Annual Report of the Great Lakes Regional Water Use Database

Representing 2014 Water Use Data

Prepared by the Great Lakes Commission for the
Great Lakes-St. Lawrence River Water Resources Regional Body and the
Great Lakes-St. Lawrence River Basin Water Resources Council

Great Lakes Commission
des Grands Lacs

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Acknowledgments

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Preface

This is the Annual Report of the Great Lakes-St. Lawrence River Regional Water Use Database, representing 2014 water use data. These data are provided by the Great Lakes-St. Lawrence River states and provinces to the Great Lakes Commission (GLC), which serves as the database repository, under the Great Lakes-St. Lawrence River Basin Water Resources Compact (Compact) and the Great Lakes St. Lawrence River Basin Sustainable Water Resources Agreement (Agreement).

The Great Lakes-St. Lawrence River Regional Water Use Database has been operational since 1988. It was established by the states and provinces in response to a provision of the 1985 Great Lakes Charter, which called for the establishment and maintenance of a regional system for the collection of data on major water uses, diversions and consumptive uses in the binational Great Lakes-St. Lawrence River Basin (Basin). The Charter (a precursor to the Compact and Agreement) was a non-binding, “good faith” agreement signed by the Great Lakes governors and premiers that set forth a series of principles and procedures for strengthening water management activities in the Basin. The Charter envisioned a centralized database as an important tool to support a regional water resources management program that guides the future development, management and conservation of the water resources of the Basin. In 1988, the GLC was selected to serve as the repository for the regional water use database. The maintenance and operation of the database has been provided by the GLC since that time, in partial fulfillment of the Charter obligations and since 2009 supporting the requirements under the Compact and Agreement through a new set of water use data collection and reporting protocols.

After two decades of collecting water use data and issuing the annual water use reports under the Charter, the database has been revised and upgraded to meet the requirements set forth by the Compact and Agreement. In 2008, to help implement the needed improvements in jurisdictional water use data collection and reporting programs, the Council of Great Lakes Governors, through its Great Lakes Water Use Information Initiative, led the states and provinces through a process that culminated in the drafting of new water use data collection and reporting protocols. The Compact Council and Regional Body adopted the new protocols in 2009. The protocols offer guidance to ensure that water use data provided to the database repository by the states and provinces is accurate, of the highest quality, and reported in a common and consistent manner. The 2014 annual water use report presents the third dataset that was assembled using the 2009 water use data collection and reporting protocols.

While the common data protocols are an important step in support of a more robust regional water management regime, it is recognized that much additional work needs to be done and that improvements in data collection, reporting, quality, accuracy and compatibility must continue to occur. Additional information describing the improvements to the data collected under the 2009 regional water use data collection and reporting protocols is provided in Appendix A. The following section describes the progress made in 2015 to improve data quality and describes the quality of the data for the 2014 annual report.

Overview

Improving Data Quality

Together with the Conference of Great Lakes-St. Lawrence Governors and Premiers, the GLC is working with the Great Lakes and St. Lawrence River states and provinces to improve data collection, reporting, quality, accuracy and compatibility. To guide the preparation of 2014 data and this report, several steps have been made to improve data quality.

An important first step to improve data quality was the development of a process to collect metadata for the 2014 water use data. For purposes of this report, metadata is information that describes water use data and includes information related to data sources, reporting compliance rates by water use sector, documenting the year for which the data is collected, any significant changes in the data between the current year and previous years, and describing reasons for those changes. To achieve this purpose, the GLC created an online data management system that assists in the documentation of metadata. For this report, the states and provinces have submitted metadata along with the associated 2014 water use data to the GLC. Through the creation of metadata, states, provinces and the GLC were better able to identify and correct errors in 2013 and 2014 datasets.

Another step to improve data quality was to work with water use specialists at the U.S. Geological Survey to conduct a review of the 2014 metadata. Based upon this review, several of the jurisdictions updated their datasets or modified their metadata. This review has also provided some recommendations to improve the documentation of the metadata which will be discussed further with the states and provinces.

The GLC will continue to work with the states and province to identify additional areas for improvement and will carry out the activities begun in 2014. While this report contains the best available information as of its publishing date (December, 2015), the states and provinces may continue to update their 2014 data housed in the online database. Therefore, discrepancies between the data online and those summarized in this report may appear. Data summarized in this report are available to download from the GLC website at projects.glc.org/waterusedata.

