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**US Army Corps of Engineers**
Detroit District

# Great Lakes Update

## 2005 Annual Summary

All of the Great Lakes water levels began 2005 higher than the previous year, but very dry conditions led to lower water levels by the end of 2005. Snow water equivalent values were higher than average in March, indicating a good possibility of water level increases. However, lower than average spring precipitation led to the development of moderate and severe drought conditions across the entire Great Lakes basin. Figure 1 shows 2005 precipitation across the Great Lakes basin compared with average. Note the number of consecutive months (9) having below average precipitation.

Lake Superior's water level was near average in early 2005, but fell below average by April. Lake

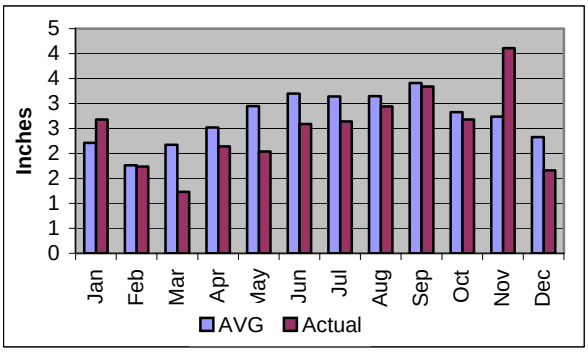


**Figure 1: 2005 Great Lakes Precipitation**

Michigan-Huron remained below average during all of 2005 and is currently below chart datum. The remaining Great Lakes and Lake St. Clair saw higher than average water levels in early 2005, but again dry conditions led to below average levels by year's end for all the lakes except Lake Ontario.

### Hydrology

Ice cover in 2005 on the Great Lakes was at its maximum during the middle of March. Lakes Erie and St. Clair were completely iced over while the upper lakes had over 50% ice cover. Ice cover reduces the loss of water to evaporation and slows the seasonal decline of water levels.

Figure 2 shows the snow water equivalent (SWE) across the upper Great Lakes basin. Values were 50% higher than average in 2005. During its peak in early March, SWE values were 8-11 inches in the major snow belt regions and 6-10 inches across the northern shoreline of Lake Superior. The National Weather Service conducts snow surveys using low-flying aircraft over the Lake Superior drainage basin each year to help in predictions of water supplies to the Great Lakes. A similar survey will be made this winter and the results will be used to forecast Great Lakes water levels for the spring-autumn period.

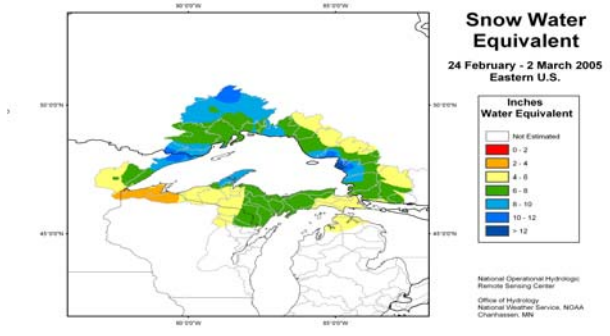


**Figure 2: Snow Water Equivalent**

Runoff from melting snow combined with increased spring rainfall brings on the period of seasonal rise on

the Great Lakes. While the total SWE was above average, spring rainfall was significantly below average, especially on the Lake Superior and Lake Michigan-Huron basins. The result of the dry conditions was a smaller than average seasonal rise on the upper lakes and widespread drought conditions across the Great Lakes basin. Warmer than average temperatures accompanied the dry conditions during the summer months. Air temperatures were 2 to 4 degrees warmer than average during the summer, which led to the highest surface water temperatures on the Great Lakes in the last 5 years. Warmer surface water temperatures are a precursor to possible increased evaporation rates during the fall and early winter.

September, October and November brought near and above average precipitation to the Great Lakes basin. During these months, the Great Lakes usually enter their period of seasonal decline. This wet period, especially in November kept the lakes from falling as much as they normally would.

The Climate Prediction Center (CPC) of the National Weather Service issues seasonal outlooks for both temperature and precipitation conditions. The CPC's latest winter outlooks for the Great Lakes region indicate equal chances for above, below or normal temperature and precipitation conditions. These outlooks are mostly based on neutral sea surface temperatures in the Pacific Ocean. Neutral sea surface temperatures show no indication of El Nino or La Nina and effects on weather patterns are negligible.

