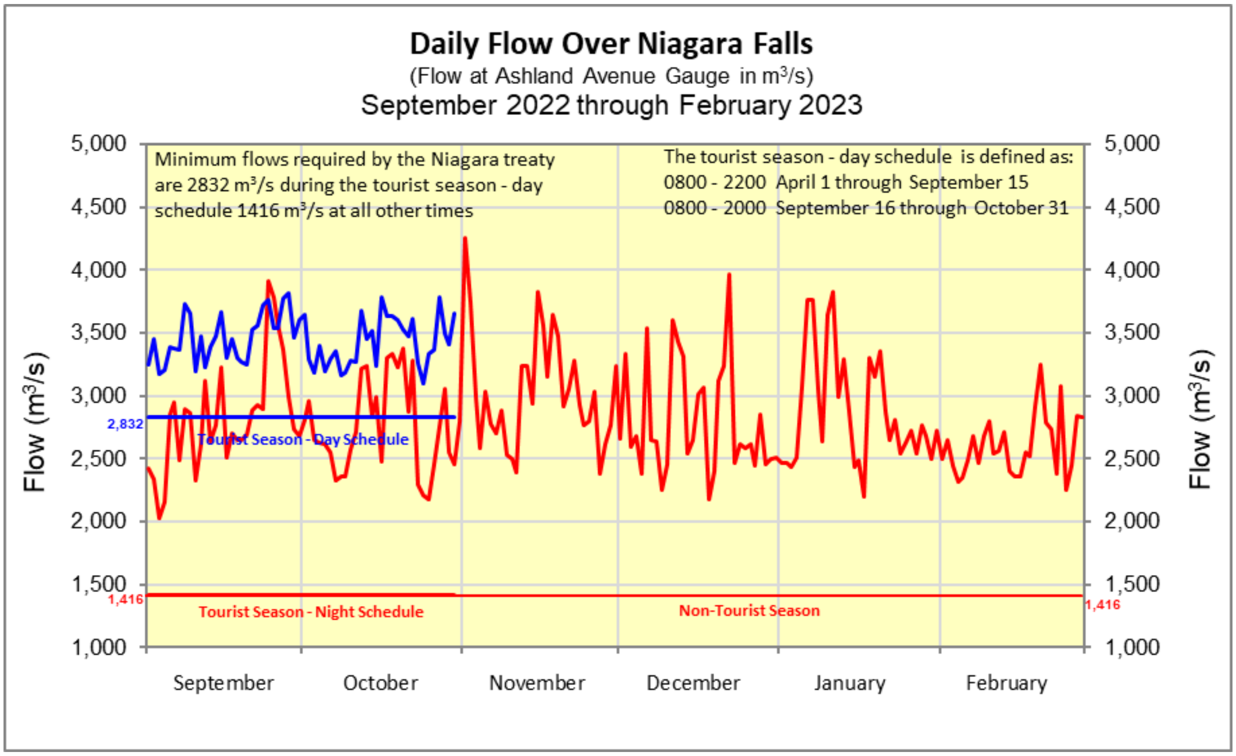


Figure 9: Daily flow over Niagara Falls (flow at Ashland Avenue in m^3/s from September 2022 through February 2023).

6. Falls Recession

As per article 2.B.b of the Niagara Board's Directive from the IJC, the board monitors the Horseshoe Falls for changes in its crestline that might result in a broken curtain of water along its crestline or suggest the formation of a notch in the crestline. The formation of a notch could signal a period of rapid Falls recession that has not been seen in more than a century. The review of recently available imagery suggests that no notable changes in the crestline of the Falls have occurred.

7. Diversions and Flow at Queenston

Diversion of water from the Niagara River for power purposes is governed by the terms and conditions of the 1950 Niagara Treaty. The Treaty prohibits the diversion of Niagara River water that would reduce the flow over Niagara Falls for scenic purposes to below the amounts specified previously in Section 5 of this report. The hydroelectric power plants, OPG's Sir Adam Beck (SAB) I and II in Canada and NYPA's Robert Moses Niagara Power Project in the United States, withdraw water from the CGIP upstream of Niagara Falls and discharge it into the lower Niagara River at Queenston, ON and Lewiston, NY, respectively. During the period of September 2022 through February 2023, diversion to the SAB I and II plants averaged 1,674 m^3/s (59,120 cfs) and diversion to the Robert Moses Niagara Power Project averaged 2,169 m^3/s (76,600 cfs).