Data Reporting by Jurisdiction

The states and provinces have water use reporting programs in place that requires water users to report their water use each year to their jurisdiction. The reporting compliance, i.e., the percentage of water users submitting the water use reports to the jurisdiction, varies across the Basin and impacts the quality of the data. Reporting compliance varies across sectors for most jurisdictions. Illinois, Minnesota and Ohio report a 100 percent reporting compliance for all sectors. Since Québec is still ramping up its reporting program, reporting compliance could not be calculated for the commercial and institutional, livestock and other self-supply sectors.

The actual year in which the data was collected impacts the comparability of data across the Basin. Except for Ontario and Michigan, all jurisdictions are reporting 2014 data for this annual report. The tables 1 and 2 summarize reporting compliance rates and the actual year the data was collected by jurisdiction.

Table 1. Actual Year of Water Use Data by Jurisdiction

Jurisdiction	Actual Data Year	Reporting Compliance
Illinois	2014 for all sectors	100% for all sectors
Indiana	2014 for all sectors	Varies across sectors*
Michigan	• 2014 for most sectors • 2012-2013 for self-supply livestock, aquaculture facilities	Varies across sectors*
Minnesota	2014 for all sectors	100% for all sectors
New York	2014 for all sectors	Varies across sectors*
Ohio	2014 for all sectors	100% for all sectors
Ontario	• 2013 for most sectors • 2009 data used for public supply intrabasin diversions	Varies across sectors*
Pennsylvania	2014 for all sectors	Varies across sectors*
Quebec	2014 for all sectors	Varies across sectors*
Wisconsin	2014 for all sectors	Varies across sectors*

*See Table 2 for reporting compliance to the jurisdiction by specific water use sector

Table 2. Reporting Compliance to the Jurisdiction by Water Use Sector

Sector	IN	MI	NY	ONT	PA	WI	QC
Public Water Supply	97	99	89	98	94	100	100
Self-Supply Commercial & Institutional	90	95	93	100	100	96	N/A**
Self-Supply Irrigation	95	85	56	99	21	96	N/A
Self-Supply Livestock	75	40	76	99	82	97	-
Self-Supply Industrial	95	95	92	88	91	94	100
Self-Supply Thermoelectric Power Production (Once-through cooling)	100	99	92	100	-	100	-
Self-Supply Thermoelectric Power Production (Recirculated cooling)	100	99	92	-	-	100	-
Off-Stream Hydroelectric Power Production	-*	-	100	-	-	-	-
In-Stream Hydroelectric Water Use	-	-	100	95	-	-	-
Other Self-Supply	81	95	62	94	-	98	N/A

*A blank indicates that the jurisdiction did not report any water use figures for that particular sector.
**N/A indicated that reporting compliance percentage could not be calculated.

