US Army Corps
of Engineers
North Central Division

Great Lakes Update

No. 124 January 3, 1996

1995 Annual Summary

Looking back at 1995 the trend of Great Lakes water levels generally followed the seasonal patterns which prevailed in 1994.

Precipitation and Temperature

Great Lakes basin air temperatures began 1995 above average. Mild winter temperatures resulted in an early snow melt, contributing to an early start to the seasonal rise in both Lakes Erie and Ontario. During the spring, summer and fall, temperatures ranged both above and below the average.

Precipitation over the Great Lakes for 1995, based on preliminary records from the U.S. National Weather Service and Canadian Atmospheric Environment Service, was near average. Some dry periods were experienced in February, March, June and September with the remaining months being wetter. One major event which occurred in 1995 was Hurricane Opal, which contributed the wet fall conditions. Total basin-wide precipitation for 1995 was 33.6 inches, about 1.3 inches above average. Figure 1 compares the monthly precipitation for 1994 and 1995 to the long-term average for the entire basin.

Lake Levels

The *"Monthly Bulletin of Lake Levels for the Great Lakes"*, which fosters this Annual Update, graphically shows the fluctuation of water levels on the Great Lakes for the years 1994 and 1995. The water level of Lake Superior was below its long-term average throughout 1995. Lakes Michigan-Huron were above or near average while Lakes St. Clair and Erie were above average for the entire year while maintaining their usual seasonal patterns. The 1995 water levels of these lakes were generally lower than those for comparable months in 1994. Lake Ontario water levels were higher than average early in the year as a result of mild temperatures and an early snow melt. Levels were below average in the spring and summer months due to reduced precipitation

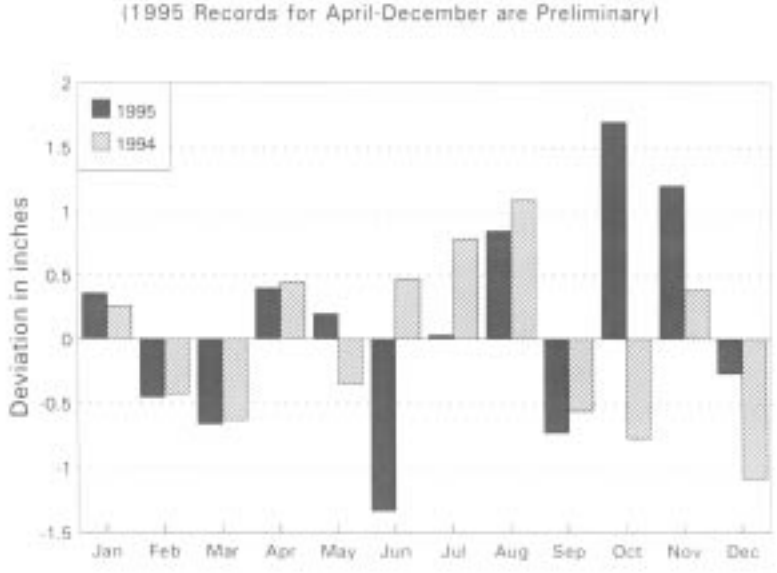

Figure 1

levels. Ontario levels were above their long-term average at the end of the year as a result of high precipitation in October and November.

During 1995, Lake Superior's water level generally followed its normal seasonal cycle, starting the year about 1.5 inches below its average. Precipitation for the year was above average, but this did not appear to significantly affect water levels until the fall months with levels peaking in October, rather than in the usual August to September period. Lake Superior's water level ended the year about 1 inch below its December long-term average.

Lakes Michigan-Huron water levels began 1995 about 7 inches above long-term average. Dry spring and summer months contributed to a decline of levels to near average by September. Levels peaked in June and ended the year about 1 inch above average. Although precipitation for the year was above average, it did not significantly affect the overall seasonal pattern.

Lake Erie water levels started 1995 about 10 inches above the January long-term average. Water levels started an early seasonal rise in January, due to mild temperatures and snow melt. Levels tended to follow their seasonal pattern ending the year about 4 inches above average. Precipitation over the basin was below average. Monthly water levels ranged between 4 and 11 inches above the long-term average throughout the year, peaking in June and ending the year about 4 inches above the December long-term average.

Although Lake Ontario water levels started the year near the long-term average, they quickly rose above average and remained there until late March. Levels then fell below average from April to August and rose above the long-term average from October to the close of the year. In general, the mean water levels ranged from 8 inches below long-term average in May, to 6 inches above the long-term average in February and November, ending the year about 5 inches above the December long-term average.

