Appendix to the Progress Reports
to the
International Joint Commission
by the

International St. Lawrence River Board of Control

Covering the periods after
March 2010

APPENDIX OBJECTIVE

The objective of this appendix is to provide the background material that was previously presented in the semi-annual reports of the International St. Lawrence River Board of Control (the Board) to the International Joint Commission (IJC). Providing the material in this manner allows the semi-annual report to focus on the issues and conditions of the reporting period, and the interested reader to refer to this appendix for the background information.

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1. Hydrological Conditions

1.1 Net basin supply to Lake Ontario

Lake Ontario is the furthest downstream of the five Great Lakes. It receives the outflow of lakes Superior, Michigan, Huron and Erie (Figure A-1). Historically, about 80 percent of the water received by Lake Ontario comes from the upstream Great Lakes. Lake Ontario outflows are controlled at a location about 160 kilometres (100 miles) from the lake (Figure A-2), with almost all of the water going through the Moses-Saunders powerhouse. Prior to construction of the powerhouse and navigation locks (Figure A-3), the flow out of Lake Ontario was controlled by a set of rapids that began about 110 kilometres (70 miles) downstream of the Lake, near the towns of Ogdensburg, New York and Prescott, Ontario.

Water supply to Lake Ontario is composed of four main factors (Figure A-4): inflow from Lake Erie through the Niagara River and Welland Canal diversion, precipitation on the surface of the lake, runoff from streams and groundwater flowing into the lake, and evaporation of water from the lake. In addition, water for consumptive use is taken from the lake.

In the semi-annual progress reports, supplies to Lake Ontario are reported in terms of net basin supplies and net total supplies. The definitions of these terms are as follows:

> The net basin supply is the aggregate of the amount of precipitation over the lake, runoff to the lake, including groundwater, and evaporation and consumptive uses from the lake's surface. Precipitation and runoff are estimated by measurements but it is not possible to accurately measure evaporation and consumptive uses. Therefore, the net basin supply is estimated as the difference between the lake's outflow down the St. Lawrence River and inflow from Lake Erie, plus any change in storage within the lake itself as a result of a rise or fall in the lake's level. An indicator of the amount of spring runoff that may be expected is obtained by monitoring the snow pack in the basin.
>
> The net total supply is obtained by adding to the net basin supply the inflows from Lake Erie through the Niagara River and Welland Canal. The Niagara River flow is computed using a stage-discharge relationship for the Niagara River below Niagara Falls and adding the flow through the hydropower turbines located along the Niagara River.

1.2 Supplies of Lake Ontario

A summary of the mean supplies to Lake Ontario for each month in the reporting period is provided in tabular and graphical form as referenced in the text of Section 1. This information includes the inflow from Lake Erie, net basin supply and total supplies, along with some statistical data to assist in understanding how they compare historically.

Also shown are the long-term average monthly net basin supplies and supplies for the previous two years. The horizontal bars above and below the plots are the recorded maximum and minimum long-term monthly net basin supplies for the period of record since 1900.

1.3 Precipitation

Monthly precipitation amounts for the Lake Ontario and Great Lakes basins for each reporting period of the semi-annual reports are provided in a table referenced in Section 1 of the report.

1.4 Snow-pack on the Lake Ontario Basin

The snow-pack on the Lake Ontario basin affects spring runoff supplies when the snow melts; however because of limited snowpack data and lack of skill in predicting melt conditions, the volumes of spring runoff are difficult to quantify.

1.5 Lake Ontario – Net Total Supply

The monthly net total supplies (NTS) to the Lake for each reporting period of the semi-annual reports are provided in tabular form (Table 3) and graphical form (Figure 1) showing the long-term average monthly NTS for the period of record and the supplies for the current reporting period. Also shown, for comparison purposes, are the monthly NTS for the previous two years. The horizontal bars above and below the curves on the graph are the long-term monthly net total supplies maxima and minima for the period of record since 1900. Also shown is a table of the six-month net total supplies for the past ten years for comparison purposes.

1.6 Ottawa River Basin

The Ottawa River is a major tributary of the St Lawrence River joining just upstream of Montreal which contributes to the water level of Lake St Louis at Pointe Claire and points downstream in the St. Lawrence River.

