International Niagara Board of Control

One Hundred Twenty Third Semi-Annual Progress Report

to the

International Joint Commission

Covering the Period March 26 through September 24, 2014

EXECUTIVE SUMMARY

The level of Lake Erie began the reporting period with a March mean level 8 cm (3.1 inches) below its 1918–2013 period-of-record, long-term average level for the month. The level of Lake Erie rose above average on a monthly basis during May and remained above average throughout the remainder of the reporting period. August's mean water level was 12 cm (4.7 inches) above average (Section 2).

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 at all times during the reporting period (Section 3).

A Falls flow violation occurred on April 28, 2014 due to operator error during the process of transitioning between non-tourist and tourist hours flows. The Falls flow was 80 m^3/s (2,825 cfs) below the Treaty requirement of 1,416 m^3/s (50,000 cfs) for the hour of 8:00 a.m. (Section 5).

Off-schedule measurements were made during the reporting period at the Cableway section in the lower Niagara River to capture the low river flows missed during the regularly schedule measurement programs at this site in 2010 and 2013 (Section 8).

The eastern basin of Lake Erie was about 94% ice covered at the beginning of the reporting period. Given the large quantity of ice still present on the eastern portion of Lake Erie and in the Maid-of-the-Mist Pool below Niagara Falls, the Board informed the Commission that the ice boom's opening would be delayed beyond April 1. Removal of the Lake Erie–Niagara River Ice Boom began on April 29, 2014 with the opening of just one span due to thick ice covering the lifting hardware of each span. After working under difficult ice conditions around the boom throughout much of the removal process, May 19, 2014 marked the end of the 2013–14 ice-boom season when the final spans of the ice boom were pulled onto its Katherine Street, Buffalo, NY storage site by NYPA's ice boom crew (Section 10).

The Board held its annual meeting with the public on September 3, 2014 in the Niagara Falls, NY. Ten members of the public attended the meeting in person, four people participated on-line via webinar/teleconference, and three people joined in by telephone only (Section 12).

There were several changes in the membership of the Board and its Working Committee over the course of the reporting period (Section 13).

COVER: Partial view of the Maid-of-the-Mist Pool and the American and Horseshoe falls at Niagara Falls. (Photo by Ms. Jeanette Fooks, Environment Canada)

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INTERNET SITES

International Joint Commission
www.ijc.org

International Niagara Board of Control
http://ijc.org/en_/inbc
http://ijc.org/fr_/inbc

Lake Erie-Niagara River Ice Boom
www.iceboom.nypa.gov

INTERNATIONAL NIAGARA BOARD OF CONTROL

Burlington, Ontario
Cincinnati, Ohio

September 24, 2014

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

Commissioners:

1. GENERAL

The International Niagara Board of Control (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 its Directive and 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 and record the amount of water available for purposes of the Treaty and record the amounts of water used for power diversions.

The Board is required to submit written reports to the IJC at its semi-annual meetings in April and October of each year. In accordance with this requirement, the Board submits its 123rd Semi-Annual Progress Report, covering the reporting period March 26 through September 24, 2014.

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. The 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 began the reporting period with a March mean level 8 cm (3.1 inches) below its 1918–2013 period-of-record, long-term average level for the month. The lake's level increased by 15 cm (5.9 inches) more than its average March through June rise in response to above-average water supply conditions. The lake's level climbed above average on monthly basis in May and remained so for the remainder of the reporting period. The lake's August 2014 mean water level was 12 cm (4.7 inches) above the long-term average for the month. Recorded monthly water levels for the period March through August 2014 are shown in Table 1 and are 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.

Lake Erie receives water from both its local drainage basin and from the 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 that 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 its inflow from Lake Michigan–Huron via the St. Clair–Detroit Rivers system is its net total supply, or NTS.

Precipitation is a major contributor to NBS, both directly on the lake and through runoff due to rain and snowmelt. Recent monthly precipitation data and departures from the 1900–2010 long-term averages are shown in Table 2. The recent departures from average and historical maximum positive and maximum negative monthly departures are depicted graphically in Figure 2. As indicated, precipitation on the Lake Erie basin was well-below average during March, slightly below average during May, and above, but close to average, during April, June and July, and August. During the period March through August 2014, the basin received 49.0 cm (19.3 inches) of precipitation—just under the average amount for the period.

The recent NBS to Lake Erie is shown compared 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, this typically happens from August through November. For the remainder of the year, combined precipitation and runoff are usually greater than the water lost to evaporation. During the reporting period, the lake's NBS was below average in March, above average during April and May, and near average during June, July and August. Significant runoff from snowmelt helped offset the lack of rain during March and May. In April, precipitation was augmented by the runoff the lake received. As a result, the March NBS was not as low, and the April and May NBS were likely higher, than one might expect given the precipitation amounts received relative to average during these months.

Inflow via the Detroit River is the major portion of Lake Erie's NTS, and is influenced by the level of Lake Michigan–Huron. Although the level of Lake Michigan–Huron continued to be below average during the reporting period, its level climbed closer to average during the reporting period. The level of Lake Michigan–Huron began the reporting period with a March mean level 34 cm (13.4 inches) below its 1918–2013 period-of-record, long-term average level for the month. However, by August, the lake was only 7 cm (2.8 Inches) below average. The inflow to Lake Erie via the Detroit River was just above the long-term average for the six-month period March through August 2014. 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.

The inflow from upstream combined with Lake Erie's NBS, resulted in below-average NTS in March, average NTS during July, and above-average NTS during April and May, June and August. Overall, Lake Erie's NTS was about 4% above average for March through August 2014. The recent NTS to Lake Erie is depicted relative to average in Figure 6.

Lake Erie discharges water to Lake Ontario through the Niagara River and the Welland Canal. The portion of the 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 for the generation of electricity at Ontario Power Generation's DeCew Falls hydroelectric power plants. The major portion 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 is also influenced by ice in the river during the winter and aquatic plant growth in the summer that can reduce the flow, and by wind that can vary levels at the eastern end of the lake 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 near-average water levels during March and April followed by above-average water level conditions from May through August are reflected in the monthly Niagara River flows during the reporting period. The outflow from Lake Erie via the Niagara River was just below the long-term average for the six-month period March through August 2014.

The combination of Lake Erie's NTS and outflow resulted in the water level changes experienced on the lake over the reporting period. While it is not possible to predict with accuracy the supplies to the lakes for the coming months, using historical supplies and the current levels of the lakes, it is possible to make some estimate of water levels for a few months out. The six-month water level forecast prepared at the beginning of September by the U.S. Army Corps of Engineers (USACE) and Environment Canada (EC) indicates that the level of Lake Erie is expected to remain above average during October 2014 through March 2015 unless very low water supply conditions are experienced.

TABLE 1 – MONTHLY AVERAGE LAKE ERIE WATER LEVELS

(Based on a network of 4 water level gauges)
International Great Lakes Datum (1985)

	Metres			Feet		
Month	Recorded* 2014	Average 1918-2013	Departure	Recorded* 2014	Average 1918-2013	Departure
March	173.99	174.07	-0.08	570.83	571.10	-0.27
April	174.20	174.22	-0.02	571.52	571.59	-0.07
May	174.35	174.30	+0.05	572.01	571.85	+0.16
June	174.40	174.33	+0.07	572.18	571.95	+0.23
July	174.40	174.31	+0.09	572.18	571.88	+0.30
August	174.37	174.25	+0.12	572.08	571.69	+0.39

* Provisional

TABLE 2 – MONTHLY AVERAGE PRECIPITATION ON THE LAKE ERIE BASIN

	Centimetres			Inches			
Month	Recorded* 2014	Average 1900-2010	Departure	Recorded* 2014	Average 1900-2010	Departure	Departure (in percent)
March	3.81	7.00	-3.19	1.50	2.76	-1.26	-46
April	8.79	8.04	+0.75	3.46	3.17	+0.29	+9
May	8.46	8.53	-0.07	3.33	3.36	-0.03	-1
June	9.63	8.81	+0.82	3.79	3.47	+0.32	+9
July	8.94	8.61	+0.33	3.52	3.39	+0.13	+4
August	9.37	8.15	+1.22	3.69	3.21	+0.48	+15