Storms

The Great Lakes Storm Damage Reporting System (GLSDRS), developed in 1993, was the subject of Update articles in March 1994 (No. 104), December 1994 (No. 113) and more recently in August 1995 (No. 121). The system was developed by the Chicago District, Corps of Engineers. The system monitors meteorological data (water levels, wave heights, wind speed and wind direction) in order to identify storm activity on the Great Lakes. Subsequent telephone surveys are conducted to collect damage information for the impacted areas.

During the 1995 calendar year, 23 telephone surveys were conducted lakeswide, yielding 1,026 interviews. Damages reported to structures, contents, vehicles, landscaping, shore protection, docks, boats, etc., were estimated at about $97,150. GLSDRS samples ten percent of the riparian property owners in affected areas, thus, total damages for 1995 are estimated at about $970, when applied to all the reaches affected by the storms.

During the period October 24 to November 8, 1995 there was particularly high storm activity on Lakes Michigan, Erie and Ontario. Between October 24-25, 1995, the Coast Guard Station at St. Joseph, MI recorded 24 to 40 knot winds and 9 to 12 foot wave heights over a continuous 14 hour storm period. During the weekend of December 9-10, 1995, a Lake Superior winter storm dropped a reported 58 inches of snow on Sault Ste. Marie, MI bringing its total snowfall for November and December to 101.7 inches, exceeding the annual winter average of 96.9 inches for that period. Shipping on the St. Ma River was halted stranding freighters until the storm let up. Snow storms buffeted other Great Lakes areas during much of December.

Lake Superior Regulation

In 1995, the International Lake Superior Board of Control continued to use Regulation Plan 1977-A and Criterion (c) of the Order of Approval as the primary basis for determining Lake Superior outflows. Criterion (c) states that when the monthly mean level of Lake Superior is below 601.7 feet (IGLD 1985), the outflow cannot be greater than that which would have occurred at the same elevation under the outflow conditio which prevailed in 1887. On oc sion, other factors will influence

the setting of outflows, as they did this past year.

ring 1995, the Edison Sault Electric Company continued repair work in the intake canal of their hydropower plant on the St. Marys River. This project, expected to be completed in 1996, requires reducing the flow through the plant during the summer months. This decreased the plant's capacity to release water from the lake. Continued renovation of the generating units at the U.S. Government hydropower plant at the St. Marys Canal (Soo Locks) also reduced the overall outflow capacity of the hydropower plants in 1995.

To avoid having to spill water through the rapids during repairs at the hydropower facilities, veral times during the year the ard directed flow deviations rom Plan 1977-A . This program was approved by the International Joint Commission, by letter dated May 31, 1994, after the power entities made requests for such deviations. Month by month flow deviations were approved by the Commission on the recommendation of the Board, taking into consideration the hydrologic conditions in the upper Great Lakes basins.

During January and February 1995, Lake Superior outflows were higher than those specified by the regulation plan. The objective of these over-discharges was to offset anticipated flow reductions in the spring of 1995 when repair work would once again reduce the power diversion capacities. By the end of February 1995, the over-discharges had lowered Lake Superior by about 1/2 inch and raised Lakes Michigan-Huron by about the same amount, compared to what they would have been with strict adherence to Plan 1977-A outflows.

Lake Superior Outflows
1995 Monthly Mean
and Long-term Average (1900-1989)