2. REGULATION OF FLOWS AND LEVELS

2.1 Application of Regulation Plan 1958-D

The Board assures that the provisions of the Orders of Approval of the International Joint Commission (IJC) relating to Lake Ontario-St. Lawrence River outflows and levels are met. Control of the outflows and levels of Lake Ontario follows a regulation plan that was designed to satisfy the criteria set out in the IJC's 1956 Orders and other requirements that were established to balance the benefits of regulation among various interests. The current plan of regulation, Regulation Plan 1958-D, was adopted by the IJC in 1963.

In 1961, the IJC authorized the Board to deviate from the outflows specified by the regulation plan in order to provide additional benefits to interests when this could be done without appreciable adverse effects on other interests. Today, the Board reviews conditions in the Great Lakes and Lake Ontario-St. Lawrence River basins at least monthly and establishes outflow strategies for the coming weeks that may or may not include deviations from Plan flows.

The outflow from Lake Ontario is computed weekly by following the procedure laid out in the Board's July 1963 Report to the IJC on Regulation Plan 1958-D. The computational procedure includes the following steps (the reader is referred to the Board's 1963 Report for additional details and considerations):

- Calculation of a provisional flow based on present conditions in the system (e.g., recent supplies and current/computed levels);
- Checking the provisional outflow against operational limits designed to protect interests; and,
- Setting a final 'Plan' outflow.

The Plan outflow is then reviewed by the Board's regulation representatives and operations advisory group (OAG), and assessed against the Board's current outflow strategy and the current operational requirements of domestic water supply, navigation, power and other interests in the system. If all are in agreement, the regulation representatives, on behalf of the Board, recommend an outflow for the coming week to the government representatives who direct the hydropower entities (who operate the structures that control the outflows) on the outflow. If not all OAG members and regulation representatives agree on the flow for the coming week, the Board is called upon to decide.

To aid in decision making, the Board analyses the risk of exceeding the criteria of the Orders and other water level indicators developed by the Board through experience.

2.2 Board regulation strategies and actions

In order to be responsive to changing conditions and the needs of various interests, the Board may hold teleconferences to review conditions in the Great Lakes-St. Lawrence River system and develop outflow strategies to respond to conditions and ensure that the Board is able to offer assistance to interests in times of critical need. The outflow strategies are designed to enhance the benefits provided by Regulation Plan 1958-D while not causing appreciable adverse effects to any interest. The Board members are provided an assessment of conditions at the beginning of each month. The strategy decisions made during the reporting period, and their rationales, are available in the minutes of the Board's meetings as published on the Board's Website: http://www.ijc.org/en_/islrbc/home .

Figures referenced in Section 2 of each semi-annual report show the daily Lake Ontario outflows during the reporting period, and the Lake Ontario actual daily and weekly computed Plan 1958-D and pre-project condition levels during the reporting period. The Board's deviations from Plan 1958-D during the reporting period are summarized in tabular form as referenced in this section.

2.3 Ice management

The hydropower entities install a series of ice booms each winter in the international section of the river to aid in the formation and stabilization of the ice cover. Hydro Quebec also installs a series of ice booms in the Beauharnois Canal each year. The Board does not direct the installation or removal of any of these booms. Installation and removal of the booms is coordinated between the hydropower entities and the St. Lawrence Seaway. The booms are normally removed as the ice deteriorates locally. Deviation from Plan 1958-D is usually required for ice management, as lower flows assist in the formation of a stable ice cover, and subsequently higher flows are required to remove stored water.

2.4 Iroquois Dam operations

Under the conditions of paragraph (j) of the IJC's Order of Approval dated 29 October 1952, the power entities are permitted to operate Iroquois Dam with Board approval. The gates of the dam can be lowered into the water to assist in ice formation and to reduce the level of Lake St.

Lawrence when there are low outflows. Boaters must use the Iroquois lock to bypass the dam when the dam gates are in use.