Great Lakes Regional Water Use for 2014

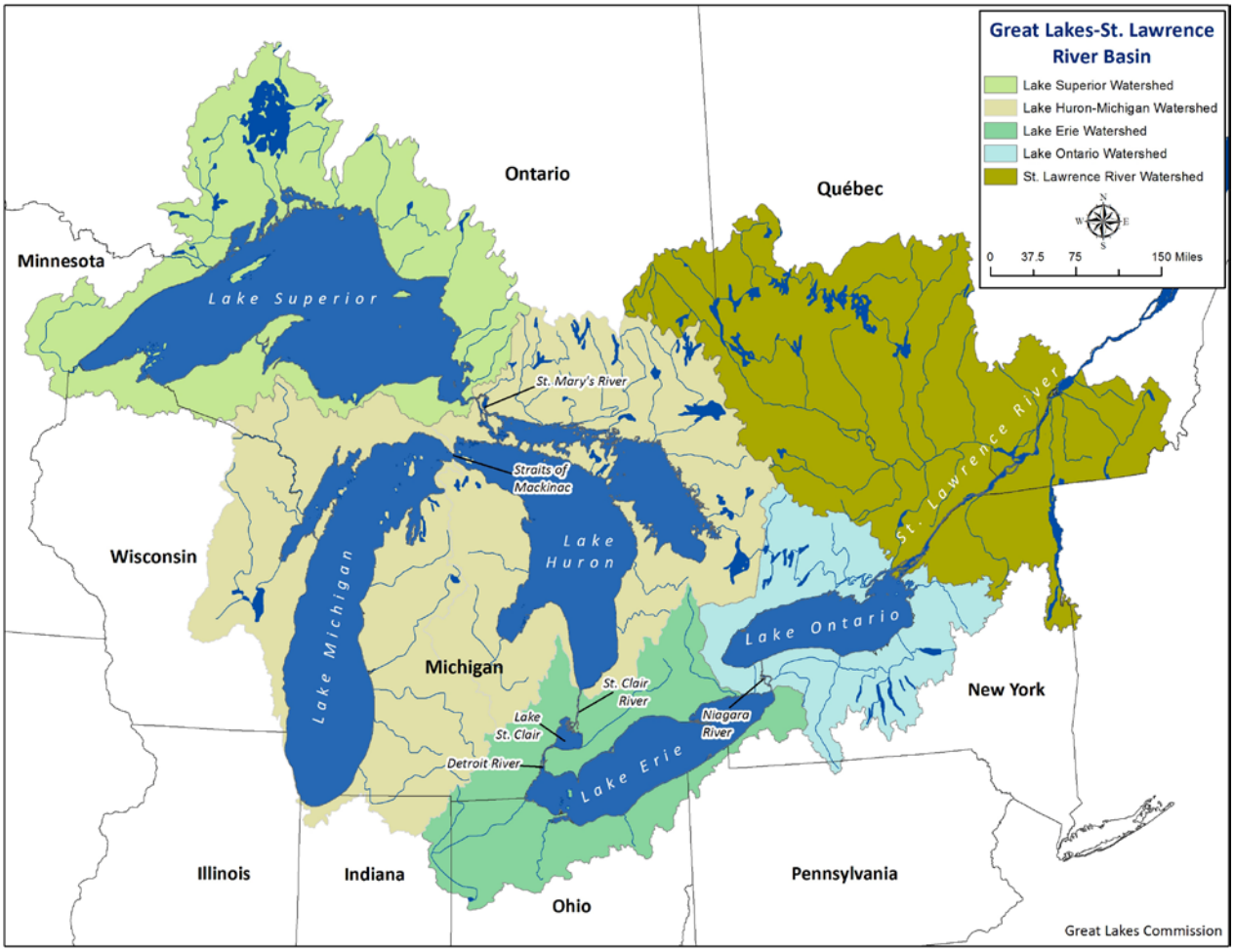

Figure 1. Great Lakes-St. Lawrence River Basin

The Great Lakes and the St. Lawrence River – the world's largest freshwater system – span an area of 289,600 square miles (750,000 square kilometers). Its total volume is 6.5 quadrillion gallons, an amount that would fill 9 billion Olympic size swimming pools.[1]

In 2014, the total reported withdrawal amount for the Great Lakes-St. Lawrence River Basin, excluding in-stream hydroelectric water use was 44,493 million gallons per day (mgd) or 160,567 million liters per day (mld). This total represents a five percent increase from the 2013 reported withdrawal amount total of 42,380 mgd. Five and a half percent of the total reported amount withdrawn (2,452 mgd) was consumed or otherwise lost to the basin.

Water withdrawals for all water use sectors, excluding the in-stream hydroelectric water use sector, are presented in the pie chart below. The 10 water use sectors are defined in Appendix C. Thermoelectric power production, industrial and public water supply are the primary water use sectors, (i.e., those withdrawing the largest volumes of water).

[1] An Olympic size swimming pool holds at least 2.5 million liters.

Water Withdrawals by Water Use Sector in mgd (excluding in-stream hydroelectric water use)