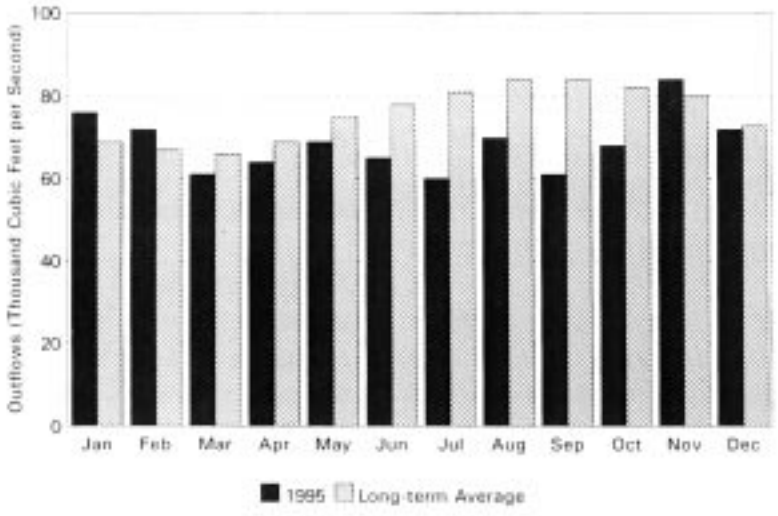

Figure 2

The over-discharging was discontinued at the end of February, due to the relatively low level of Lake Superior as compared to Lakes Michigan-Huron. Flows in March, April and May were specified by Plan 1977-A. Because of the balancing nature of the regulation plan, the effects of the winter over-discharges on lake levels were completely dissipated by May. With Plan 1977-A specifying below average Lake Superior outflows, only small under-discharge deviations were made during the summer. These took place in June and August 1995. The impacts of these deviations on the levels of the lakes were negligible.

Flows from September through December were specified by Plan 1977-A. Heavy October rains on the Lake Superior basin kept the level of that lake rising into the fall more than usual. As a result, the November outflow was the highest outflow for the year, but it was still only slightly above average. Figure 2 compares the monthly Lake Superior outflows in 1995 with the long-term average flows.

Flow changes resulting from the monthly regulation of Lake Superior are accomplished by varying the amount of water allocated to hydropower production; and, when necessary, by opening or closing gates in the Compensating Works at the head of the St. Marys Rapids. During 1995, a 1/2 gate open setting plus an additional 500 cfs of water through the north most gate (Gate No.1) were maintained. This

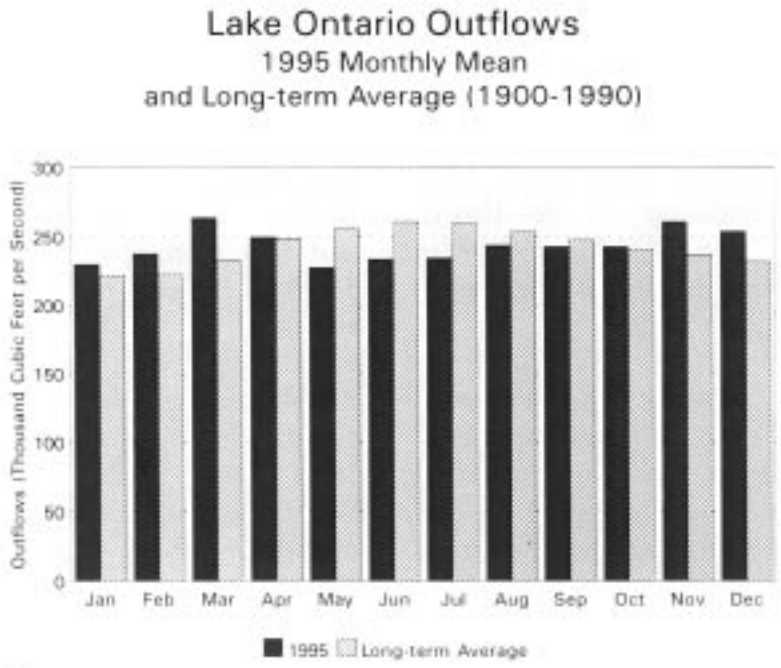

Figure 3

satisfied the minimum water requirements for the fish habitat in the rapids.

Lake Ontario Regulation

The winter of 1994-1995 was very mild. In early January, ice formed in various parts of the St. Lawrence River (near the International Rapids Section, Moses-Saunders Powerhouse and Beauharnois Canal). The ice held for several days, then melted and partially reformed again. Lake Ontario Plan outflows were released during the winter months, except during periods when ice formation was occuring. Figure 3 shows a comparison of 1995 monthly outflows with the long-term average monthly outflows.

The international reach of the St. Lawrence River became ice-free by March 16 and likewise, the Beauharnois Canal was ice-free by March 23 (1 day before commercial navigation resumed between Lake Ontario and Montreal). The first peak of the Ottawa River freshet occurred during March 17-22. Due to the unusual mild winter, there was very little snowmelt runoff from the Lake Ontario and Ottawa basins. This resulted in lower levels on both Lake Ontario and the Port of Montreal. The usual second peak of the Ottawa River freshet never occurred. As of mid-June, 1.57 inches of water was stored on Lake Ontario.