Diversion from the canal to OPG's DeCew Falls Generating Stations averaged 200.9 m^3/s (7,100 cfs) for the period September 2022 through February 2023.

Records of diversions for power generation covering the period September 2022 through February 2023 are shown in Figure 10.

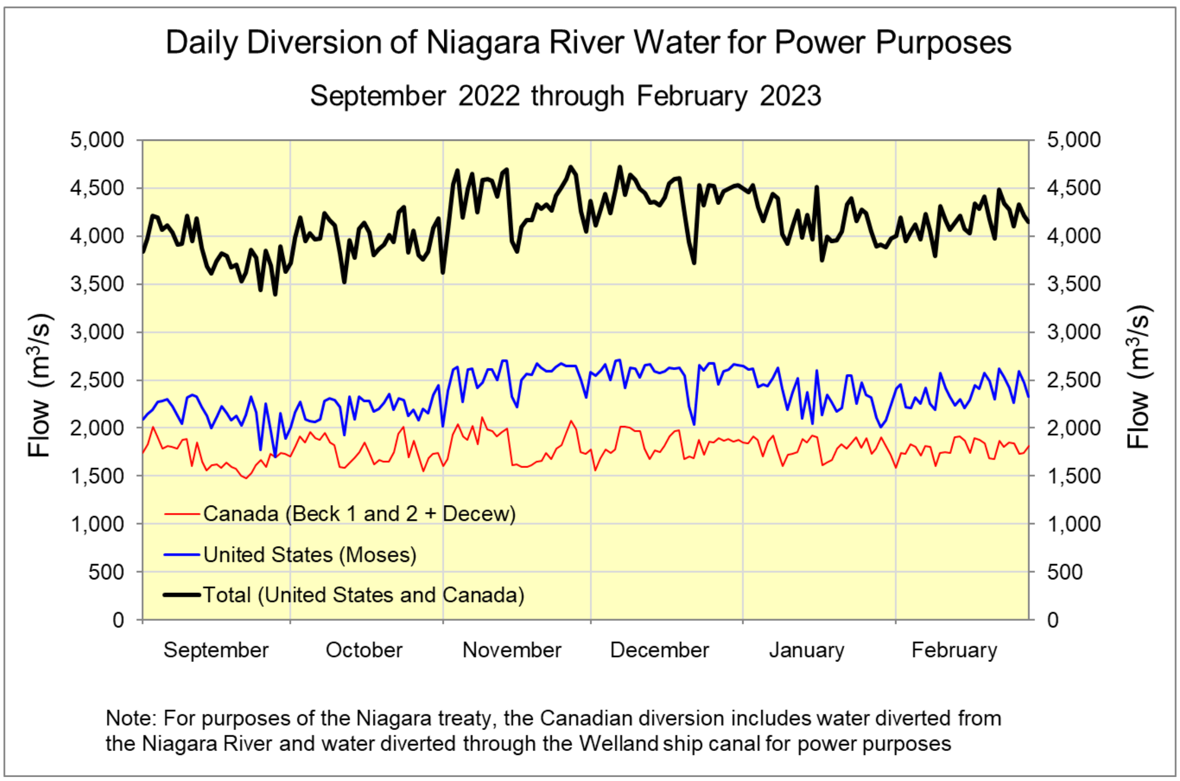


Figure 10: Daily diversion of Niagara River water for power purposes.

The monthly average Niagara River flows at Queenston, Ontario, for the period September 2022 through February 2023, and departures from the 1900–2021 long-term average are shown in Table 3. Maximum and minimum monthly average flows for the 1900–2021 period of record are shown in Table 4. During the period September 2022 through February 2023, the flow at Queenston averaged 6,254 m^3/s (220,860 cfs), which is 576 m^3/s (20,340 cfs) above the 1900-2021 average of 5,678 m^3/s (200,520 cfs). Monthly values ranged between 6,119 m^3/s (216,090 cfs) and 6,366 m^3/s (224,810 cfs) (Section 7).