* Provisional

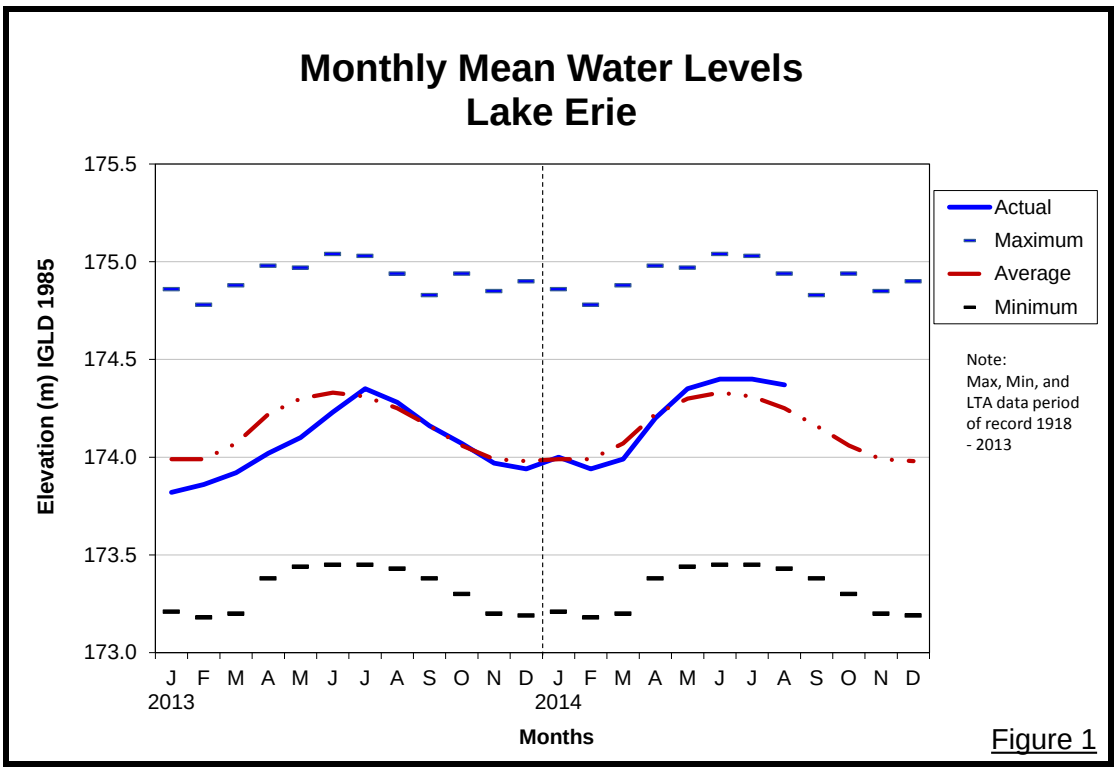


Figure 1

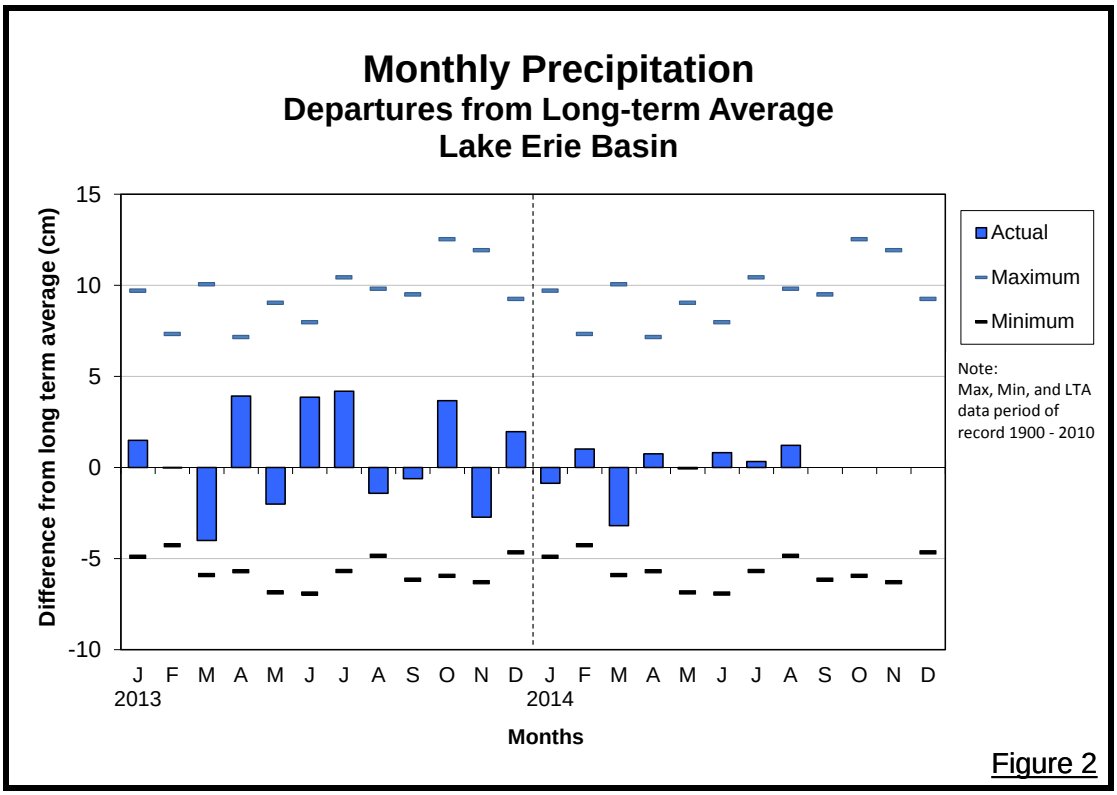


Figure 2

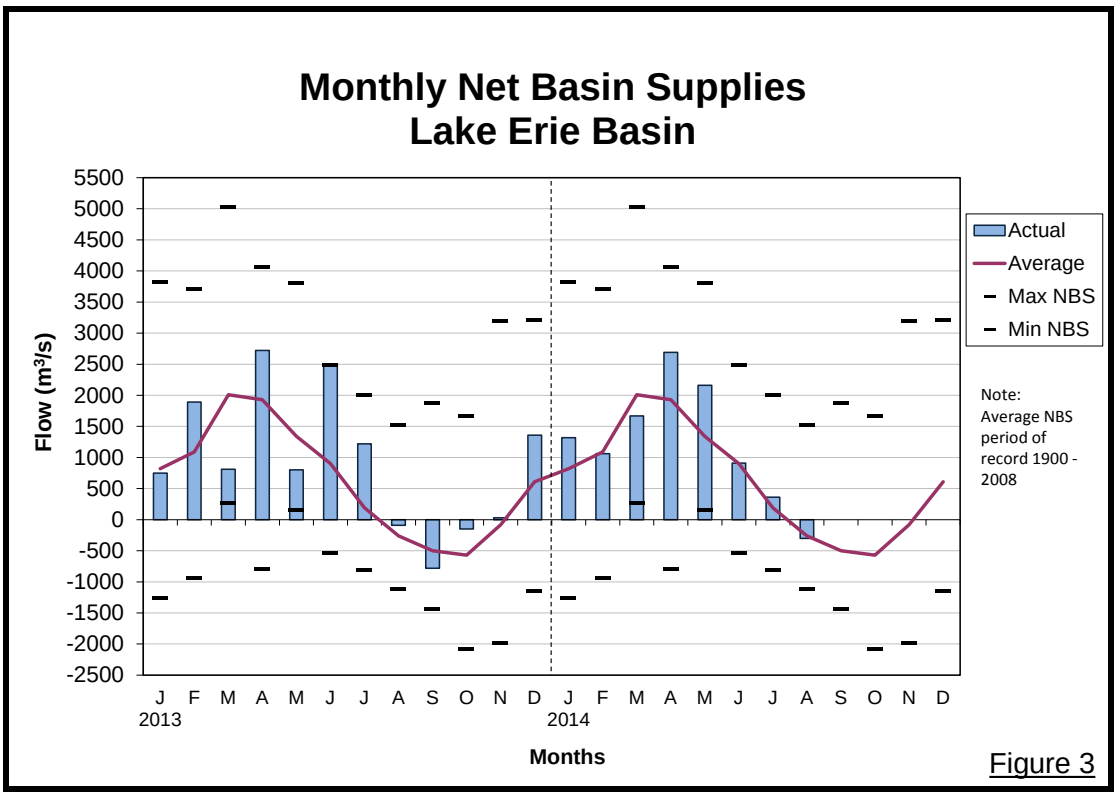


Figure 3

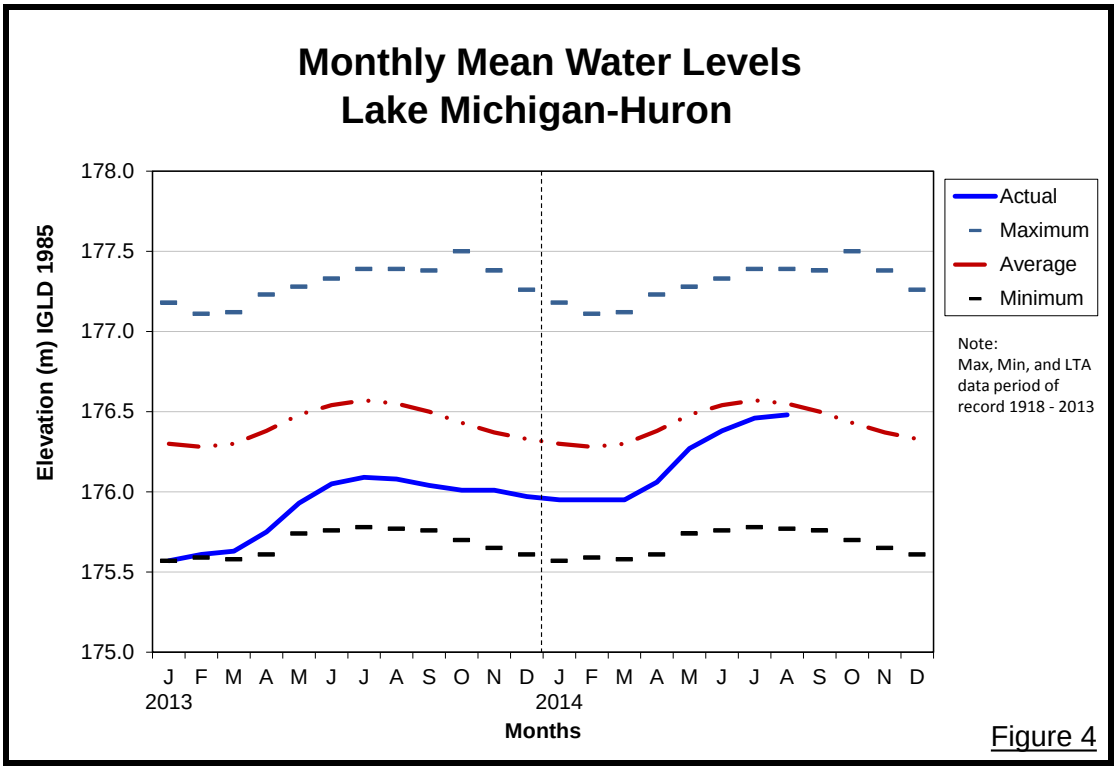


Figure 4

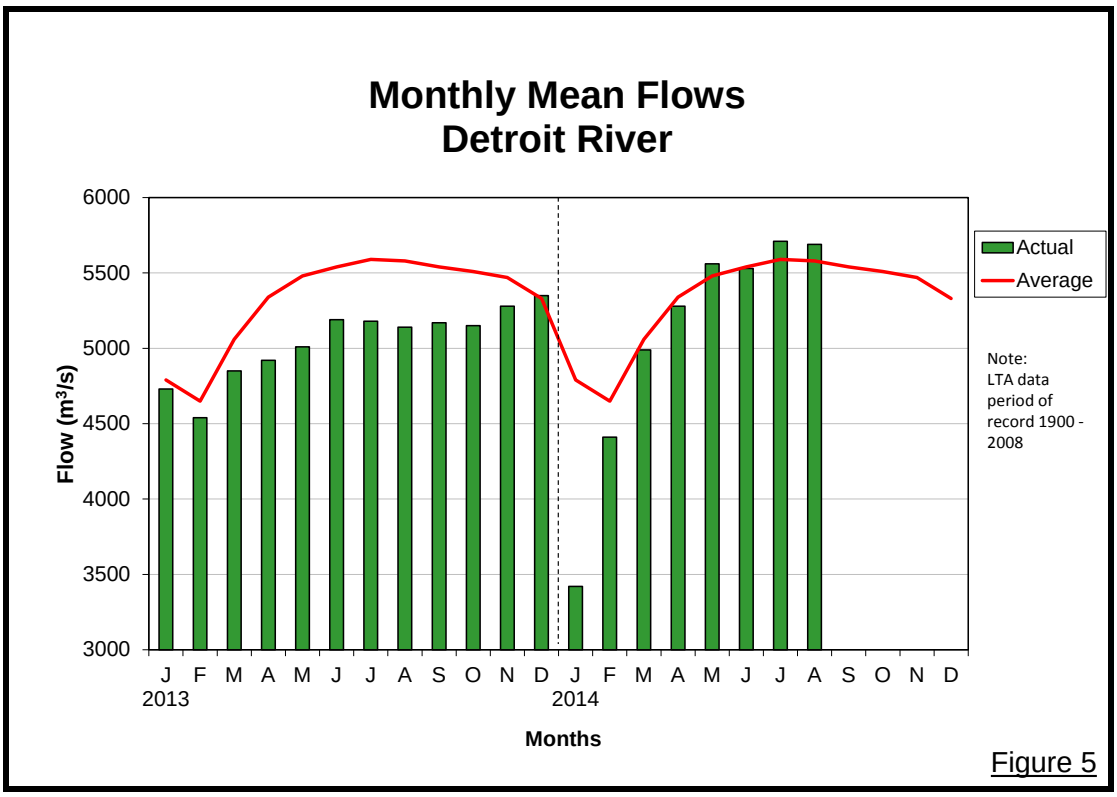


Figure 5

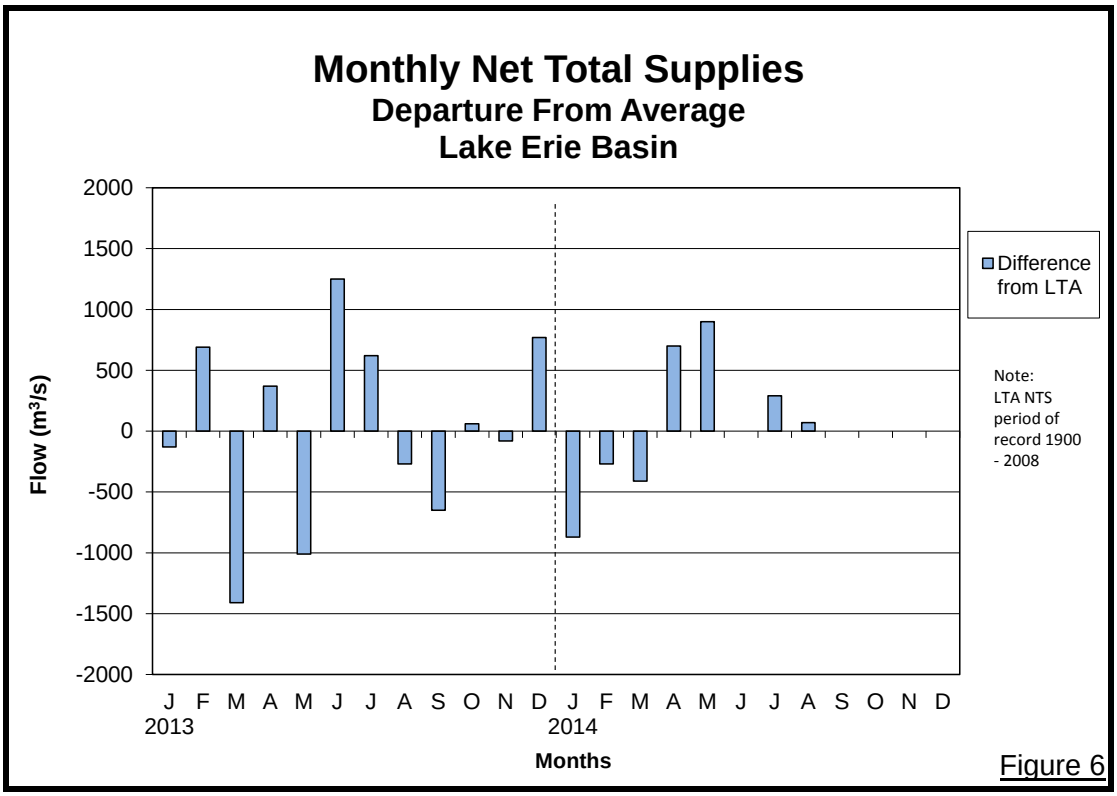


Figure 6

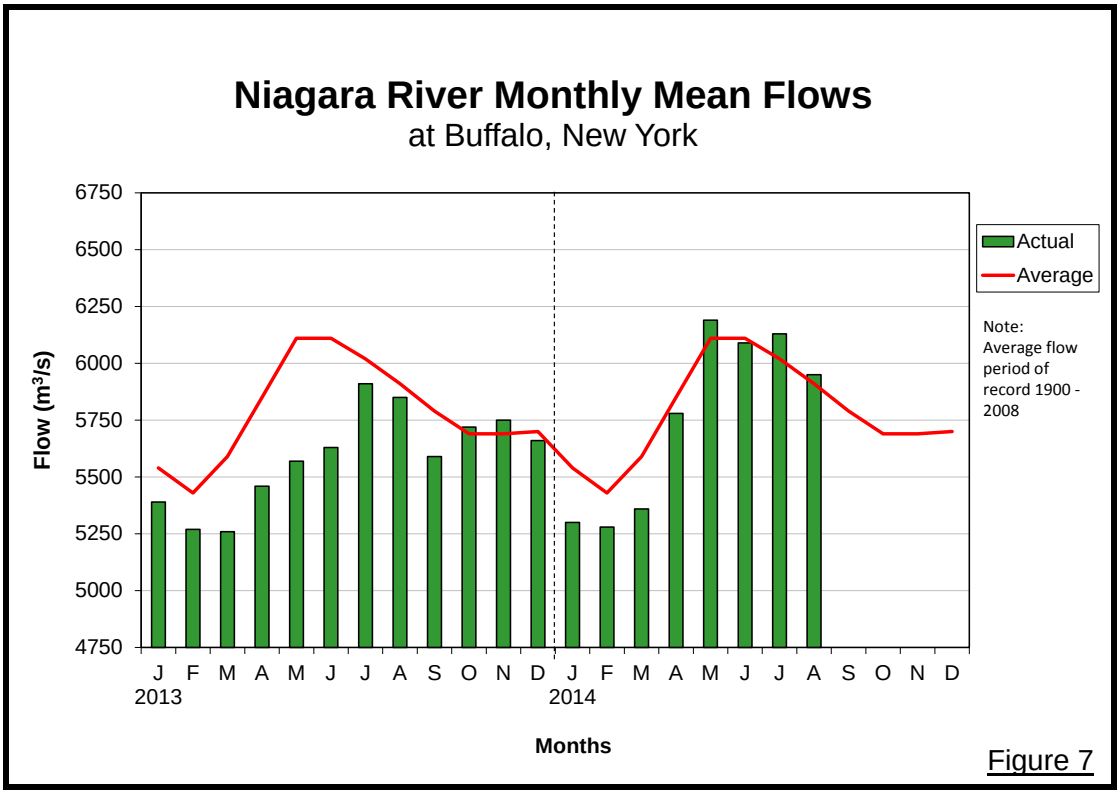


Figure 7

3. OPERATION AND MAINTENANCE OF THE INTERNATIONAL NIAGARA CONTROL WORKS

The water level in the CGIP is regulated in accordance with the Board's 1993 Directive. The Directive requires that the Power Entities—Ontario Power Generation (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 ameliorate 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 Power Entities complied with the Board's Directive at all times during the reporting period.

The accumulated deviation of the CGIP's level from March 1, 1973 through August 31, 2014 was +0.72 metre-months (+2.4 foot-months) above the long-term operational average elevation. The maximum permissible accumulated deviation is ±0.91 metre-months (±3.0 foot-months).

Tolerances for regulation of the CGIP were suspended for seventeen days during the reporting period. They were suspended on April 26 and 27, May 6, 27 and 28, July 12 and 13, and August 25 and 26 due to emergency conditions associated with five rescue operations—four of which were successful. Tolerances were also suspended on April 30 and May 1 to 3 due to ice conditions and on August 12 to 15 due to the discharge measurements carried out in the lower Niagara River in support of the water management activities of Board and the INC.

The locations of the water level gauges on the Niagara River are shown in Enclosure 1. Recorded daily Material Dock water levels covering the period January through August 2014 are shown in Enclosure 2.