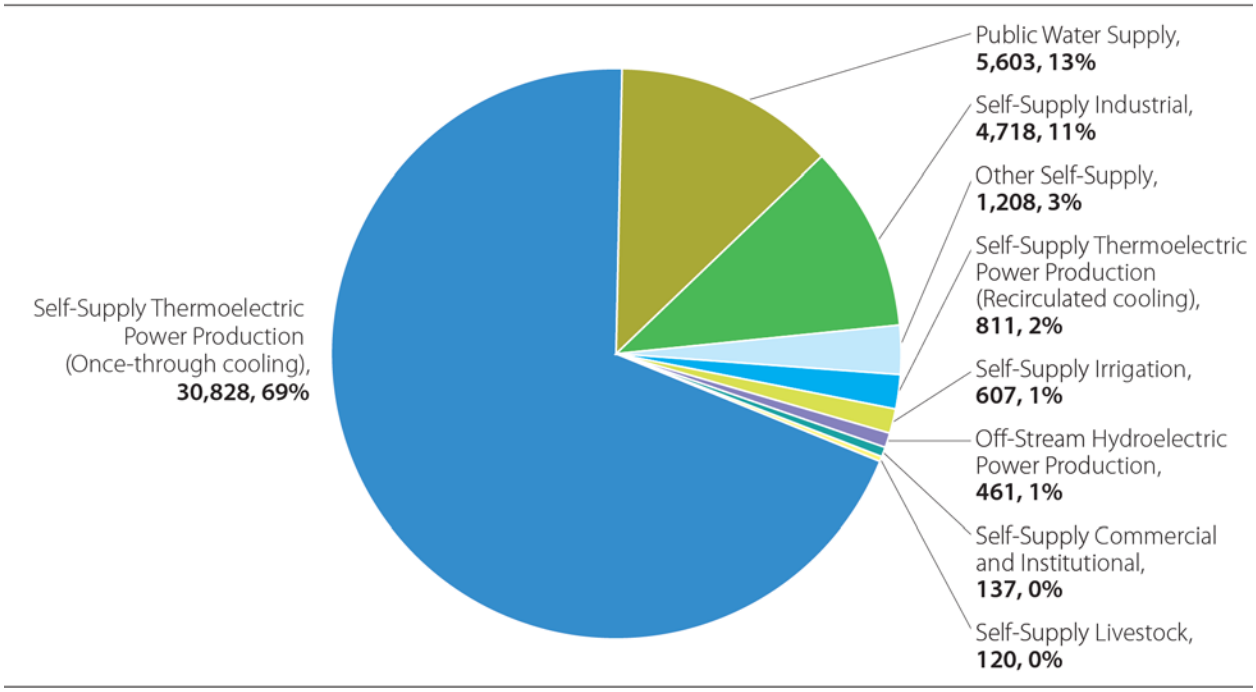

Figure 2.

The Lake Michigan watershed has the greatest withdrawal, followed by Lakes Ontario and Erie, respectively. The graph below shows withdrawals by watershed broken down by water source, e.g., Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW).

Water Withdrawals by Watershed in mgd (excludes in-stream hydroelectric water use)

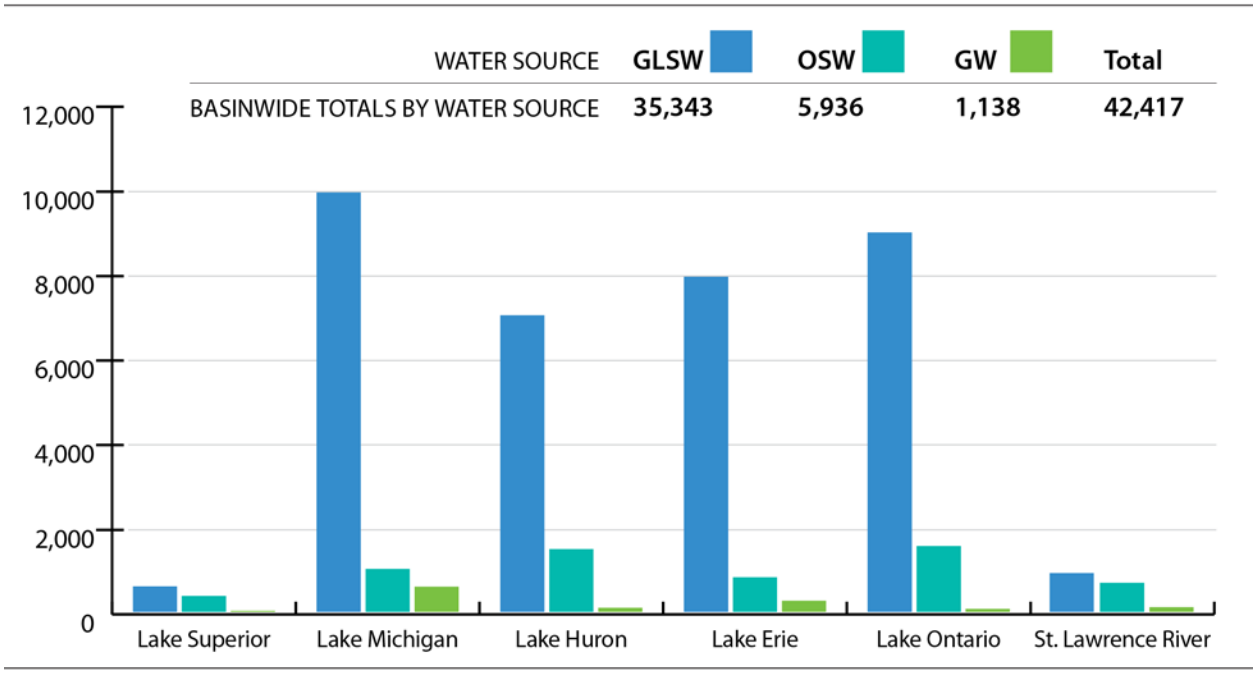

Figure 3.