Table 3: Monthly Niagara River flows at Queenston.

	Cubic Meters per Second			Cubic Feet per Second		
Month	Recorded 2022-2023	Average 1900-2021	Departure	Recorded 2022-2023	Average 1900-2021	Departure
September	6313	5775	538	222,940	203,940	19,000
October	6119	5700	419	216,090	201,290	14,800
November	6191	5725	466	218,630	202,180	16,450
December	6282	5759	523	221,850	203,380	18,470
January	6257	5607	650	220,960	198,010	22,950
February	6366	5502	864	224,810	194,300	30,510
Average	6254	5678	576	220,860	200,520	20,340

Table 4: Monthly maximum and minimum Niagara River flows at Queenston.

	Maximum Flows			Minimum Flows		
Month	Year	m^3/s	ft^3/s	Year	m^3/s	ft^3/s
September	2019	7274	256,880	1934	4340	153,270
October	1986	7220	254,970	1934	4320	152,560
November	2019	7228	255,250	1934	4190	147,970
December	1985	7410	261,680	1964	4270	150,790
January	2020	7593	268,140	1964	3960	139,850
February	2020	7751	273,720	1936	3320	117,240

8. Flow Measurements in the Niagara River and Welland Canal

Discharge measurements are regularly scheduled in the Niagara River and Welland Canal as part of a program to verify the gauge ratings used to determine flow in these channels for water management purposes. Measurements are obtained through joint efforts of the USACE and ECCC. Measurement programs require boats, equipment and personnel from both agencies to ensure safety, quality assurance checks between equipment and methods, and bi-national acceptance of the data collected. The USACE and ECCC continue efforts to standardize measurement equipment and techniques. Historically, measurements were made at several locations as described below.

Upper Niagara River: Regularly scheduled measurements are taken near the International Railway Bridge, located in the Upper Niagara River, on a 3-year cycle to provide information to evaluate stage-discharge relationships for flow entering the Niagara River from Lake Erie. The regularly scheduled discharge measurements near the International Railway Bridge were taken in May 2022. These measurements support the stage-discharge relationship known as the Buffalo rating equation, due to the use of water level data from the Buffalo NOAA gauge. The Buffalo rating equation is used in the Great Lakes water supply routing models to estimate the flow in the Niagara River.

Lower Niagara River: Discharge measurements are made on a 3-year cycle at the Ashland Avenue Gauge Rating Section, located just upstream of the OPG and NYPA hydroelectric generating stations at Queenston–Lewiston, to verify the 2009 Ashland Avenue gauge rating of the outflow from the Maid-of-the-Mist Pool below the Falls. The Ashland Avenue gauge rating is used to determine the flow over Niagara Falls for purposes of the 1950 Niagara Treaty. Measurements taken in September 2019 have been compiled in a final report. The next measurements at this location have been delayed due to logistics and lingering COVID related restrictions and are currently scheduled for 2023. This set of measurements has been coordinated between ECCC, USACE and the Power Entities.

American Falls Channel: Discharge measurements are made in the American Falls Channel on a 5-year cycle to verify the rating equation used to determine the amount of flow in the American Falls channel and to demonstrate that a dependable and adequate flow of water is maintained over the American Falls and in the vicinity of Three Sisters Islands as required by the IJC directive to the board. Since the American Falls flow is directly related to the operation of the CGIP, the board monitors this relationship. The measurements are made using a section near the upper reach of the American Falls channel near the American Falls Gauge site. Following the 5-year cycle, the next scheduled measurements at this location are delayed pending acquisition of new measuring equipment.

Welland Canal: Discharge measurements are made on a 3-year cycle in the Welland Supply Canal above Weir 8 to verify the index-velocity rating for the permanently installed Acoustic Doppler Velocity Meter (ADVM), which are used in the determination of flow through the Welland Canal. Measurements were made in the Welland Supply Canal in December 2021. The next measurement series in the Welland Supply Canal will take place in fall of 2024.