The latest Monthly Bulletin of Lake Levels predicts lower water levels on all the Great Lakes when compared to 2005.

## Water Levels

The *"Monthly Bulletin of Lake Levels for the Great Lake"* displays water levels on the Great Lakes for the years 2004 and 2005. The following discussion uses monthly mean levels.

Lakes Superior, Michigan-Huron, St. Clair, and Erie began 2005 at water levels higher than those of January 2004. Only Lake Ontario was lower.

Lake Superior levels started 2005 at 601.4 feet, 1 inch below its January LTA. Levels peaked in July at 601.8 feet, 4 inches below its July LTA. The lake ended the year at 601.4 feet, 5 inches below its LTA.

Lakes Michigan-Huron began the year at 577.7 feet, 10 inches below its January LTA. The lake peaked in June at 578.1 feet, 15 inches below its LTA. The year ended at 577.1feet, 18 inches below its LTA.

Lake St. Clair started out at 574.1 feet, 6 inches above its January LTA. Levels peaked in April at 574.4 feet, 2 inches above its LTA. The year ended at 573.2 feet, 8 inches below its LTA.

Lake Erie began 2005 at 571.7 feet, 10 inches above its LTA. The lake peaked in May at 572.2 feet, 4 inches above its LTA. Levels ended the year at 570.4 feet, 5 inches below its LTA.

Lake Ontario started 2005 at 245.2 feet, 8 inches above its January LTA. Levels peaked in May at 246.5 feet, 3 inches above its LTA. The year ended with levels at 244.6 feet, 1 inch above its LTA.

## Lake Superior Regulation

During 2005, the International Lake Superior Board of Control (Board) continued to use Regulation Plan 1977-A as the basis for determining Lake Superior outflows. The Board is a bi-national body that reports to the International Joint Commission (IJC) on boundary water management issues including the management of Lake Superior outflows. Flow changes resulting from monthly Lake Superior regulation are accomplished by varying the amount of water allocated to hydropower production and, when necessary, opening or closing gates in the Compensating Works at the head of the St. Marys Rapids.

Annual water supplies to Lake Superior were below average in 2005. Only February, June, October, November and December were above average. Annual precipitation over the Lake Superior basin was below average. In order to maintain minimum flow requirements in the St. Marys Rapids and to support fishery spawning a one-half gate open setting was maintained in the Compensating Works during 2005 except for July and August when Regulation Plan 1977-A called for five gates open and one gate open , respectively. Flow measurements used to support gate flow recalibration were done from August 3rd through the 12th at the Compensating

Works. During this time gate settings ranged from ½ to 7 gates open. At the end of the measurements the gates were set at a one-half gate open setting where they remained. October 25th, in support of U. S. Coast Guard and Canadian authorities efforts to recover a drowned fisherman from the rapids area below the Compensating Works all gates were closed except for Gate 16, which was opened 18 inches to maintain flow in the rapids during recovery operations. When recovery operations were complete the gates were returned to their original setting of one-half open.

Flow variations due to peaking and ponding operations by the hydropower plants at Sault Ste. Marie, Michigan and Ontario cause St. Marys River water levels downstream of the plants to fluctuate. When Lake Superior levels and outflows are below average these fluctuations can be of concern to commercial navigation users. Comparing 2005 to 2004, Lake Superior outflows were higher than those of 2004 from January to August, while levels were higher from January to July.

In May 2004 the IJC renewed the authority to continue peaking and ponding operations by the hydropower companies. The authority was extended to March 20, 2006 and is subject to prior approval by the Board each month. The Board may suspend ponding operations on weekends and holidays for 8 hours each day if operations are expected to cause sustained weekend levels at the U.S. Slip gauge to be below chart datum. The Board suspended weekend and holiday ponding operations during October (last two weekends), November and December because St. Marys River levels at U.S. Slip gauge were expected to be, or were, below chart datum. Lake Superior levels and outflows and Lakes Michigan-Huron levels were sufficiently high enough during the rest of the 2005 shipping season that ponding operations were allowed.