Gate 1 of the INCW remained out of service for rehabilitation work following the completion of OPG's Niagara Tunnel Project. It returned to service on December 19, 2013 following work to repair seven hinges and replace seals. However, it exhibited a significant vibration and was therefore restricted to "full open/full closed operation for ice management emergencies only". This restriction was modified on January 22 to March 10, 2014 to allow operation from 100% to 30% closed to better manage ice floes. The gate underwent an urgent outage from March 10 to March 27, 2014 at which time the main cylinders were removed, honed and had their seals replaced. This work resolved the gate's vibration problem.

Gates 1 to 4 of the INCW were removed from service on a planned basis from May 14 to May 16, May 20 to May 22, and June 11, 2014 to allow for reduced current flow along the Sir Adam Beck (SAB) intake wall in order to facilitate the loading/offloading of the gate dewatering structure to a work barge. During the period from June 6 to July 16, 2014 these gates, as well as Gates 5 to 8, were also subject to a number of forced outages due to the intermittent failure of devices used to control the gates. This has prompted an investigation into the cause and possible replacement of the gate's control devices.

Gates 5 to 18 of the INCW were removed from service in varied combinations from May 13 to June 11, 2014 to facilitate work by an external barge company associated with the removal of the dewatering structure from the downstream side of Gate 14 and its re-installation into the downstream side of Gate 16. In addition, installation of the dewatering structure in the upstream side of Gate 16 was undertaken by the NYPA Havasu Barge. This work was undertaken to facilitate a major maintenance program of Gate 16 during the restrictive load limitation on the INCW deck.

Gate 14 of the INCW continues on outage to remediate and test the overpressure system. This work is expected to be complete by the end of September 2014, at which time the gate will be returned to full service.

During a structural inspection of the INCW, carried out in November 2012, OPG identified a potential issue with the concrete stability of its bridge supports. As a result of this deficiency, the temporary vehicle load restriction that was placed on the structure remains in effect. OPG will be initiating a multi-year project in October 2014 to correct this deficiency.

4. GAUGING STATIONS

The Niagara River gauges used to monitor the CGIP levels and the flow over Niagara Falls are the Slater's Point, Material Dock, American Falls and Ashland Avenue gauges (see Enclosure 1). The Slater's Point and Material Dock gauges are owned and operated by the Power Entities. The American Falls gauge is owned and operated by the U. S. National Oceanic and Atmospheric Administration (NOAA). Both NOAA and the Power Entities own and operate water level gauges at the Ashland Avenue location.

Subject to on-going comparison checks of the water level data from the Power Entities' and NOAA's Ashland Avenue gauges by the INC, the Power Entities' gauge is used for officially recording water levels used to determine the flow over Niagara Falls. The Power

Entities' gauge at Ashland Avenue was not reporting water level data for short periods of time during April, May and June due to communications failures. The frequency of failure is being addressed through establishing an alternate communications line between the water level gauge and the Power Entities. The NOAA gauge at Ashland Avenue was used as an alternate during each of these outages, with the exception for the reading on one hour in June when the Ontario Power Generating Station tailwater gauge was used. A comparison of water level readings from the Power Entities' and NOAA's Ashland Avenue gauges showed that they were within the acceptable INC tolerances of $\pm$2 cm ($\pm$0.8 in) on a daily basis for all other days during the reporting period.

NOAA has informed the Board of an on-going issue at the Ashland Avenue water level gauging station. Rock falls from erosion of the river bank in the vicinity of the gauge and rock pushed by ice have repeatedly covered the end of the station's intake pipe. Divers have been forced to excavate the stations intake on an annual basis using hydraulic jetting and manually moving rocks, some quite large, to ensure the gauge remains operable. Discussions between NOAA and the Power Entities about potential short- and long-term solutions to the problem have been initiated. Representatives of the Board and the INC will be visiting the gauging station in November to assess the problem further.

Water levels from the Material Dock gauge were unavailable for a short period on March 27, 2014 to replace the water level gauge transmitter unit and on June 2, 2014 for the station's biennial diving inspection and maintenance of the gauge well. During that time, water level readings were obtained from the Slater's Point gauge.

Water levels from the Fort Erie gauge, used by the Niagara River Control Centre (NRCC) located at the INCW to determine the upper Niagara River flow for operational purposes, were unavailable for short periods of time on March 25, 2014 to replace the water level gauge transmitter unit and on June 2, 2014 for biennial diving inspection and maintenance of the gauge well. During these times, the Buffalo water level gauge was used to provide an estimated elevation at the Fort Erie gauge.

All gauges required for the operation of the INCW were in operation during the remainder of the reporting period.

A temporary water level datalogger was initially installed at the Maid of the Mist Steamship Company dock by OPG on August 8, 2012. The datalogger was in place on a trial basis and recorded water levels during the latter portion of the ice-free season of 2012. It was reinstalled in April 2013 and again in April 2014 to record water levels during the 2013 and 2014 ice-free seasons. Once sufficient data is acquired and assessed, the case for installing a permanent water level gauge in the vicinity of this location, to act as an alternative for the Ontario Power Generating Station tailwater gauge and backup for the Ashland Avenue gauge, will be investigated further.

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) day time hours, the required minimum Niagara Falls flow is 2,832 m^3/s (100,000 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). The operation of the INCW, in conjunction with power diversion operations, ensures sufficient flow over the Falls to meet the requirements of the 1950 Niagara Treaty. Falls flow met or exceeded minimum Treaty requirements at all times during the reporting period with the sole exception on April 28, 2014, as described below. The recorded daily flow over Niagara Falls, covering the period January through August 2014, is shown in Enclosure 3.

The flow over Niagara Falls was 80 m^3/s (2,825 cfs) below the Treaty requirement for 8:00 a.m. on April 28, 2014. During the process of transitioning between non-tourist and tourist hour flows, the operator on shift was using a tool to verify the setting of the control gates. He mistakenly interpreted the indication to close one foot of a gate with closing one full gate in order to prevent overshooting his target flow. This action resulted in flow over Niagara Falls below the minimum requirement for 8:00 a.m. Once

recognizing his error, he released additional water in attempt to correct the problem. However, there was insufficient time to recover. The Falls flow, as indicated by the Ashland Avenue gauge rating, was restored above the minimum required by 8:05 a.m. The NRCC operating staff has been re-instructed on the use of the tool used to verify the gate settings to ensure they apply the proper interpretation in the future. The operators have been instructed to manually determine the gate settings first and then use the tool to check their calculations.

6. FALLS RECESSION

As part of its activities, 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 occurred during the reporting period.

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 SAB I and II in Canada and NYPA's Robert Moses Niagara Power Project in the United States, withdraw water from the CGIP above Niagara Falls and discharge it into the lower Niagara River at Queenston, ON and Lewiston, NY, respectively. During the period of March to August 2014, diversion for the SAB I and II plants averaged 1,618 m^3/s (57,140 cfs) and diversion to the Robert Moses Niagara Power Project averaged 1,901 m^3/s (67,130 cfs).

The average flow from Lake Erie to the Welland Canal for the period March 2014 through August 2014 was 208.5 m^3/s (7,360 cfs). Diversion from the canal to OPG's DeCew Falls Generating Stations averaged 159.1 m^3/s (5,620 cfs) for the same period of time.

Records of diversions for power generation covering the period March through August 2014 are shown in Enclosure 4.

The monthly average Niagara River flow at Queenston, ON and departures from the 1900–2013 long-term average are shown in Table 3 for the period of March through August 2014. Maximum and minimum monthly average flows for the 1900–2013 period of record are shown in Table 4. During the period March through August 2014, the flow at Queenston averaged 5,966 m^3/s (210,690 cfs), with the monthly values ranging between 5,445 m^3/s (192,290 cfs) and 6,200 m^3/s (218,950 cfs). The flow at Queenston for the same period in 2013 averaged 5,653 m^3/s (199,630 cfs), with the monthly values ranging between 5,350 m^3/s (188,930 cfs) and 5,923 m^3/s (209,170 cfs).

TABLE 3 - MONTHLY NIAGARA RIVER FLOWS AT QUEENSTON

	Cubic Metres per Second			Cubic Feet per Second		
Month	Recorded 2014	Average 1900-2013	Departure	Recorded 2014	Average 1900-2013	Departure
March	5445	5642	-197	192,290	199,250	-6,960
April	5890	5892	-2	208,000	208,070	-70
May	6200	6087	113	218,950	214,960	3,990
June	6106	6064	42	215,630	214,150	1,480
July	6125	5964	161	216,300	210,620	5,680
August	6029	5847	182	212,910	206,480	6,430
Average	5966	5916	50	210,690	208,920	1,770

TABLE 4 - MONTHLY MAXIMUM AND MINIMUM NIAGARA RIVER FLOWS AT QUEENSTON

	Cubic Metres per Second				Cubic Feet per Second	
Month	Maximum	Year	Minimum	Year	Maximum	Minimum
March	7320	1974	4130	1934	258,500	145,850
April	7550	1974	4380	1935	266,630	154,680
May	7560	1974	4530	1934	266,980	159,980
June	7610	1986	4470	1934	268,740	157,860
July	7510	1986	4360	1934	265,210	153,970
August	7190	1986	4370	1934	253,910	154,330

8. FLOW MEASUREMENTS IN THE NIAGARA RIVER AND THE 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 EC. 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 EC continue efforts to standardize measurement equipment and techniques. Measurements are made at several locations as described below. No regularly-scheduled measurements were made during the reporting period. Off-scheduled measurements were made during the reporting period at the Cableway Section located in the lower Niagara River to capture the low flows that the USACE and EC crews were unable to measure as planned during the regularly-scheduled measurement programs in late 2010 (due to power entity issues) or 2013 due to high flow in the Niagara River resulting from high wind conditions on Lake Erie.