9. Power Plant Upgrades

OPG is continuing a unit rehabilitation program which began at the Sir Adam Beck plant 1 in 2007. The G5 overhaul is complete and Interim Unit Rating Table (URT) was developed and approved. The Gibson test for unit G5 was completed in April 2022. The G4 overhaul is scheduled for 2025-2026. The unit G1 and G2 frequency conversion requires a new URT which was submitted 22 September 2021. Gibson testing for units G1 and G2 is scheduled for March and April of 2023. Sir Adam Beck plant 2 overhaul is scheduled to begin in May 2025. PG5 overhaul was completed in November 2022. PG3 overhaul is ongoing with return to service expected in Oct 2028. PG1 overhaul will commence April 2025 and is scheduled for completion in February 2026. The DeCew Falls 2 G1 unit is scheduled for a runner and shaft replacement in 2023 - 2024.

OPG is in the process of replacing the existing Water Record Accounting (WRA) system for the SAB and DeCew GS. The Kisters WISKI product will be used and is expected to be in operation in late 2023. Through careful planning and understanding of existing processes, the impact to existing regulatory processes is expected to be minimal.

NYPA continues to improve the Lewiston Pump Generating Plant. The PG7 and PG2 remaining re-work is postponed until PG5 investigation and repair is completed. The PG7 and PG2 work is planned for completion by December 2024. Work on PG5 still remains and is expected to be completed in the first quarter of 2023. Work on PG5 commenced on February 1, 2022.

NYPA also continues work in the Robert Moses Plant with the installation of the backbone equipment for the SCADA system. RM-6 controls and mechanical upgrades starting in April 2023 and is expected to take 15-months. The main control room replacement completed was December 2022. Project completion is expected 2035.

10. Ice Conditions and Ice Boom Operation

In accordance with Condition (d) of the Commission's October 5, 1999 supplementary Order of Approval, installation of the ice boom may begin when the Lake Erie water temperature, as measured at the Buffalo Water Intake, reaches 4ºC (39ºF) or on December 16, whichever occurs first. The Power Entities approached the INWC in early December 2022 with concerns that the decreased draft for the boom installation barge on the Canadian side of the ice boom could cause unsafe conditions for their crew when installing the span between junction plates 22 and 23 of the ice boom. Fort Erie Beach shallow depth and pier remnants down stream of Junction plate 23 have historically been a safety concern for grounding the installation barge on the lake bottom. Installation vessels did beach in that area during the approach of Junction Plate 23 during December 2022 of installation.

After reviewing the concerns with NYPA and OPG, the INWC and the board concurred that the current conditions were a safety hazard and recommended that the request for a supplemental order of approval from the IJC be pursued for installation of a 21-span ice boom as opposed to the 22 span boom previously approved and installed annually. The request was submitted to the IJC by the board, who then reviewed and approved the request and issued a supplemental order of approval on December 20th, 2023 for a 21-span ice boom installation for the 2022-2023 ice season. Installation of the Ice boom began on December 16, 2023 and was completed on December 21, 2023. The boom was installed without span V between Junction Plates 22 and 23 for 2022-2023 Ice Boom Season.

A public comment period was advertised from December 23rd, 2022 through January 20th, 2023. Public comments on concerns over a reduced length ice boom were collected in this timeframe. There was only one comment expressing concern about the installation of the ice boom in general not specific to a reduced length boom installation. No other comments were received.

Weekly reports on the ice conditions for Lake Erie and the Niagara River were prepared and submitted to the board by the Power Entities beginning on December 24, 2022. Data jointly compiled by the Canadian Ice Service and the U.S. National Ice Center of weekly ice coverage for Lake Erie during this reporting period is shown in Figure 11. The 2022-2023 ice season was well below average.

The board is working with the Power Entities to ensure there is an ice monitoring plan in place for ice conditions in the Niagara River and an assessment of the performance of the 21-span ice boom. The results of the ice condition monitoring and performance assessment will be discussed with the IJC at the next semi-annual appearances in April of 2023.