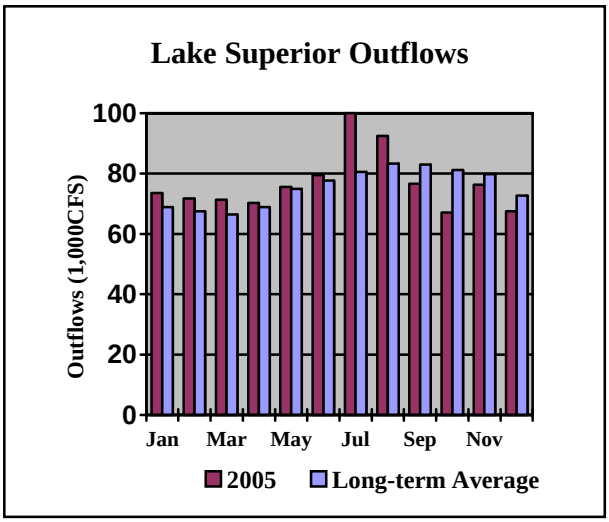


**Figure 3: Lake Superior Outflows**

Outflows were 3% above average in 2005, ranging from a low of 67,100 cubic feet per second (cfs) in October to a high of 108,800 cfs in July. Figure 3 compares the monthly Lake Superior outflows in 2005 to long-term average flows for the 1900-1999 period of record.

Further information can be found on the Internet at: *http://www.lre.usace.army.mil/glhh*

## Lake Ontario Regulation

As part of its operations, the International St. Lawrence River Board of Control (Board) periodically assessed the hydrologic conditions in the Lake Ontario - St. Lawrence River system to formulate an outflow regulation strategy.

By the end of November 2004 Lake Ontario was at its low for the year, about 3.1 inches below its long-term-average (LTA) for that time of the year and 8.3 inches below its year ago level.

In December 2004 the Board reviewed conditions in the Lake Ontario-St. Lawrence River basin and decided to maintain its strategy of outflows as specified by Plan 1958-D with provision to vary outflows as needed to assist the ice formation process. Over discharges were also authorized if necessary due to low levels in the Montreal area and to meet critical hydropower needs. By the end of December 3.7 inches of water was stored on Lake Ontario.

Ice cover formation began in the Beauharnois Canal near Montreal late in December. By January 21st, ice cover was complete in the canal, and in the International Section by January 27th. Typically this is done each winter after the navigation season is closed. Rough ice cover increases resistance to water flow, and weak ice cover risks ice jams, which could be problematic for outflow regulation during the winter. Various flow deviations were authorized by the Board between January 29 and February 4 to aid in ice stabilization.

Mild weather in the first half of February caused the loss of much of the ice cover in the main channel from Morrisburg upstream to Cardinal. On February 15, the two main ice booms that spanned the St. Lawrence River broke near mid-channel. In spite of the ice boom failure and unusual ice conditions, outflows in January and February were as specified by Plan 1958-D and 1.1 inches of water was stored on Lake Ontario.

In March 2005, the Board modified the regulation strategy that had been in place since the previous fall. On March 9, the Lake Ontario level was 245.60 feet, 8.7 inches above average, and 5.5 inches above the level one year earlier. This was mainly due to above average supplies and precipitation during the previous month. The Board's new strategy was to eliminate the conserved water on Lake Ontario, as conditions allowed. By March 25, water stored on the lake was decreased to 0.9 inches.

The ice cover in the International Section gradually deteriorated in March with no problems. On March 30-31 in the Beauharnois Canal a large amount of ice broke loose in the canal and jammed on the upper side of the powerhouse damaging turbines. This forced an emergency flow reduction on March 31 and April 1. By April 1, the Lake Ontario level was 245.50 feet, 2.8 inches above average, and 2.4 inches above the level one year earlier resulting in 1.1 inches of water stored on Lake Ontario.

Water supplies to Lake Ontario were above average in 2005. Only March, June, July, August, and September. Annual precipitation over the Lake Ontario basin was below average. In order to keep Lake Ontario water levels within regulation and maintain minimum flow requirements in the St. Lawrence River to support shipping, The Board decided to closely follow the outflows prescribed by regulation Plan 1958-D throughout the year.