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 for evaluating stage-discharge relationships for flow entering the

Niagara River from Lake Erie. The Buffalo rating equation is used in Great Lakes water supply routing models to estimate the flow in the Niagara River and to verify other Niagara River flow estimates. An updated Buffalo equation was accepted by the Board of Control at the 2014 Spring meeting. The most recent regularly-scheduled discharge measurements near the International Railway Bridge were taken in May 2012, with additional low flow measurements made in November 2012. Following the 3-year cycle, the next scheduled measurements at this location are expected to be made in the Spring of 2015.

EC is also taking continuous measurements of water levels at a new International Gauging Station (water levels and flow monitoring) located near the International Railway Bridge section. Flow measurements were taken throughout 2012 to 2014 to observe the trending impact of aquatic plant growth on flow. EC hopes to use continuous Acoustic Velocity measurement data to assist with assessing flow conditions under ice during this winter. Continuous daily discharge data is being published at this location for ice free periods. Since it's installation in the Spring of 2013, several discharge measurements have been acquired to develop the calibration that may start to be used to confirm year-round discharge data this year.

Lower Niagara River: Discharge measurements are made on a 3-year cycle at the Cableway 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. In the Spring of 2007, Acoustic Doppler Current Profiler (ADCP) technology replaced the use of conventional current meter measurements at the Cableway section. Measurements have been made using only ADCP technology since that time. In accordance with the 3-year measurement cycle at the Cableway section, a suite of discharge measurements at flows close to the 1,416 and 2,832 m^3/s (50,000 and 100,000 cfs) Falls flow minimums specified in the 1950 Niagara Treaty were scheduled for October 30 through November 1, 2013. The October 30 to November 1 dates were

selected for efficiency of the measurement session to coincide with the change from 1950 Niagara Treaty tourist season to non-tourist season minimum Falls flow requirements. On October 30 and 31, four measurements at flows from 2,300 to 3,500 m^3/s (81,220 to 123,600 cfs) were successfully taken. However, due to increased flow in the Niagara River due to high winds out of the west on November 1, the Power Entities were unable to provide stable flow over Niagara Falls and past the Ashland Avenue gauge near the 1,400 and 1,800 m^3/s (49,440 and 63,570 cfs) amounts as planned. The Falls flow ranged from 1,979 and 4,365 m^3/s (69,890 and 154,150 cfs) on November 1 during the daylight hours when measurements can be taken. During midday, boating conditions were sufficiently safe, and the Power Entities were able to provide approximately one hour of reasonably stable flow conditions to allow the USACE and EC crews on site to complete an additional measurement. This measurement provided an additional confirmatory flow value in the range of 2,600 m^3/s (91,820 cfs). Plans to measure the early morning low flows during Summer 2014 were made. The USACE and EC crews successfully completed the planned suite of discharge measurements at flows close to the 1,416 m^3/s (50,000 cfs) Falls flow minimums specified in the 1950 Niagara Treaty during the week of August 11–15, 2014. The results of the 2013 and 2014 flow measurements are being analyzed, along with the practicality of gathering various flow data at various times of the year.

In addition to the measurements at the Cableway section, measurements were made downstream of the OPG and NYPA hydroelectric generating stations at Queenston–Lewiston during run-of-river conditions on October 29, 2013 and August 12 and 13, 2014 in order to measure the total flow in the lower Niagara River. Each total flow measured will be finalized and then compared to the sum of the outflow from the Maid-of-the-Mist Pool (flow over Niagara Falls) and the discharges from the hydroelectric generating stations.

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. Since American Falls flow is directly related to the operation of the CGIP, the Board monitors this relationship. The last measurements in the American Falls channel were made in May 2012. Following the 5-year cycle, the next scheduled measurements at this location are expected to be made in the Spring of 2017. However, the timing of these measurements may need to be changed due to possible rehabilitation or replacement of the two American Falls Channel pedestrian bridges as described in Section 11.

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 two permanently installed ADVMs, which are used in the determination of flow through the Welland Canal. Regularly-scheduled measurements were last made in the Welland Supply Canal in May 2010. However, due to the St. Lawrence Seaway Management Corporation's inability to provide water level data for the time of the 2010 measurements, these measurements could not be used to verify the rating. Therefore, off-schedule measurements were made in the Welland Supply Canal in May 2012. It is expected that the next regularly-scheduled measurements in the Welland Supply Canal will take place in 2015.

9. POWER PLANT UPGRADES

OPG began a unit rehabilitation program in 2007 for a number of its Beck I units—Units G3, G7, G9 and G10. G1 and G2, which are 25 Hz units, remain removed from service at this time, and rehabilitation of G4, G5, G6 and G8 will be considered after work is completed on the other units as they were more recently upgraded. The upgrades of Units G7 and G9 were completed in March 2009/February 2012 (in two parts) and December 2010, respectively. Work to replace the G3 runner and for a generator re-wind began in April 2012 and was completed in July 2013. G10 is expected to go out of service in August 2015 for rehabilitation.

The Beck I units were originally built with Johnson Valves at the bottom of the penstocks that could be activated to stop water from entering the units. These valves were removed from Units G3, G7 and G9 when they were upgraded, and their function replaced with headgates that can prevent water from entering the penstocks. As Units G3 and G9 were upgraded, sleeves were installed where the Johnson Valves had been located in order to improve flow through that portion of the penstock. A sleeve was not installed when G7 was initially upgraded in 2009. The unit was taken out of service again, from early March 2011 until late February 2012, to complete this work. Due to the limited production gain with the sleeves in place, OPG has decided not to include this alteration in future upgrades.

Although an Index Test for G7 was scheduled for May 2012, it was postponed because of vibration problems with the unit. Full Gibson Testing was performed on the unit over a period of time during November and December 2013 after the vibration issues were resolved. Representatives of the INC witnessed one of the tests on December 6, 2013. The results of the Gibson test are being analyzed. It is recognized that the rating table currently being used for G7 does not reflect the improvements in performance of the unit expected with the installation of the Johnson Valve sleeve because the table was based on earlier model tests, and that it may result in a slight over-reporting of the water used by the unit. Similarly, G3 is being operated on an interim rating table until a Gibson test takes place. The test is tentatively scheduled for November 2014. A new rating table has been finalized for G9, and will be submitted to the INC for approval.

10. ICE CONDITIONS AND ICE BOOM OPERATION

Lake Erie ice conditions for the 2013–14 ice seasons were dictated by sustained cold temperatures throughout the winter. The ice season began early and ended late. Ice cover maps produced jointly by the Canadian Ice Service and the US National Ice Center based on RADARSAT (Radar Satellite) information indicated a high percentage of ice cover on Lake Erie throughout the ice season. The majority of this ice was defined as thick. The lake's weekly ice cover during the 2013–14 ice season is shown in Figure 8.

Thick ice formed around the ice boom and encapsulated many of its spans making its eventual opening and removal difficult.

The current Order of Approval governing the operation of the ice boom requires that all floating sections of the boom be opened by the first day of April unless there is more than 650 km^2 (250 square miles) of ice remaining on eastern Lake Erie. Other factors such as the quality of ice, ice build-up in the Niagara River above or below the Falls, or a prediction of unfavourable weather are also considered.

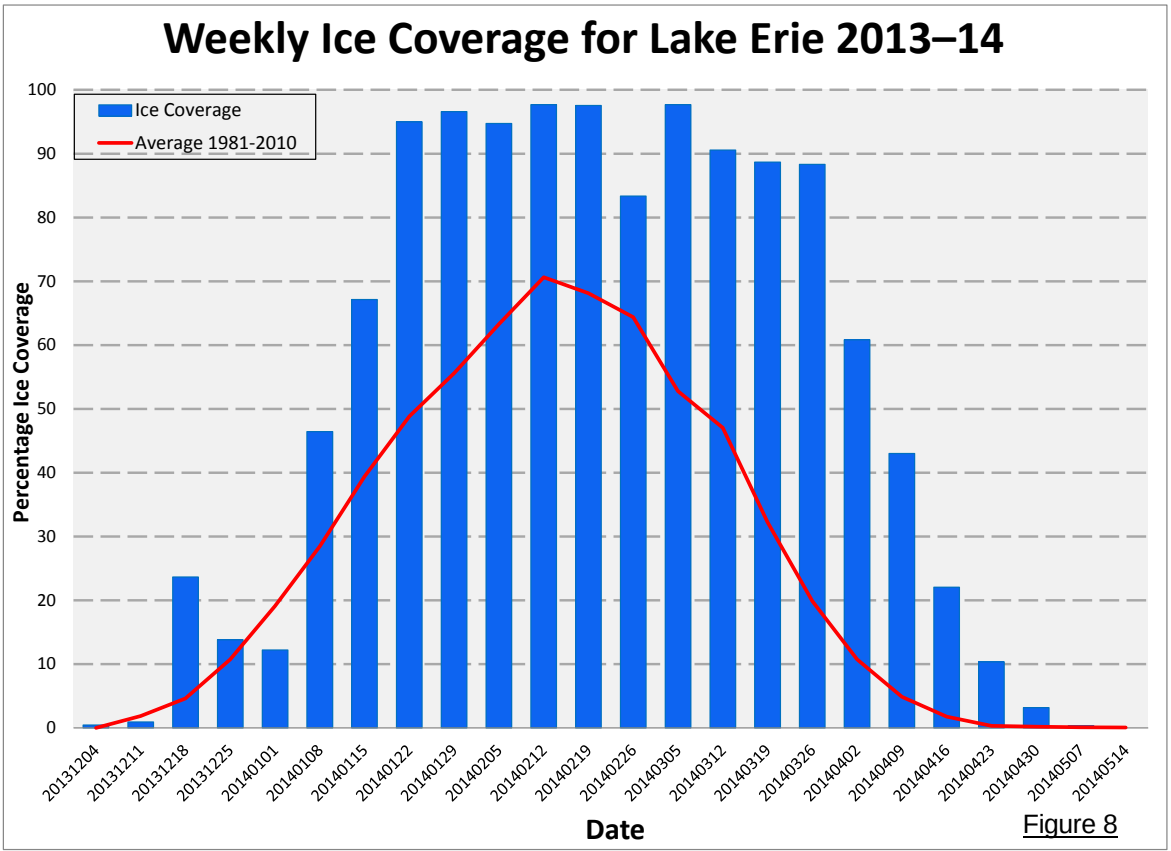


Figure 8

Satellite imagery for March 26, 2014 showed that the eastern basin of Lake Erie, the portion of the lake east of a line between Long Point, Ontario and Erie, Pennsylvania, was 95 percent ice covered. That is an area of about 4,860 km^2 (1,875 square miles) of ice. Considering the quantity of ice remaining on Lake Erie, the Board informed the Commission by letter dated March 27, 2014 that the ice boom's opening would be

delayed beyond April 1. A media advisory regarding the delay in ice boom opening was also issued by the Board at that time. Further, based on the areal extent and thickness of the lake's ice cover, representatives of Power Entities and the Board's Working Committee decided to postpone the use of fixed-wing ice observation flights to determine the extent and condition of ice remaining on the eastern basin in preparation for removal of the ice boom until after available satellite imagery showed that the extent of ice cover in lake's eastern basin was less than 75%.