2.5 Results of Regulation

2.5.1 Upstream

Lake Ontario

The effects of inflow conditions moderated by Regulation Plan 1958-D and the Board's outflow strategies on the daily water levels on Lake Ontario for the previous two years and the current year to date are shown in Figure 3 of each of the semi-annual reports, compared to the long-term average starting in 1918. As a means of informing the IJC on the impacts of regulation activities on levels and outflows, the Board provides the IJC with a comparison of Lake Ontario's actual monthly levels and outflows to those that would have been obtained under preproject conditions (that is, the levels and outflows that would have occurred had regulation not been undertaken). A summary of this comparison for the reporting period is provided in a table referenced in this section of the report. The referenced figure provides a comparison of the daily levels to long-term average, and the levels of the previous two years.

Lake St. Lawrence

The period of record for this water level gage is from 1960.

2.5.2 Downstream

Lake St. Francis at Summerstown

The regulation of Lake Ontario outflows has a limited effect on the levels of Lake St. Francis, as the lake level is regulated by hydropower plant operations at Beauharnois and Les Cèdres, Québec. The historic range of monthly mean levels on Lake St. Francis since completion of the Moses-Saunders project is about one-fifth that of Lake St. Lawrence. The water levels of Lake St. Francis are shown in a figure referenced in Section 2 of each of the semi-annual reports. The period of record for this water level gage is from 1960.

Lake St. Louis at Pointe Claire

Lake St. Louis water levels, in contrast, are influenced by the discharges from both the St. Lawrence and Ottawa Rivers, and are subject to much greater fluctuations. The period of record for this water level gage is also from 1960.

Port of Montreal

Water level fluctuations in Montreal Harbour are influenced by the discharges from the St. Lawrence and Ottawa Rivers, winds, the tide, and in winter, by downstream ice conditions. The water levels of the harbor are shown in a figure referenced in Section 2 of each of the semi-annual reports. The period of record for this water level gage is from 1967. Water level data prior to 1967 are not used to compute the averages or extremes as the St. Lawrence River near and below Montreal was altered by a dredging project in 1967.

3. BOARD ACTIVITIES

3.1 Board Meetings & Conference Calls

The Board, as mentioned in the previous section, oversees the operations of the hydropower project in the international reach of the St. Lawrence River. The Board, primarily through the offices of the regulation representatives, monitors conditions throughout the Lake Ontario-St. Lawrence River and Ottawa River systems. The regulation representatives provide the board with weekly regulation data, monthly reviews of hydrological conditions, monthly risk analyses using water level outlooks, and advise the Board on regulation strategy options and their potential impacts on water levels and interests throughout the system. The Board's operations advisory group (OAG) holds weekly teleconferences to apprise the regulation representatives of operational requirements and constraints. The committee on river gaging monitors the power entities' program for operation and maintenance of the gaging system required for Board operations, and reports to the Board annually.

The Board typically assesses conditions on a monthly basis in the basin and adjusts its regulation strategy through meetings, conference calls, telephone and e-mail. Should conditions change rapidly, the Board can (and has) met more often. Board members in attendance at these meetings and teleconferences are noted in a table referenced in this section.

3.2 Public Outreach and Engagement

The Board members and associates present on topics related to the Board when invited, post regularly on its Facebook page, https://www.facebook.com/ISLRBC , and photos to its Flickr page, https://www.flickr.com/photos/ijc_islrbc as well as providing learning modules and FAQs on its website: http://www.ijc.org/en_/islrbc/home. The Communications Committee, individual

Board members and the secretaries actively engage in outreach, information exchange and liaison with stakeholders throughout the Lake Ontario-St. Lawrence River system. Board members and staff respond to a number of inquiries and requests for interviews from the media and general public concerning water level conditions and the Board's strategies. These are detailed in each semi-annual report to the IJC.

The Board's experience demonstrates that communications have become ever more important to the Board and IJC. Therefore, effective communications remains a key focus of the Board. Each semi-annual report summarizes the Board's communications activities during the reporting period. To lead this effort, the Board has a standing committee (the Communications Committee), consisting of two Board members, the Board secretaries, the regulation representatives, and the public information officers of the IJC. The board actively works with the Great Lakes St Lawrence River Adaptive Management Committee on public outreach and engagement.