Adjustments to Plan 1958-D were made intermittently to accommodate various situations throughout the year. Flows higher than those specified by Plan 1958-D were released March 19-25. Levels downstream were maintained below flood alert level and capacity of the hydropower facilities. This was done to reduce conserved water on Lake Ontario. The Lake Ontario outflow had been reduced below the Plan 1958-D flow for several days during the first and last weeks of April, due to the levels of Lake St. Louis rising above the flood alert level of 72.5 feet at Pointe Claire. Lake St. Louis would have risen to approximately 74.15 feet if the Board had not reduced Lake Ontario outflows. Very dry conditions in May resulted in below average supplies to Lake Ontario. The Board reviewed conditions and decided to maintain outflows prescribed by Plan 1958-D, with the provision to allow over-discharges as needed to meet critical hydropower needs. During May and June, flows were increased 2-days to accommodate ships entering the Port of Montreal and to meet the hydropower needs in New York State and Ontario. The flow increases resulted in 0.1 inches of water being removed from Lake Ontario. The Board maintained this strategy through September due to below average precipitation and supplies to the basin.

Lake Ontario peaked at 246.55 feet on May 3, 7.1 inches above the LTA for that time of year, and 6.7 inches above the level a year ago. The net accumulated deviations, as a result of under-discharges, was 1.9 inches of water stored on the Lake. By mid-July the Lake Ontario level had fallen to 245.86 feet, 2.8 inches below LTA, and 6.3 inches below the level of a year ago. The level of Lake Ontario underwent its normal seasonal decline for the September to mid-October period, and by October 28, the Lake Ontario level was 244.68 feet, 0.8 inches above average, and 0.4 inches below the level of one year earlier, and the Board actions from August through October resulted in a net accumulated deviation to 1.6 inches of water stored on the Lake.

Lake Ontario's level rose slightly during the month of November ending the month at 244.71 feet, a rise of 0.8 inches compared to the beginning of the month. This level was 4.3 inches above the level of one year earlier. On average, the Lake Ontario level falls by 1.2 inches in November. During November, the Lake Ontario outflow was as specified by Plan 1958-D.

Lake Ontario ended December at 244.6 feet, 1 inch above its LTA, with about 1.6 inches of water conserved on Lake Ontario.

Figure 4 below compares 2004 Lake Ontario outflows with period of record (1900 - 1999) monthly LTA outflows. Further information on ILSBC activities can be found on the internet at: *http://www.islsrbc.org/*.

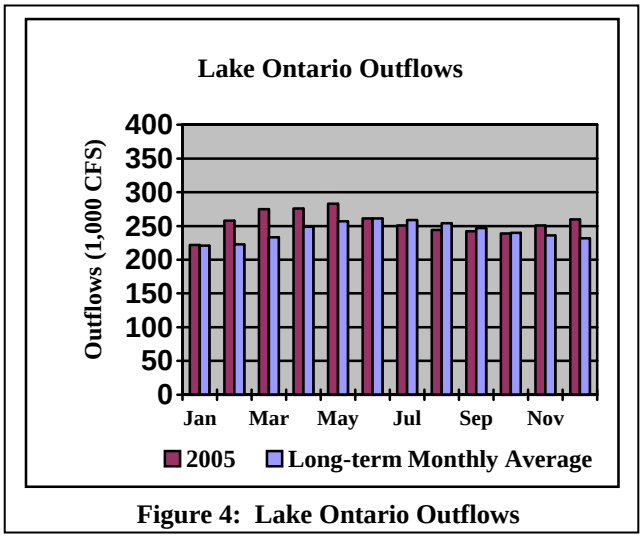


**Figure 4: Lake Ontario Outflows**

## Public Concerns

Concerns have been expressed about the impacts of below average water levels on boating, access, shoreline property, wetlands, businesses, erosion and water quality. The large change in the St. Marys River flow in July due to the five gates open setting at the Compensating Works required by Plan 1977-A caused concern. Georgian Bay residents expressed concern about St. Clair River flow capacity increases. Via letters and telephone calls fishery biologists, lamprey control scientists, and anglers expressed concerns about the increases in the St. Marys River flows during July and the August flow measurement program. The news media has continued to show interest in lake levels and their effects on the ecology and economics of the region.