The first fixed-wing observation flight took place during the afternoon of April 23, 2014, revealing 1,033 km^2 (399 square miles) of ice remaining on the eastern end of Lake Erie. True colour satellite images and images from RADARSAT satellite indicated that there was no significant melting during the rest of the week after the first flight. A second fixed wing flight on April 28, 2014 revealed 622 km^2 (240 square miles) remaining on Lake Erie. Considering the amount of ice remaining and the absence of ice in the Maid-of-the-Midst Pool below Niagara Falls, the Board issued a Media Advisory on April 29, 2014 that preparations for the boom opening were underway.

Ice boom crews planned to begin phase 1 of the ice boom removal on April 29, 2014 by opening three spans beginning at the Canadian side to allow a controlled amount of ice to flow past the openings. However, only one span, Span V which is closest to the Canadian shoreline, could be opened and left trailing due to thick ice cover and unsafe work conditions created by wind. On April 30, 2014, large amounts of thick ice prevented crews from opening spans from the Canadian side. Their efforts were shifted to Spans M, N and O which are located close to the Canada/U.S. border. Spans M and N were removed and tied to the Buffalo breakwall while Spans O and V remained opened and trailing. Many of the boom's buoy barrels were buried in the ice and required NYPA's B-1 ice breaker to free them. Large amounts of ice, rotted on top and solid under water flowed through the open spans and by May 2, 2014 only two additional spans were removed. On May 6, 2014, ice boom crews were unable to disconnect the remaining six spans as a result of ice pressure. The final spans were

removed from the lake and placed behind the Buffalo breakwall on May 7, 2014, completing Phase 1 of the removal process.

On May 8, 2014, an ice field moving out of Lake Erie buried two buoy barrels, preventing their removal. The ice field prevented buoy barrel removal and the crew focused on breaking up the ice field. Later that day, Phase 2 began and the ice boom crew was able to remove 9 buoy barrels. Twelve barrels were removed from the Lake and taken to shore on May 9. Phase 2 of the removal of the ice boom removal process was completed on May 12, 2014 when the remaining two buoy barrels were removed.

Phase 3, the final phase of the ice boom removal process, began on May 13, 2014 when ice boom crews began towing the 152-metre (500-foot) long spans to the Katherine Street storage site where they were pulled onto shore. The final spans were pulled onto the Katherine Street storage site on May 19, 2014, marking the end of the 2013–14 ice-boom season. The ice boom performed as designed during the 2013–14 ice season.

The Board reviewed the operation of the ice boom and concludes that it continues to function as intended and, considering the 1999 Supplementary Order regarding installation and the proactive action taken when conditions warrant, recommended that the Commission continue to authorize use of the Lake Erie–Niagara River Ice Boom.

11. OTHER ISSUES

Welland River Watershed: The Board continues to investigate the potential impact of fluctuating water levels of the CGIP on the Welland River watershed. Current issues in the watershed include concern of potential flooding of private property and degradation of the ecosystem. In addition to the potential for impacts from the CGIP, other potential contributors to these issues include urban and agricultural land use practices, past hydraulic modifications of the river (e.g. siphons to carry the river under the Welland

Canal and dams for flow control) and the natural flat topography of the river. Discussions are ongoing among the Niagara Peninsula Conservation Authority (NPCA), Ontario Ministry of Natural Resources and Forestry, Welland River property owners, Welland River Floodplain Association, OPG and EC with the short-term goal to better characterize the timing and extent of water level fluctuations in the Welland River through existing data and potential new water level measurement gauges if necessary. Due to the multi-jurisdictional nature of initiatives on the Welland River, discussions require coordination between all of the above agencies and are taking some time to progress. These data will then be used to provide better clarity to potential correlations between water levels in the Welland River and CGIP, and the potential for impact by level fluctuations in the CGIP on the Welland River watershed. Two Water Survey of Canada (WSC) flow gauges, expected to be outside of the influence of level changes in the CGIP, have been identified as potentially having useful data for comparisons of CGIP level changes. Discussion has been initiated regarding the potential for installation of a level gauge(s) by the NPCA in the section of the Welland River where level changes in the river are expected. Data from the existing WSC gauges, and potential future gauges as they become available, will be used to inform and provide advice to the Board on the need for further action.

American Falls Bridges Project: With the continual deterioration of two of the pedestrian bridges spanning the American Falls Channel over the last several years, New York State Parks (NYSP) has worked with consultants to evaluate their existing structure conditions and possible rehabilitation and replacement alternatives. The two pedestrian bridges in question are the ones crossing the American Falls Channel from Prospect Park to Green Island and from Green Island to Goat Island. NYSP has requested that the New York State Department of Transportation (NYSDOT) assist them through project scoping, design and construction to either rehabilitate the structures to a like-new condition or replace them. Phase 1, the planning and scoping phase, was completed in Fall 2013. The second phase, preliminary design, began in early 2014 and is continuing. The final phase, the design and construction phase, is scheduled for the Spring of 2017.

The IJC and the Board may be asked to review the project's plans, which could include rehabilitating the existing bridges, relocating the bridges with portions of the old bridge structure removed or left in place, and the need to cofferdam each bridge pier and/or the entire river channel during construction. The options considered could have a temporary or permanent impact on flow in the American Falls Channel.

U.S. Representatives of the Board attended a NYSDOT Stakeholder meeting and have met with the NYSDOT's contractor that is working on a hydraulic model of the Niagara River near the proposed project. Representatives of the Board have provided data to the NYSDOT contractor. These data include metadata, hydraulic cross-sections and Niagara River rating equations for developing flows for the model.

Miller's Creek Marina: The Niagara Parks Commission (NPC) is investigating the possible enhancement of the Miller's Creek Marina (MCM) and its associated properties located on Canadian side of the upper Niagara River nine kilometres downstream of the International Peace Bridge. The site includes the existing marina facilities, adjacent shoreline and a large internal parcel separated by the Niagara Parkway and Recreational Trail. The NPC is exploring new opportunities for MCM in a broad, consultative manner. Based on its mandate, the NPC is developing a project vision that is exploring water-based recreation and tourism opportunities for the site. The NPC has developed its guiding principles and objectives for the project, but has not yet created a concept or site plan. The Board will continue to monitor the marina's enhancement project as it relates to its mandate at Niagara.

12. PUBLIC OUTREACH

In accordance with the Commission's requirements, the Board held its annual public meeting on September 3, 2014 at the Earl W. Brydges Library in the Niagara Falls, NY. Ten members of the public attended the meeting in person, four people participated on-line via webinar/teleconference, and three people joined in by telephone only.

Information on the Board's membership, role and activities, as well as the current and projected Great Lakes water levels, was presented and discussed at the meeting.

Following the Board's presentation, members of the public provided comments and asked questions related to the monitoring and timing of the removal of the ice boom and raised their concerns about its potential economic and environmental impacts. Following the plenary session, one-on-one and group discussions also took place between the Board and Welland River property owners and a local Mayor from the town of Pelham which the Welland River flows through.

The Board is working on a frequently asked questions section for its website to help answer questions about the Lake Erie-Niagara River ice boom and other board related activities. The Board will also investigate using its website to provide updates on Lake Erie ice conditions leading up to the decision to remove the ice boom in the spring.

13. MEMBERSHIP OF THE BOARD AND ITS WORKING COMMITEE

There were several changes in the membership of the Board and its Working Committee over the course of the reporting period. The changes in the order that they occurred are as follows:

- Mr. Kyle C. McCune, USACE, was appointed interim Secretary of the U.S. Section of the Board by COL Robert D. Peterson, US Alternate Chair on April 3, 2014 following the retirement of Mr. John W. Kangas.
- LTC Karl D. Jansen assumed command of the USACE Buffalo District on June 5, 2014. Upon doing so, LTC Jansen became the U.S. Co-Chair of the Board's Working Committee, filling the position formerly held by LTC Owen J. Beaudoin.
- BG Margaret W. Burcham relinquished command of the U.S. Army Engineer Division, Great Lakes and Ohio River, on May 30, 2014. Upon doing, so BG Burcham also resigned her appointment as the Board's U.S. Section Chair.