4. RIVER GAGING COMMITTEE REPORT

The Board's St. Lawrence Committee on River Gaging monitors the power entities' program of operating and maintaining 15 water level gages required for the Board to monitor water levels and flows related to the operation of structures and forebay elevations. The committee members are the U.S. regulation representative (U.S. Co-chair), a representative from Ontario Power Generation (Canadian Co-chair), a representative from the New York Power Authority and the Canadian regulation representative. Committee associates perform annual inspections of the water level gaging network.

The Committee thus ensures the accuracy of flow and water level measurements. This includes annual inspections of the computational methods used at each of the eight outflow structures as well as auditing the power entities' data processing. The committee is charged with providing the Board with an annual report on the inspection results and computed outflows. Each semi-annual report records the status of the river gaging committee annual reports and any recent issues.

5. RAISIN RIVER DIVERSION

The Raisin River diversion is located at the village of Long Sault, ON. It is operated by the Raisin Region Conservation Authority to augment flow in the upper reaches of this small river, as necessary. The purpose of this diversion is to augment low summer flows in the Raisin River to provide a reliable source of water for farms and villages, and to improve the environment for fish and wildlife, as well as recreational uses.

6. ST. LAWRENCE SEAWAY REPORT

Each semi-annual report records the first or last ship of the recording period.

7. HYDROPOWER PEAKING AND PONDING

By letter dated 13 October 1983, the IJC authorized Ontario Power Generation and the New York Power Authority to continue to carry out peaking and ponding operations at the Moses-Saunders Dam. Conditions governing peaking and ponding operations are specified in Addendum No. 3 to the Operational Guides for Regulation Plan 1958-D. The authority to peak and pond had been subject to IJC review and approval every five years. However, the IJC approved peaking and ponding operations on 28 November 2011, until the adoption of any revised Orders for the regulation of the St. Lawrence River or a period shorter than five years.

The semi-annual reports record peaking and ponding activities which occurred during the reporting period.

8. BOARD AND COMMITTEE MEMBERSHIP CHANGES

Each semi-annual report records changes in membership of the Board, its regulation representatives, secretaries, gaging committee, and operations advisory group.

9. ABBREVIATIONS AND TERMS USED IN THIS REPORT

actual (data)	the actual recorded value
avg	average
Board	International St. Lawrence River Board of Control (unless otherwise specified)
cfs	cubic feet per second
cm	centimetre(s)
cms	cubic metres per second
computed level, outflow	the level or outflow computed by Regulation Plan 1958-D
deviation (outflow)	a Lake Ontario outflow different from the Plan 1958-D outflow
exceedence probability	the percent of time that the value was exceeded in the past
ft	foot/feet

IJC	International Joint Commission
ISLRBC	International St. Lawrence River Board of Control
in	inch(es)
lake	Lake Ontario (unless otherwise specified)
level	water level
LTA	long-term average
m	metres
m^3/s	cubic metres per second
mm	millimetres
NYPA	New York Power Authority
OAG	the Board's operations advisory group
OPG	Ontario Power Generation
Peaking	hour-to-hour flow changes over the course of a day
Plan	Regulation Plan 1958-D
Ponding	day-to-day flow changes over the course of a week
preproject	the levels and outflows that would have occurred had regulation not been undertaken
regulation	management of levels and flows in the Lake Ontario-St. Lawrence River system by physical control of outflows from Lake Ontario
Regulation Plan 1958-D	current plan of regulation for Lake Ontario
Seaway	the St. Lawrence Seaway (commercial navigation facility)
Study Board	International Lake Ontario-St. Lawrence River Study Board
supply	quantity of water received
tcfs	thousand cubic feet per second