## Upper Great Lakes Plan of Study

In May 2005, the IJC decided to revise its plan for an Upper Great Lakes Study. The directive focuses on reviewing IJC Orders for Lake Superior outflow regulation and water level impacts on affected interests in the upper Great Lakes system from Lake Superior downstream through Lake Erie. The revised plan will assume no changes to the Treaties and other bi-lateral agreements between Canada and the United States will be made.

Two recent events that might impact the study were also added to the study plan. The first issue looks at possible physical changes in the upper St. Clair River, which could impact water level changes on the upstream (Michigan-Huron) and downstream lakes (St. Clair and Erie). The second issue involves incorporating lessons learned from the near complete Lake Ontario – St. Lawrence River Study, which may help streamline the study.

The study area is quite large, encompassing Lake Superior, Lakes Michigan-Huron and Georgian Bay, Lake Erie, and all connecting channels. Due to the large geographic area of the study, the study will need to rely on existing data and studies for use in a streamlined evaluation methodology.

At first, efforts will focus on improvements to Lake Superior outflow regulation including: a review of how Lake Superior outflow regulation affects water levels and flows in the upper Great Lakes system; identification of potential improvements to the regulation plan; reviewing current institutional arrangements governing Lake Superior outflow regulation; and, testing regulation plan performance under climate variability scenarios.

Also during the early part of the study, the factors affecting physical changes in the St. Clair River will be investigated to provide a better insight into current water level changes. Factors include: precipitation, evaporation, tributary flows; diversions and consumptive uses; glacial rebounding and subsidence; and, flow capacity of the St. Clair—Detroit River system. Investigation of potential remediation options will be done if required.

Water management options will be explored and their effects on resources including: ecosystems; recreational boating and tourism; hydropower; commercial navigation; municipal, industrial, and domestic water use; and coastal zone will be investigated.

Public consultation on the draft plan of study was conducted at four locations in the basin during September and comments were received through the IJC web site, e-mails, and letters. All comments were incorporated to the maximum extent possible during the development of the final version of the Plan of Study. Following public consultation the final Plan of Study was submitted to the IJC on October 14, 2005. Implementation of the Plan of Study would not be initiated until funds are appropriated by the Governments of the United States and Canada.

## The International Lake Ontario-St. Lawrence River Study Board completes its Five-Year Study

The International Lake Ontario-St. Lawrence River Study Board held its final meeting with the IJC on December 5, 2005 ending its five-year Study to develop a revised regulation plan for Lake Ontario.

The current plan, 1958-D, which has been in effect since October 1963, was designed for the hydrologic conditions experienced from 1860 to 1954. For that reason, 1958-D has not performed well under the extreme high and low water supply conditions experienced since that time. As a result, the Commission and its International St. Lawrence River Board of Control have had to deviate from the Plan to better address changing needs and interests.

In December 2000, the Commission issued a directive to the International Lake Ontario-St. Lawrence River Study Board to:

- review the current regulation of levels and flows in the Lake Ontario-St. Lawrence River system;
- develop an improved understanding of the system among all concerned; and
- provide all information needed for the review.

Over the five-year Study period, a considerable amount of new data was collected and scientific investigations performed. Innovative technologies were applied to develop and evaluate new regulation plans. Many new findings, conclusions and clarifications of previously uncertain views and theories were developed during the course of this work.

The Study Board introduced a new planning approach referred to as "Shared Vision Planning." This approach combines scientific and public input in an interactive analytical framework that has helped the Study Team and Public Interest Advisory Group explore numerous plan formulation opportunities, operating nuances and performance impacts in an organized fashion. Ecosystem response, shoreline dynamics and economic models were incorporated to evaluate costs and benefits.

The Study Board used highly sophisticated hydrologic modeling to ensure the reliability, resilience and robustness of each plan scenario. In addition, the Board analyzed four different climate change scenarios and used them to thoroughly test candidate plans, ensuring plan performance under extreme potential conditions.

Throughout 2005, workshops and public meetings were held to refine options and incorporate stakeholder input. Through these meetings, workshops, and input from the study's Technical Work Groups, three plan options have emerged, which address a wide range of interests and within the basin.