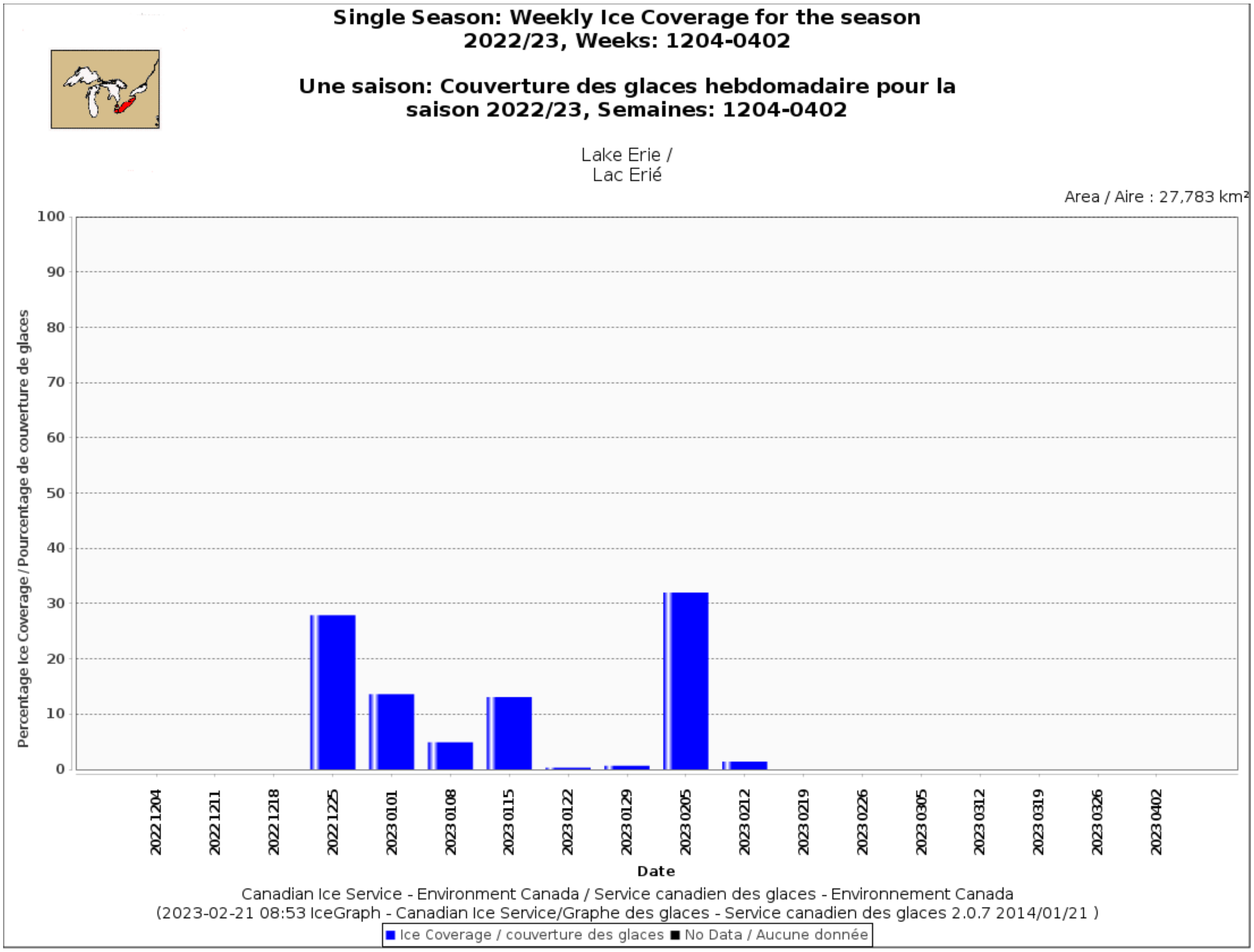


Figure 11: Weekly ice coverage for Lake Erie during the 2022-2023 ice season.

Due to the availability of satellite imagery of Lake Erie for observations of ice on lake, helicopter and fixed- wing flights to determine the extent and condition of the ice cover were not needed this year.