Figure A-1. Great Lakes Drainage Basin - St. Lawrence River system

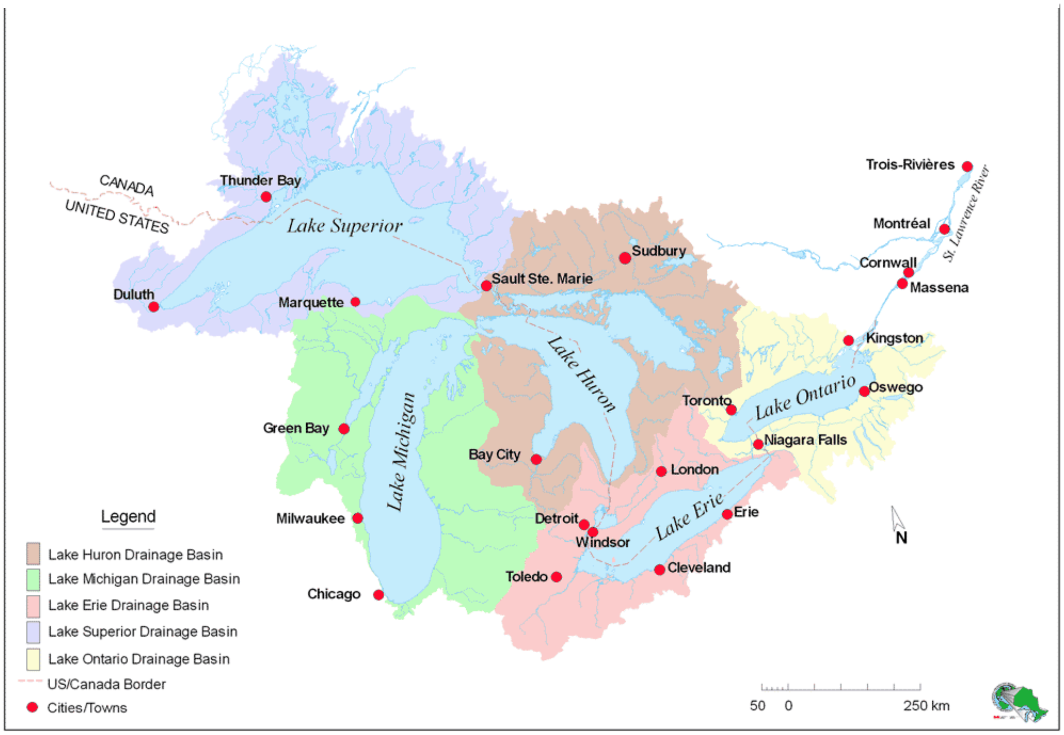

Figure A-2. Map of Lake Ontario-St. Lawrence River system

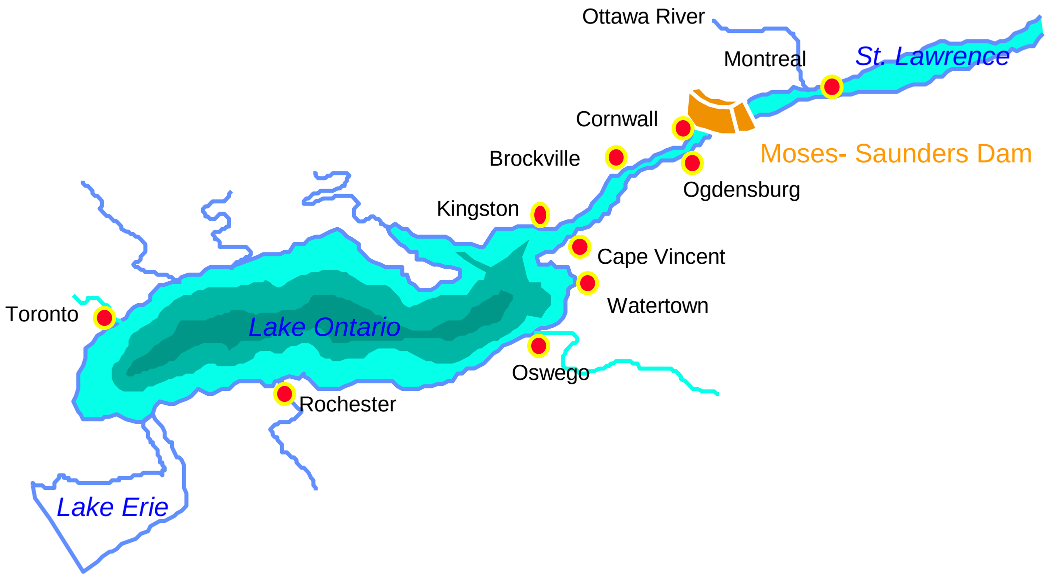

Figure A-3. Map of Upper St. Lawrence River control structures