All plans were judged on an objective appraisal of economic and environmental scores. Each candidate plan fulfills two of the Study Board's principal goals of providing net economic and environmental improvements, when compared to the existing plan of operation, Plan 1958-D with deviations. However, it is difficult to satisfy, at all times, the myriad of specialized demands on the part of each of the competing interests in the Lake Ontario–St. Lawrence River system. Changes to the criteria and existing operating plan are not possible without harm to some interests. The majority of Board members do not consider these damages a "disproportionate loss."

The Study Team's analysis uncovered a number of surprises and challenged conventional wisdom on many fronts, especially in the comparison of various alternative plans against Plan 1958-D with deviations. The current operating plan comes close to minimizing damages for Lake Ontario shoreline property owners. Regulation plans developed to optimize benefits for shoreline property interests on Lake Ontario could only improve benefits to Ontario shoreline properties by an average of less than $1 million U.S. per year, while causing major losses elsewhere in the system. Erosion of a certain amount of Lake Ontario shoreline will occur regardless of the regulation plan. The difference between plans lies in how quickly it will happen.

On the lower St. Lawrence River downstream of the Moses-Saunders dam at Massena, New York/ Cornwall, Ontario, there are some flood damages that, although not large in economic terms relative to some other interests, result in differences between

plans that can be significant downstream of Montreal in the Sorel/Lac St. Pierre area. Shoreline erosion on the lower river is not a major economic issue since most developed properties are already protected.

A key issue raised by recreational boaters throughout the system is the desire to maintain higher water levels until later in the fall, thereby extending the boating season and making it easier to haul boats out of the water. Each of the candidate plans provide benefits to boaters to varying degrees.

All plans produce benefits for commercial navigation, with the main difference between the candidate plans being costs due to delays in shipping on the Seaway. There is usually enough water on Lake Ontario to keep ships fully loaded, and none of the candidate plans is significantly better than the rest in terms of avoiding shallow depths in the Seaway. The plans do differ in how well they maintain minimal acceptable depths at the Port of Montreal, especially during extended droughts.

All plans produce benefits in terms of hydropower. Benefits are greatest when releases are similar to those that would occur without regulation, assuming actions to limit ice jams in the winter and early spring.

Municipal, industrial and domestic water-use facilities are generally not vulnerable to water level changes. The exceptions are the Russell and Ginna power generating stations and the Monroe County potable water treatment plant in Greece on the south shore of Lake Ontario. The Monroe County facility would experience problems within the historical high water level range, the Ginna station at historical low water levels, and the Russell station at both historical high and low levels. Under any plan, all facilities will require upgrading to remain fully operational under high or low water level conditions in the future. The Study also found that the Montreal water supply system could be at risk under very low flow and level.

The current regulation plan of operation has reduced the range and occurrences of extreme Lake Ontario levels as intended under the existing Orders of Approval. From an environmental perspective, this has reduced the diversity of plant types along the shore, decreased wetlands, and cut populations of animal species who rely on coastal wetlands. All of the candidate plans provide limited environmental improvements over the present plan of operation. The Study's Environmental Technical Work Group has taken the position that the best plan for the natural environment is one that would provide natural "pre-Moses-Saunders-dam" level and flow conditions and that a plan that to provide such conditions should be considered a long-term goal for the system.

Stakeholder participation and collaboration had a decisive role in the formulation and evaluation of all plans, as well as the final set of candidate plans that the Study Board has forwarded to the Commission

The Study represents a unique opportunity to make a change – to literally rebalance the system once in 50 years. But trade-offs have to be made among the competing interests. These trade-offs have been quantified the relative benefits and costs determined. The result is an intensive, comprehensive and detailed analysis of the physical and ecological dynamics that are interacting with the human uses of the system.

The final decision by the Commission will be a difficult one, as it tries to balance all interests equitably. The Study's final report will be available in the Spring of 2006. The Commission will be holding a set of public meetings after release of the report to gather additional input before a final decision on an option is made. Check the Study's website: www.losl.org for further updates and the IJC's website: www.ijc.org for future activities.

## Meetings with the Public

The International Lake Superior Board of Control hosted a multi-city conference call for the public on July 12, 2005 between Sault Ste. Marie, Michigan and Midland, Ontario.