The pie chart below shows total withdrawals portioned by jurisdiction, excluding in-stream hydroelectric water use. Ontario, with a land area spanning five watersheds (i.e., lake basins) was the largest withdrawer of Great Lakes water at 17,506 mgd or 39 percent of the total withdrawal amount. In contrast, Pennsylvania, with a land area of 508 square miles within the Lake Erie watershed, withdrew just 36 mgd.

Water Withdrawals by Jurisdiction in mgd (excludes in-stream hydroelectric water use)

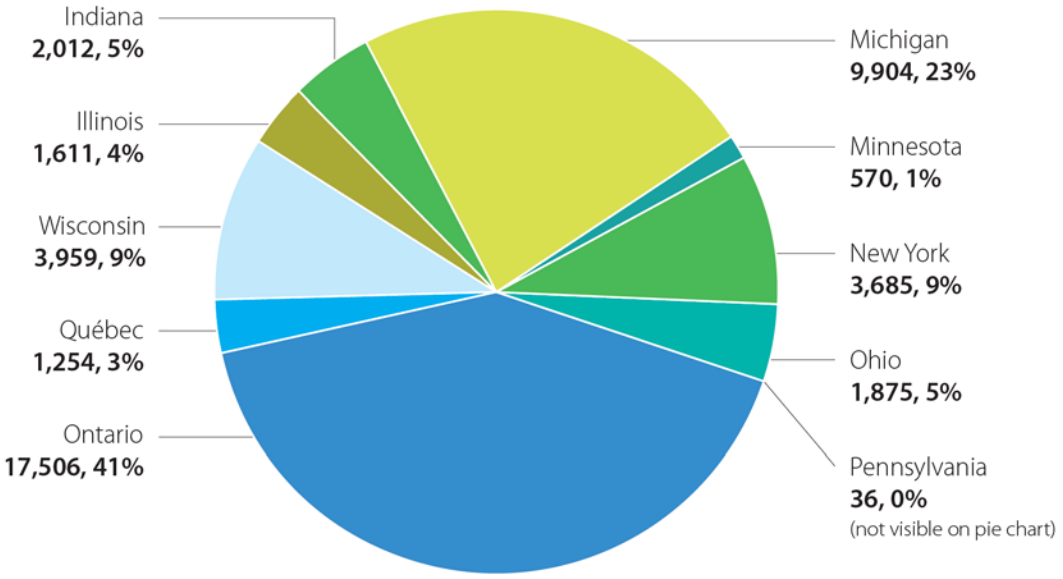

Figure 4.

Hydroelectric Power Generation

In the past years of reporting annual water use, withdrawals for hydroelectric purposes (both in-stream and off-stream) have been the largest single sector of use, typically representing more than 95 percent of the region's total water withdrawals. In-stream hydroelectric power production continues to be a major water use for the Great Lakes-St. Lawrence River region (e.g., New York produced more hydroelectric power than any other state east of the Rocky Mountains in 2011[2]). However, beginning in 2012, under the 2009 water use data collection and reporting protocols, the reporting of in-stream hydroelectric power production data is optional. In-stream hydroelectric power water use is not considered a withdrawal because the water remains in the water body and is not associated with water consumption.

The regional water use database is designed to receive and report on both 1) off-stream hydroelectric power production water withdrawals; and 2) in-stream hydroelectric water use data submitted by the states and provinces. For 2014, the regional database has incomplete data for the in-stream hydroelectric water use sector. Québec and Indiana did not report hydroelectric water use, although both jurisdictions reported it in the past.

Off-stream hydroelectric is considered a withdrawal since the water is removed to a retention area or a reservoir that serves as a pump-storage system. This storage substantially increases the surface area of the

[2] U.S. Energy Information Administration. 2012. http://www.eia.gov/state/?sid=NY

water body, and in so doing, increases the evaporation expected from that body of water, resulting in a consumptive use. After being used, the water is returned to the original water source. Both off-stream and in-stream totals are presented in a chart format in each of the watershed and jurisdiction summaries contained in this report. In 2014, a withdrawal total of 41 mgd was reported for the off-stream hydroelectric power production sector. This withdrawal amount was reported by the states of New York and Minnesota.