For the period March through September 1995, the Lake Ontario-St. Lawrence basin received below long-term average rainfall. The monthly precipitation for the Lake Ontario basin from March through September ranged from 38% to 91% of average. In fact, the entire Great Lakes basin received below long-term average rainfall 6 out of the 7 months during this period. The Montreal area had experienced even dryer conditions than Lake Ontario. In May, the level in the Port of Montreal was 32.9 inches below the long-ter 1967-1994 average and wa levels were approaching chart datum. In July, the level dropped below chart datum for 4 days. Consequently, the International St. Lawrence River Board of Control (ISLRBC) authorized the Regulation Representatives to increase the outflow of Lake Ontario when necessary to maintain at least chart datum for the Port of Montreal. By October, the Port of Montreal had experienced 5 new monthly minimum levels (April, May, July, August and September) since previous minimum levels were experienced in 1967. The over-discharge from Lake Ontario from regulatory plan flow was not required until early September and by mid-October, the tota accumulated deviations h lowered the lake by 0.08 inch.

Heavy rainfall finally began in late October throughout the Lake Ontario-St. Lawrence River basin as well as in the Ottawa basin. Normal operations were again in effect for Lake Ontario in November. Shortly thereafter, some winter operations and power emergency deviations were authorized. As of early December 1995, 0.39 inch of water was stored on Lake Ontario.

Many complaints regarding low water levels on Lake Ontario and along the St. Lawrence River from recreation boaters were received by the Corps Offices in Chicago, Illinois and Buffalo, New Yo and by Environment Canada Cornwall, Ontario during the

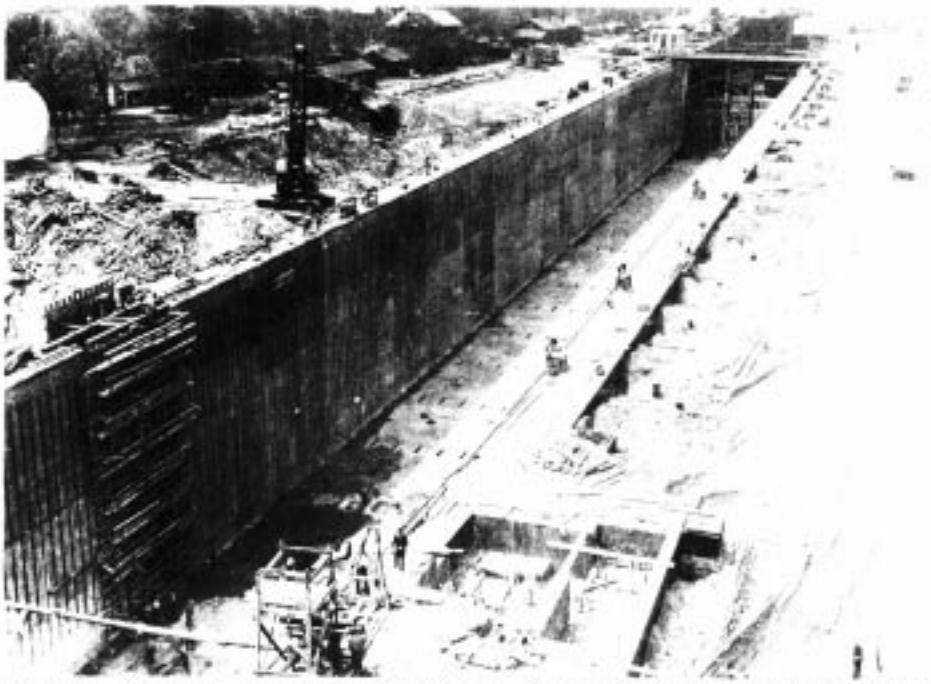

Figure 4. MacArthur Lock Construction -- 1995 marked the 50th anniversary of the end of World War II. The new "MacArthur Lock" named in honor of the Supreme Commander of Allied Forces in the Southwest Pacific was authorized in March 1942 by President Franklin D. Roosevelt. Construction started in April 1942 and the new lock was placed in operation July 11, 1943, a record time of 13 months, at a cost of $14,000,000. Except for being closed during the winter months the MacArthur Lock was operated 7 days a week und the clock providing passage for iron ore and other commodities essary to the Allied war effort throughout the world. It is still in operation providing passage to ships of both foreign and U.S. origin. *(Soo Area Office Photo and text provided by Carmen Paris.)*

summer and early fall.