The International Niagara Board of Control (INBC) met on March 8 and September 21, 2005 to discuss routine matters under the Board's jurisdiction. The board held its annual meeting with the public on September 20, 2005 in Niagara-on-the-Lake. For more information on activities of the INBC visit: *http://www.ijc.org/conseil_board/niagara/en/niagara/_home_accueil.htm*

The St. Lawrence River Board of Control held its annual meeting with the public on May 11, 2005 in

Belleville, Ontario. It held two multi-city teleconferences. The first was on March 29, 2005 between Dorval, Que.; Brockville, Ont.; Burlington, Ont.; Oswego, NY.; and Rochester, NY. The second was held on September 14, 2005 between Montreal, Que.; Cornwall, Ont.; Whitby, Ont.; Alexandria Bay, NY.; and Rochester, NY. At each of its public events, the Board described how it functions, how regulation works, the context underlying the regulation strategies of the past year and the outlook of water levels for the summer and fall.

## Commercial Navigation

The Soo Locks opened the 2005 shipping season on March 25, 2005 as scheduled. Through November 2005, the estimated tonnage passing through the Soo Locks at Sault Ste. Marie, MI was about 1.4% below the comparable 2004 tonnage. U.S. and Canadian vessels carried 52.7 and 14.2 million short tons (MST) of cargo respectively, as compared to respective 2004 tonnages of 53.3 and 14.3 MST. Foreign flagged vessels carried about 3.56 MST down 6.7% from the 2004 tonnage of 3.8 MST.

Through November 2005, an estimated total of 7,006 vessels had transited the locks as compared to 6,990 vessels the previous year. Cargo vessels totaled 3,656 compared to 3,626 the year before. There were 2,188 U.S. flagged vessels, 1,058 Canadian flagged vessels and 410 foreign flagged vessels (ocean going or "salties"). Other vessels transiting the locks such as pleasure craft, tour boats, Cost guard and scientific research vessels numbered 3,350. The U.S. locks will close on January 15, 2006 and reopen on March 25, 2006.

The Canadian lock at Sault Ste. Marie, Ontario opened May 15, 2005. By season-end on October 15, 2005, a total of 2,780 vessels carrying 85,742 passengers had transited the locks. The vessels were primarily pleasure craft and tour boats, as well as some commercial and government vessels. The lock is expected to reopen in mid-May 2006.

Preliminary figures through November 2005 indicate the tonnage passing through the Lake Ontario-Montreal section of the St. Lawrence Seaway was down about 0.4% from 2004 at about 27.8 million metric tons (MMT). Vessel traffic was down about 0.04% over 2004 at 2,441 (combined lake and ocean vessels).

Preliminary data on the type of cargo transiting the Seaway through November 2005 include iron and steel down 34.2% to about 2.33 MMT); grain up 2.1% to about 8.15 MMT); Coal down 8.5% to about 0.63 MMT); general cargo down 26% to about 3.0 MMT); and petroleum products down 4.7% to about 1.4 MMT); For additional details on Seaway activities visit their website on the Internet at: *http://www.greatlakes-seaway.com/.* The St. Lawrence Seaway Development Corporation provided these figures.

## New Lock

A new "Poe sized" lock is proposed to replace the existing Davis and Sabin Locks at the Soo Locks complex at Sault Ste. Marie, MI. The purpose of this project is to provide for more efficient movement of waterborne commerce. Approval of the Limited Re-evaluation Report (LRR) by the Assistant Secretary of the Army for Civil Works (ASA CW) and execution of the Project Cooperation Agreement (PCA) with the non-Federal sponsor, the Great Lakes Commission (GLC) is still required. It is anticipated that approval of the LRR and PCA execution will be completed in FY 06.

## 2005 Great Lakes Updates

The following reports were published in 2005:

**2004 Annual Summary**, Vol. No. 158, January 2005.

**Celebrating 150 Years at "The Soo"**, Vol. No. 159, April 2005

**Upper Great Lakes Plan of Study Revisited**, Vol. No. 160, July 2005

**Wave Absorbers at Federal Harbors on the Great Lakes**, Vol. No. 161, October 2005

Previous Great Lakes Update articles are available at: *http://www.lre.usace.army.mil/glhh/news.*

## General Notes

All elevations shown in this article are referenced to the IGLD 1985 datum. Information about the Great Lakes water levels, outflows, and weather is available at: *http://www.lre.usace.army.mil/glhh.*