11. Meeting with the Public

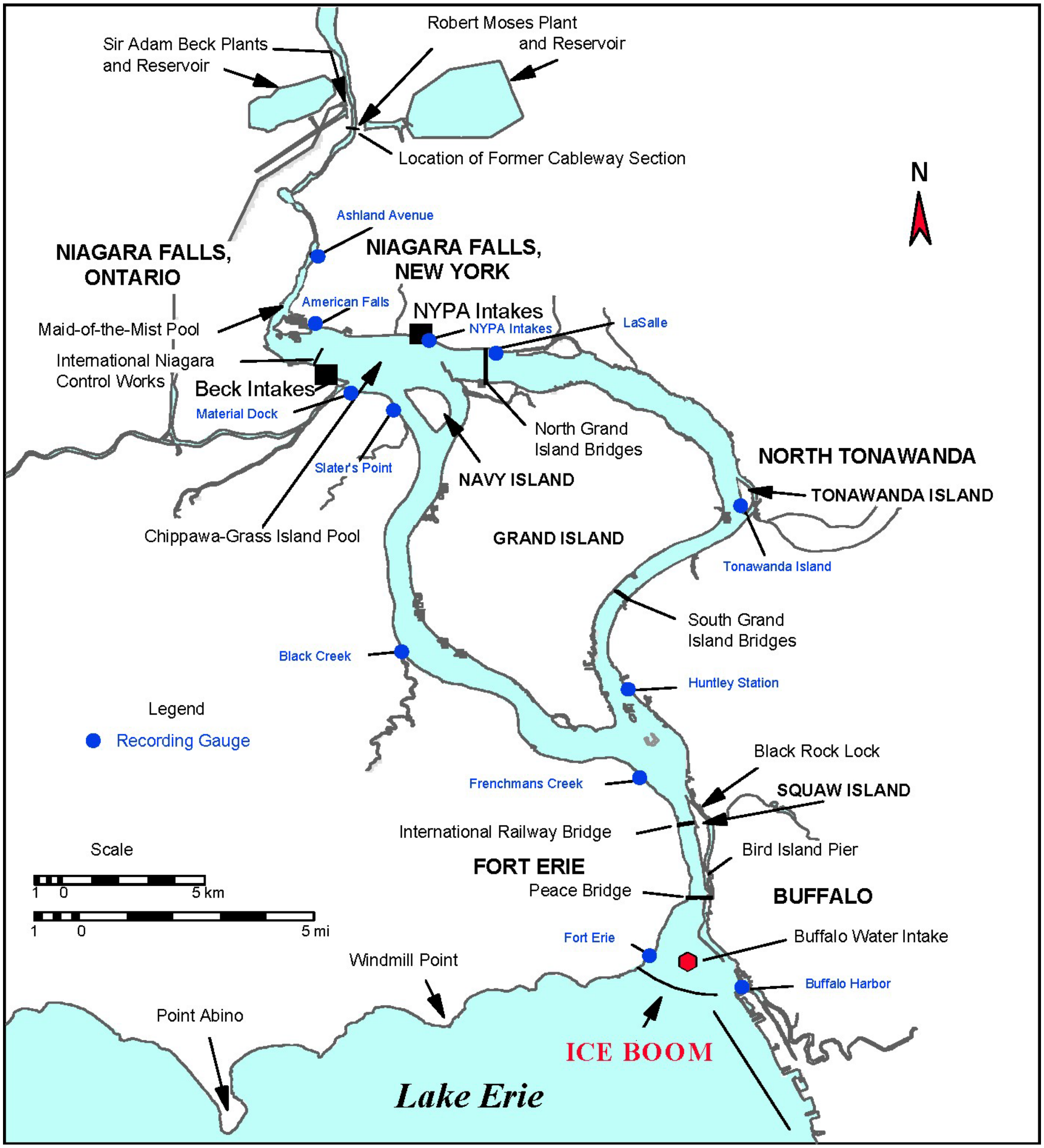
There were no public meetings held during this reporting period. In accordance with the Commission's requirements, the Board held a webinar-style meeting in conjunction with the other two Great Lakes Boards in August of 2022. This meeting was very successful with high public participation. The Board will plan for another webinar-style meeting over the summer months of 2023.

12. Membership of the Board and the Working Committee

Mr. Keith Kompoltowicz was introduced as a new US Working Committee member.

13. Attendance at Board Meetings

The Board met once during this reporting period. The meeting was held on September 29, 2022 in Burlington, Ontario. Mr. Aaron Thompson, Canadian Section Chair, and BG Kimberly Peeples, US Section Chair, were in attendance, along with Canadian and US members, Mr. David Capka. The Canadian and US Secretaries were also in attendance.



Enclosure 1: Map of the upper Niagara River showing water level gauge locations.