Since early 1994, two new regulation plans have been evaluated for performance. They are called the "Interest Satisfaction Model" and "Plan 35P". The ISLRBC has authorized the Regulation Representatives to evaluate these plans for a period of three years. The study is currently near the end of the second year of evaluation.

Meetings With The Public

During 1995 meetings of the rnational St. Lawrence River ard of Control with the public were held in Montreal, Quebec. (November 7); Kingston and Cornwall, Ont (September 19 and 20); Rochester, NY (September 18); Alexandria Bay, NY (August 9); and Dorval, Quebec. (May 15). Riparians, recreational boaters, navigation and environmental interests were all represented in at least one of these meetings. In all, more than 800 people attended. Meetings with the public were also held by the International Lake Superior Board of Control at Sault Ste. Marie, Ontario. (September 27) and International Niagara Board of Control on September 28, at Niagara-on-the-Lake, Ontario.

Commercial Navigation

As of the end of November 1995, tonnage passing through the Soo Locks at Sault Ste. Marie, Michigan was only 3.4% above the comparable tonnage for 1994. United States and Canadian vessels carried about 56 and 15 million short tons of cargo, respectively, while foreign vessels carried about 3 million short tons. Through November 1995, a total of 3,975 cargo vessels had transited the locks as compared to 3,804 passages the previous year. Of these, 2,435 passages were U.S.-flagged vessels, 1,201 were Canadian-flagged, and 339 were foreign vessels (ocean-going or "salties"). In addition to the cargo vessels, there were also 6,417 transits by other types of vessels, such as pleasure craft, tour boats, Coast Guard, and scientific research vessels. This was down from the 6,785 transits in 1943. The Corps has the authority to keep the locks open until January 15, so long as the shipping interests request late closing, which they have requested again this winter (1995-1996). Historically, 1995 marked the fiftieth anniversary of the end of World War II. Figure 4 shows the MacArthur Lock under construction during the 1942-1943 period.

According to the St. Lawrence Seaway Development Corporation's preliminary figures, through the end of November 1995, 35.7 million metric tons (MMT) of cargo moved through the Lake Ontario-Montreal section of the Seaway in 1995. This was 1.5 MMT more than in 1994. As of the end of November 1995, the yearly total vessel transits

were2,554 (1,685 lakers and 869 ocean vessels) as compared to 2,575 (1,435 lakers and 1,140 ocean vessels) in 1994.

Seaway officials reported preliminary information on a number of individual cargos during the 1995 season including: iron ore (up 2% to 10.4 MMT); grain (up 21% to 13.1 MMT); coal (up 93% to 0.9 MMT); and, petroleum products (down 30% to 0.9 MMT).

Figure 5 - 1994 Great Lakes Updates

In 1995, the Bulletin provided monthly updates on various Great Lakes - St. Lawrence River topics. For 1995, these were as follows:

January	- 1994 Annual Summary, No. 114	**July**	- The Lakes Michigan -- Huron Connector, No. 120
February	- The Port of Cleveland, No. 115	**August**	- The Great Lakes Storm Damage ReportingSystem: Its Cyberspace Expansion and Report update, No. 121
March	- St. Lawrence Board Membership Increased; and Rumrunners on the St. Clair/Detroit River System, No. 116	**September**	- Carbon Dioxide, Nitrous Oxide and Climate Change, No. 122
April	- The Welland Canal Gateway to the Interior, No. 117	**October**	- Regular publication of the *Great Lakes Update* ceased.
May	- Climate Change, No. 118	**November**	- No Article
June	- Water and Climate Change, No. 119	**December**	- Special Article, Responses to questions at Public Meetings, No. 123

Table 1

Possible Storm Induced Rises (in feet) at Key Locations on the Great Lakes January 1996