- COL Robert D. Peterson, Deputy Commander of the U.S. Army Engineer Division, Great Lakes and Ohio River, resigned his appointment as the Board's US Alternate Chair on July 3, 2014, the day of his retirement.
- Ms. Deborah H. Lee, USACE, was appointed Alternate U.S. Section Chair for the International Niagara Board of Control on an interim basis by the IJC on July 2, 2014 for the period July 3 to September 30, 2014.
- In a September 11, 2014 letter to the Commission, the Great Lakes and Ohio River Commander COL Steven J. Roemhildt requested that BG Richard G. Kaiser, who is taking Command of the Division effective September 26, 2014, be appointed as the U.S. Chair of the International Niagara Board of Control. The letter also requested that Ms. Lee's appointment as Alternate U.S. Section Chair be extended for a year as the Commander assesses a number of options for staffing that position.
- Mr. Derrick R. Beach, Environment Canada, was appointed Secretary of the Canadian Section of the Board by Mr. Aaron F. Thompson, Canadian Chair, on July 15, 2014, replacing Mr. Charles F. Southam in advance of his retirement in early 2015.
- Mr. Jonathon B. Staples, Ontario Ministry of Natural Resources and Forestry, was appointed to the Canadian Section of the International Niagara Working Committee by Dr. Frank R. Seglenieks, Canadian Co-Chair, on July 14, 2014 filling the vacancy created by the retirement of Mr. Leo H. Christl in 2009.

14. ATTENDANCE AT BOARD MEETINGS

The Board met once during this reporting period. The meeting was held on September 24, 2014, in Cornwall, ON. Mr. Aaron F. Thompson, Canadian Section Chair. Ms. Deborah H. Lee, Alternate U.S. Section Chair, and Ms. Jennifer L. Keyes, Canadian Member were in attendance. Mr. William H. Allerton, U.S. Member was unable to attend.

Original Signed by

Mr. AARON F. THOMPSON
Chair, Canadian Section

Original Signed by

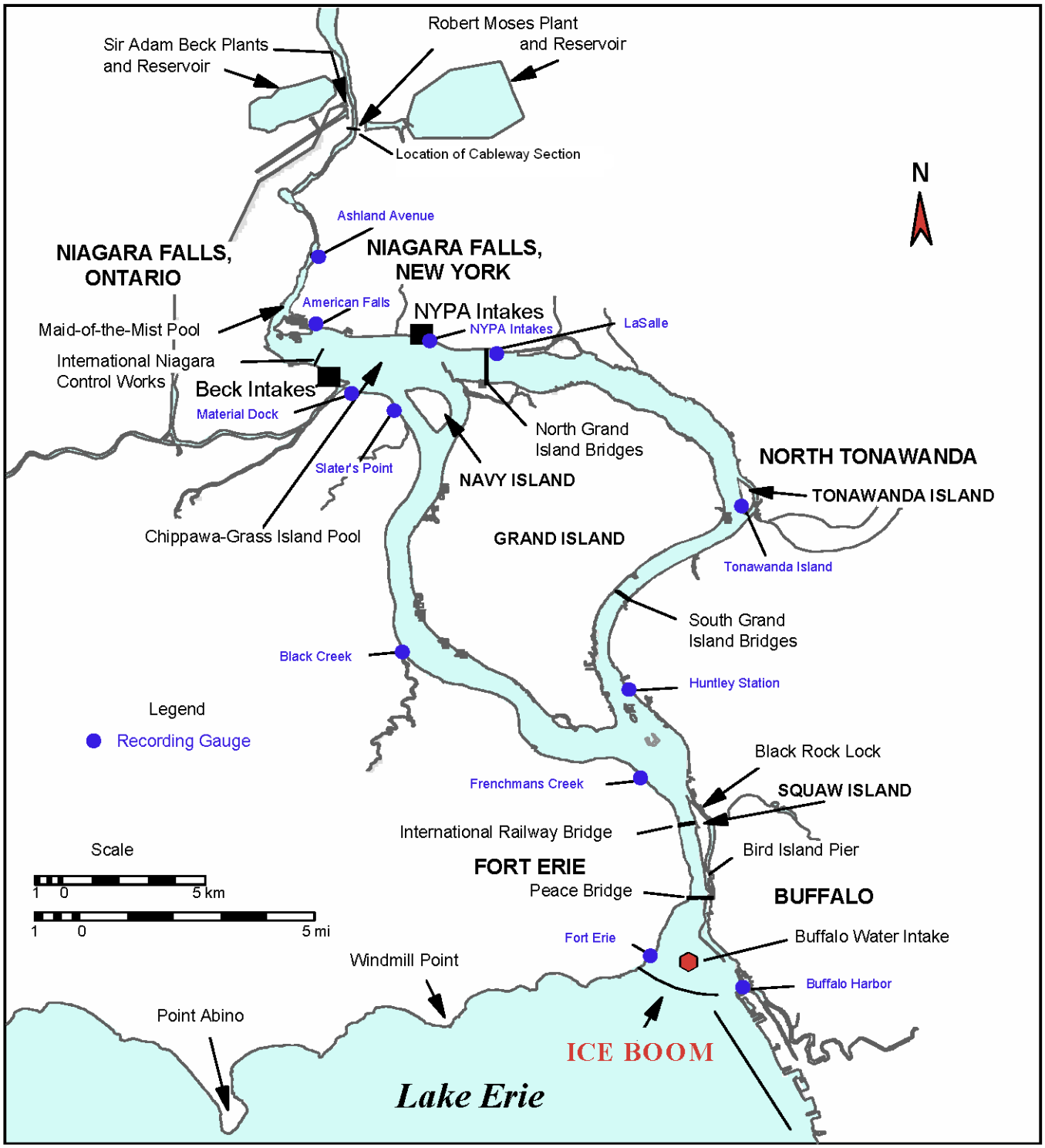
Ms. DEBORAH H. LEE
Alternate Chair, United States Section

Original Signed by

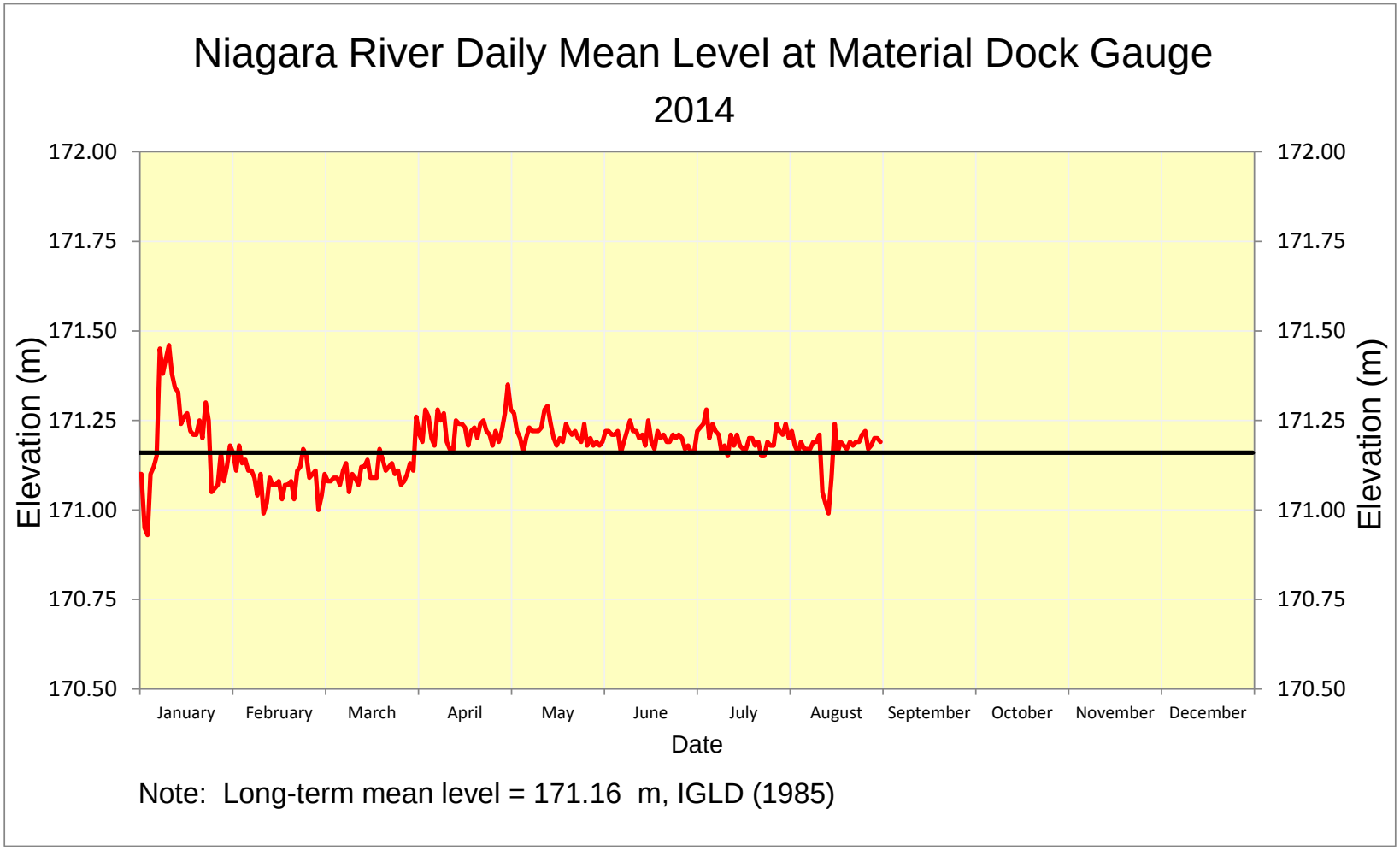
Ms. JENNIFER L. KEYES
Member, Canadian Section