Diversions and Consumptive Uses

Diversions and consumptive uses of water are key components of the regional water use database. The Compact and Agreement definitions for diversions and consumptive use are presented in Appendix B. Consumptive uses and diversions (less return flow) reflect water not being returned (i.e., water loss) to the source watershed. These water use data are considered particularly informative for assessing the cumulative hydrologic effects of water use in the region.

The total reported 2014 diversion from the Great Lakes-St. Lawrence River Basin was 1,266 mgd or 4,792 mld. The majority (88% or 1,121 mgd) of this amount was associated with the Illinois diversion, which takes water from Lake Michigan and discharges it into the Mississippi River watershed. The reported amount associated with the Illinois diversion is relatively constant with the 2013 reported amount of 1,120 mgd. Smaller diversions throughout the region make up the balance of the total, and some of the diverted water is returned to the source watershed as return flow. There are a number of diversions into the Basin, including the Long Lac and Ogoki diversions (two incoming diversions from the Hudson Bay watershed into northern Lake Superior) which contributed 3,382 mgd (12,802 mld) to the entire Basin in 2014. This is an increase of 368 mgd or 12 percent from the 2013 reported amount of 3,014 mgd. This increase is well within the range of flow variability observed from 1944-2013. The flow from these diversions has ranged from 1,643 to 5,181 mgd[3]. When conditions in the Long Lac and Nipigon (downstream of Ogoki) watersheds are wet, the diversions are often reduced, and water that otherwise would have been diverted into Lake Superior is instead directed through natural outlets that flow toward Hudson Bay. Conversely, when conditions are dry in the downstream watersheds, the diversion flow may be higher. Overall, the net diversion, i.e., incoming diversions minus outgoing diversions, is a gain of 2,121[4] (8,029 mld), meaning that more water is diverted into the Basin than is diverted out of the Basin.

Consumptive use is defined as that portion of the water withdrawn or withheld from the Basin that is lost or otherwise not returned to the Basin due to evaporation, incorporation into products, or other processes. Consumptive use is most often calculated by applying a consumptive use coefficient to the reported withdrawal amount. The current database framework documents the consumptive use coefficient used for each water withdrawal record and the percentage of the consumptive use amount that was determined through actual measurement. The total reported consumptive use for the Basin was 2,490 mgd (9,426 mld) - an increase of 158 mgd or nearly 7 percent from the 2013 total consumptive use amount of 2,333 mgd. The public water supply at 720 mgd and industrial at 736 mgd were primary contributors to the total consumptive use amount. At 1,047 mgd (3,967 mld), the Lake Michigan watershed had the largest consumptive use total among the five lake watersheds and the St. Lawrence River watershed.

Taking in consideration both consumptive use and diversions, the reported water loss to the Basin was 369 mgd (1,397 mld) for the year 2014, which is a 56 percent decrease from the 2013 net water loss of 847 mgd. Tables 1-3 summarize water withdrawals, diversions and consumptive uses at the regional scale.

[3] Information on the flow variability of the Long Lac and Ogoki diversions was provided by Ontario Power Generation.
[4] The Great Lakes Regional Water Use Database records all incoming diversions with a negative sign and all outgoing diversions with a positive sign. This sign convention is different from what is used in the interim cumulative impact assessment, Appendix D.

Table 3. Basin 2014 Water Use Data Summary by Watershed

Watershed	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Lake Superior	600	33,176	21	33,797	0	-3,374	46
Lake Michigan	9,919	1,015	591	11,526	0	1,218	1,047
Lake Huron	7,010	17,749	92	24,851	42	0	141
Lake Erie	52,103	1,393	259	53,755	4,181	-13	440
Lake Ontario	50,369	98,919	65	149,353	-4,220	41	373
St. Lawrence River	160,914	52,865	109	213,888	0	7	442
Total	280,914	205,117	1,138	487,170	3	-2,121	2,490

In millions of gallons per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 4. Basin 2014 Water Use Data Summary by Sector