	Degrees of Possibility				
	20%	10%	3%	2%	1%
LAKE SUPERIOR					
Duluth	1.0	1.1	1.3	1.5	1.6
Grand Marais	0.6	0.7	0.8	0.8	0.9
Marquette	0.8	1.0	1.1	1.2	1.3
Ontonagon	0.5	0.7	1.0	1.2	1.4
Point Iroquois	1.2	1.4	1.7	1.9	2.0
Two Harbors**	---	---	---	---	---
LAKE MICHIGAN					
Calumet Harbor	1.6	1.8	2.1	2.3	2.5
Green Bay	1.4	1.6	1.9	2.1	2.3
Holland	1.0	1.2	1.4	1.6	1.7
Kewaunee	0.8	0.9	1.0	1.0	1.1
Ludington	0.9	1.1	1.3	1.4	1.5
Milwaukee	1.0	1.2	1.4	1.5	1.7
Port Inland	1.2	1.6	2.3	2.9	3.5
Sturgeon Bay	0.9	1.0	1.1	1.2	1.3
LAKE HURON					
Detour Village	0.7	0.7	0.8	0.9	0.9
Essexville	1.4	1.9	2.4	2.9	3.4
Harbor Beach	0.7	0.9	1.2	1.5	1.8
Harrisville	0.6	0.7	0.8	0.9	1.0
Lakeport**	---	---	---	---	---
Mackinaw City	0.9	1.0	1.1	1.2	1.3
LAKE ST. CLAIR					
St. Clair Shores	0.8	0.9	1.1	1.3	1.4
LAKE ERIE *					
Barcelona**	---	---	---	---	---
Buffalo	4.7	5.3	6.0	6.4	6.8
Cleveland	1.1	1.3	1.6	1.8	2.0
Erie	2.2	2.5	2.7	2.9	3.1
Fairport	0.8	1.0	1.3	1.5	1.8
Fermi Power Plant	2.2	2.5	3.0	3.4	3.7
Marblehead	1.8	2.2	2.9	3.4	3.9
Sturgeon Point	3.9	4.5	5.1	5.6	6.0
Toledo	2.6	3.1	3.8	4.3	4.7
LAKE ONTARIO					
Cape Vincent	1.0	1.1	1.3	1.4	1.5
Olcott	0.5	0.6	0.7	0.7	0.8
Oswego	0.9	1.0	1.3	1.4	1.6
Rochester	0.5	0.6	0.7	0.7	0.8

* The water surface of Lake Erie has the potential to tilt in strong winds, producing large differentials between the ends of the lake.

** Gage has been removed or data is not available at this location.

Note: The rises shown above, should they occur, would be in addition to the still water levels indicated on the Monthly Bulletin. Values of wave runup are not provided in this table.

Great Lakes Basin Hydrology

During the month of December precipitation was above average on the Lake Superior basin and below average on the Lakes Michigan-Huron, Erie and Ontario basins. For the year to date, precipitation is about 4% above average for the er Great Lakes basin. The net supply of water to Lake Superior was above average in December, while the supplies to L Michigan-Huron, Erie and Ontario were below average. Table 2 lists December precipitation and water supply information for all of the Great Lakes.

In comparison to their long-term (1918-1994) averages, the December monthly mean water level of Lake Superior was 1 inch below average, the level of Lakes Michigan-Huron, Lakes St. Clair, Erie and Ontario were 1, 4, 4, and 5 inches above average respectively. Shoreline residents are cautioned to be alert whenever adverse weather conditions exist, as these could cause rapid short-term rises in water levels. Should the lakes approach critically high levels, further information and advice will be provided by the Corps of Engineers.

TABLE 2
GREAT LAKES HYDROLOGY[1]

PRECIPITATION (INCHES)								
BASIN	DECEMBER				YEAR-TO-DATE			
	1995[2]	Average (1900-1994)	Diff.	% of Average	1995[2]	Average (1900-1994)	Diff.	% of Average
Superior	2.2	2.0	0.2	110	33.2	30.3	2.9	110
Michigan-Huron	2.1	2.3	-0.2	91	33.7	32.0	1.7	105
Erie	1.7	2.6	-0.9	65	32.6	34.9	-2.3	93
Ontario	2.1	2.9	-0.8	72	35.4	35.1	0.3	101
Great Lakes	2.1	2.3	-0.2	91	33.6	32.3	1.3	104

LAKE	DECEMBER WATER SUPPLIES[3] (CFS)		DECEMBER OUTFLOW[4] (CFS)	
	1995[2]	Average (1900-1989)	1995[2]	Average (1900-1989)
Superior	-11,000	-24,000	72,000	73,000
Michigan-Huron	21,000	29,000	184,000[5]	183,000
Erie	4,000	17,000	206,000[5]	199,000
Ontario	9,000	27,000	254,000	232,000

[1]Values (excluding averages) are based on preliminary computations.
[2]Estimated.
[3]Negative water supply denotes evaporation from lake exceeded runoff from local basin.
[4]Does not include diversions.
[5]Reflects effects of ice/weed retardation in the connecting channels.

CFS = cubic feet per second.

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