Original Signed by

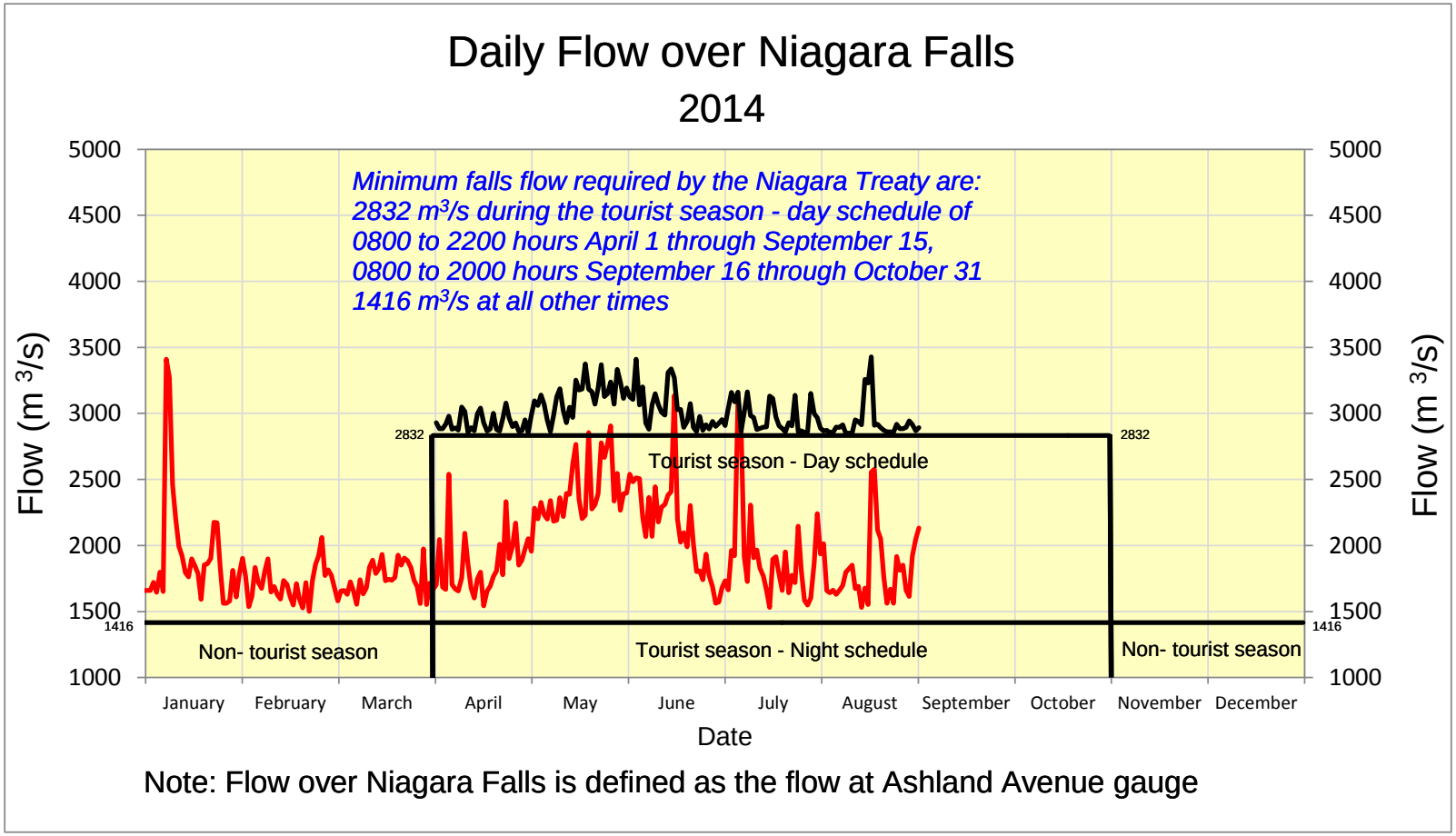
Mr. WILLIAM H. ALLERTON
Member, United States Section


Robert Moses Plant
and Reservoir
Sir Adam Beck Plants
and Reservoir
Location of Cableway Section
N
Ashland Avenue
NIAGARA FALLS,
ONTARIO
NIAGARA FALLS,
NEW YORK
American Falls
NYPA Intakes
NYPA Intakes
LaSalle
Maid-of-the-Mist Pool
International Niagara
Control Works
Beck Intakes
Material Dock
North Grand
Island Bridges
NORTH TONAWANDA
TONAWANDA ISLAND
Slater's Point
NAVY ISLAND
Chippawa-Grass Island Pool
GRAND ISLAND
Tonawanda Island
South Grand
Island Bridges
Black Creek
Huntley Station
Legend
Recording Gauge
Black Rock Lock
Frenchmans Creek
SQUAW ISLAND
International Railway Bridge
Bird Island Pier
Scale
FORT ERIE
Peace Bridge
BUFFALO
1 0 5 km
1 0 5 mi
Fort Erie
Buffalo Water Intake
Windmill Point
Buffalo Harbor
Point Abino
ICE BOOM
Lake Erie

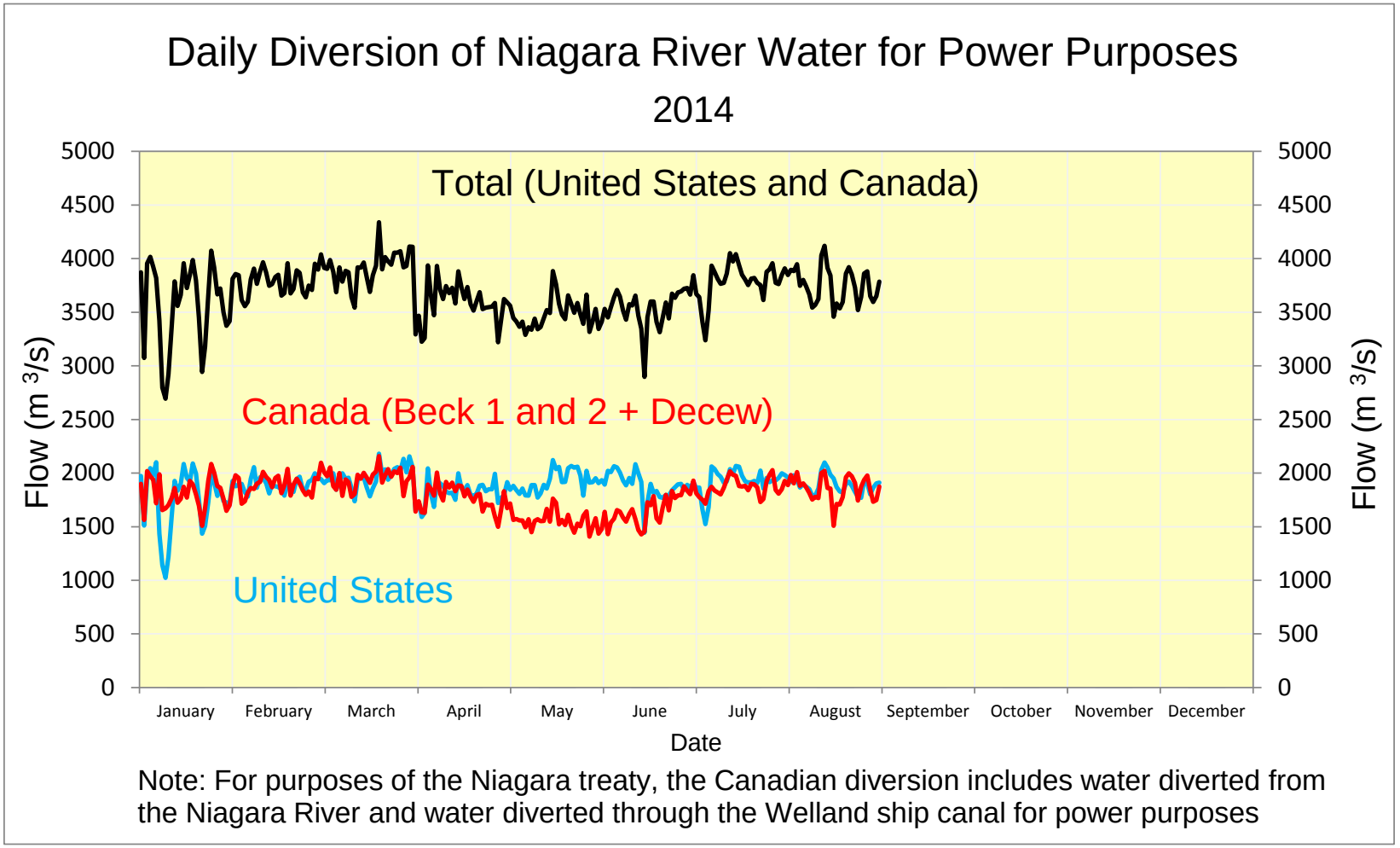
ENCLOSURE 1


Niagara River Daily Mean Level at Material Dock Gauge
2014
172.00
171.75
171.50
171.25
171.00
170.75
170.50
Elevation (m)
January
February
March
April
May
June
July
August
September
October
November
December
Date
Note: Long-term mean level = 171.16 m, IGLD (1985)

Enclosure 2


Daily Flow over Niagara Falls
2014
Minimum falls flow required by the Niagara Treaty are:
2832 m³/s during the tourist season - day schedule of
0800 to 2200 hours April 1 through September 15,
0800 to 2000 hours September 16 through October 31
1416 m³/s at all other times
Flow (m ³/s)
5000
4500
4000
3500
3000
2500
2000
1500
1000
2832
2832
1416
1416
Tourist season - Day schedule
Non- tourist season
Tourist season - Night schedule
Non- tourist season
January
February
March
April
May
June
July
August
September
October
November
December
Date
Note: Flow over Niagara Falls is defined as the flow at Ashland Avenue gauge

Enclosure 3



Note: For purposes of the Niagara treaty, the Canadian diversion includes water diverted from the Niagara River and water diverted through the Welland ship canal for power purposes

Enclosure 4