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	4,258	750	470	5,478	3	958	720
Self-Supply Commercial & Institutional	59	56	14	129	0	2	23
Self-Supply Irrigation	3	131	271	405	0	0	356
Self-Supply Livestock	1	90	64	154	0	0	20
Self-Supply Industrial	3,192	1,149	302	4,642	0	30	736
Self-Supply Thermoelectric Power Production (Once-through cooling)	26,801	2,764	2	29,567	0	0	506
Self-Supply Thermoelectric Power Production (Recirculated cooling)	760	23	6	790	0	13	89
Off-Stream Hydroelectric Power Production	0	41	0	41	0	0	0
In-Stream Hydroelectric Water Use	245,571	199,181	0	444,752	0	-3,382	0
Other Self Supply	269	931	11	1,211	0	258	40
Total	280,914	205,117	1,138	487,170	3	-2,121	2,490

In millions of gallons per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 5. Basin 2014 Water Use Data Summary by Jurisdiction (includes in-stream hydro)

Jurisdiction	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Illinois	1,611	0	0	1,611	0	1,123	0
Indiana	1,840	68	105	2,012	0	82	422
Michigan	7,964	1,431	510	9,905	0	0	516
Minnesota	327	2,548	6	2,882	0	8	32
New York	129,481	82,287	29	211,798	0	45	249
Ohio	1,387	408	80	1,875	0	-20	134
Ontario	134,093	117,532	210	251,836	3	-3,382	361
Pennsylvania	31	2	3	36	0	0	6
Québec	786	392	77	1,255	0	3	413
Wisconsin	3,394	449	117	3,960	0	20	356
Total	280,914	205,117	1,138	487,170	3	-2,121	2,490

In millions of gallons per day; Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Watershed Summaries

Lake Superior

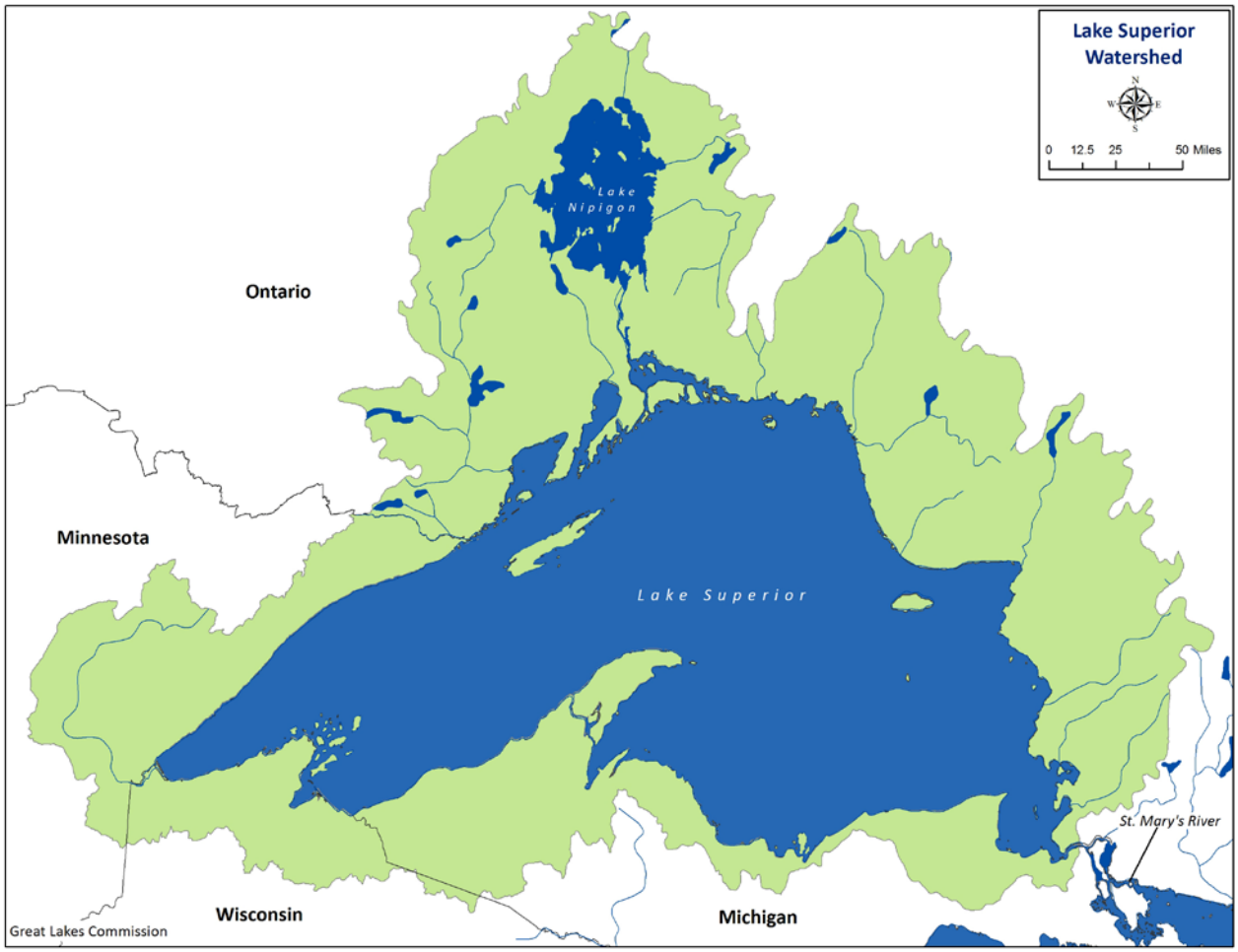

Figure 5. Lake Superior Watershed

Overview of Watershed Characteristics

Lake Superior is the largest of the Great Lakes and the world's third-largest freshwater lake by volume, holding about 2,900 cubic miles (12,100 cubic kilometers) of water. Lake Superior can hold all the water in the other Great Lakes, plus three more Lake Eries.[5] Its surface area is roughly the size of South Carolina, or approximately 31,700 square miles (82,103 square kilometers).

Basic Stats of Lake Superior

Length: 350 mi / 563 km

Breadth: 160 mi / 257 km

Elevation: 600 ft / 183 m

Depth: 483 ft / 147 m average, 1,330 ft / 406 m maximum

Volume: 2,900 cubic mi / 12,100 cubic km

Lake Surface Area: 31,700 square mi / 82,100 square km

Watershed Drainage Area: 49,300 square mi / 127,700 square km

Outlet: St. Marys River to Lake Huron

Retention / Replacement Time[1]: 191 years

Population in the Watershed: United States 444,000; Canada 229,000. Total: 673,000

[5]Retention time is the calculated quantity expressing the mean time water spends in the lake
Minnesota Sea Grant. 2012. http://www.seagrant.umn.edu/superior/facts

Water Withdrawals

Four jurisdictions share the Lake Superior watershed – Michigan, Minnesota, Ontario and Wisconsin – which collectively withdrew 996 mgd of water, excluding in-stream hydroelectric water use (32,801 mgd). This amount is a 0.8 percent decrease from the 2013 total withdrawal amount of 1,004 mgd. Thermoelectric power production, once-through and recirculated cooling (603 mgd) and industrial (280 mgd) were the major water use sectors.

Other surface waters within the Lake Superior watershed were primarily used to generate electricity with in-stream hydroelectric. Excluding in-stream hydroelectric water use, 60 percent (600 mgd) of the total reported withdrawal amount from the watershed came directly from Lake Superior. The remaining withdrawals came directly from other surface waters (38% or 375 mgd) and groundwater (2% or 21 mgd).

Water Diversions and Consumptive Uses

Reported water loss in the Lake Superior watershed totaled 55 mgd (5 percent of the total withdrawal amount). It was comprised mainly of the aggregated industrial water diversion in Minnesota of 8 mgd and the total watershed consumptive use for all four jurisdictions of 46 mgd. Industrial use (30 mgd), use for thermoelectric power, recirculated cooling (7 mgd) and the public water supply (7 mgd) sectors were the largest contributors, respectively, to the total consumptive use for the watershed.

Water gain (3,382 mgd) in the Lake Superior watershed came from the historic Long Lac and Ogoki diversion in Northern Ontario. On average, these diversions into the basin together were about two times by volume larger than the Illinois diversion out of the Basin.

Table 6. Lake Superior Watershed 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	47	3	16	66	0	0	7
Self-Supply Commercial & Institutional	1	1	0	2	0	0	0
Self-Supply Irrigation	0	0	1	1	0	0	1
Self-Supply Livestock	1	25	3	28	0	0	1
Self-Supply Industrial	153	126	2	280	0	8	30
Self-Supply Thermoelectric Power Production (Once-through cooling)	374	205	0	579	0	0	7
Self-Supply Thermoelectric Power Production (Recirculated cooling)	24	0	0	24	0	0	0
Off-Stream Hydroelectric Power Production	0	15	0	15	0	0	0
In-Stream Hydroelectric Water Use	0	32,801	0	32,801	0	-3,382	0
Other Self Supply	0	0	0	0	0	0	0
Total	600	33,176	21	33,797	0	-3,374	46

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Michigan

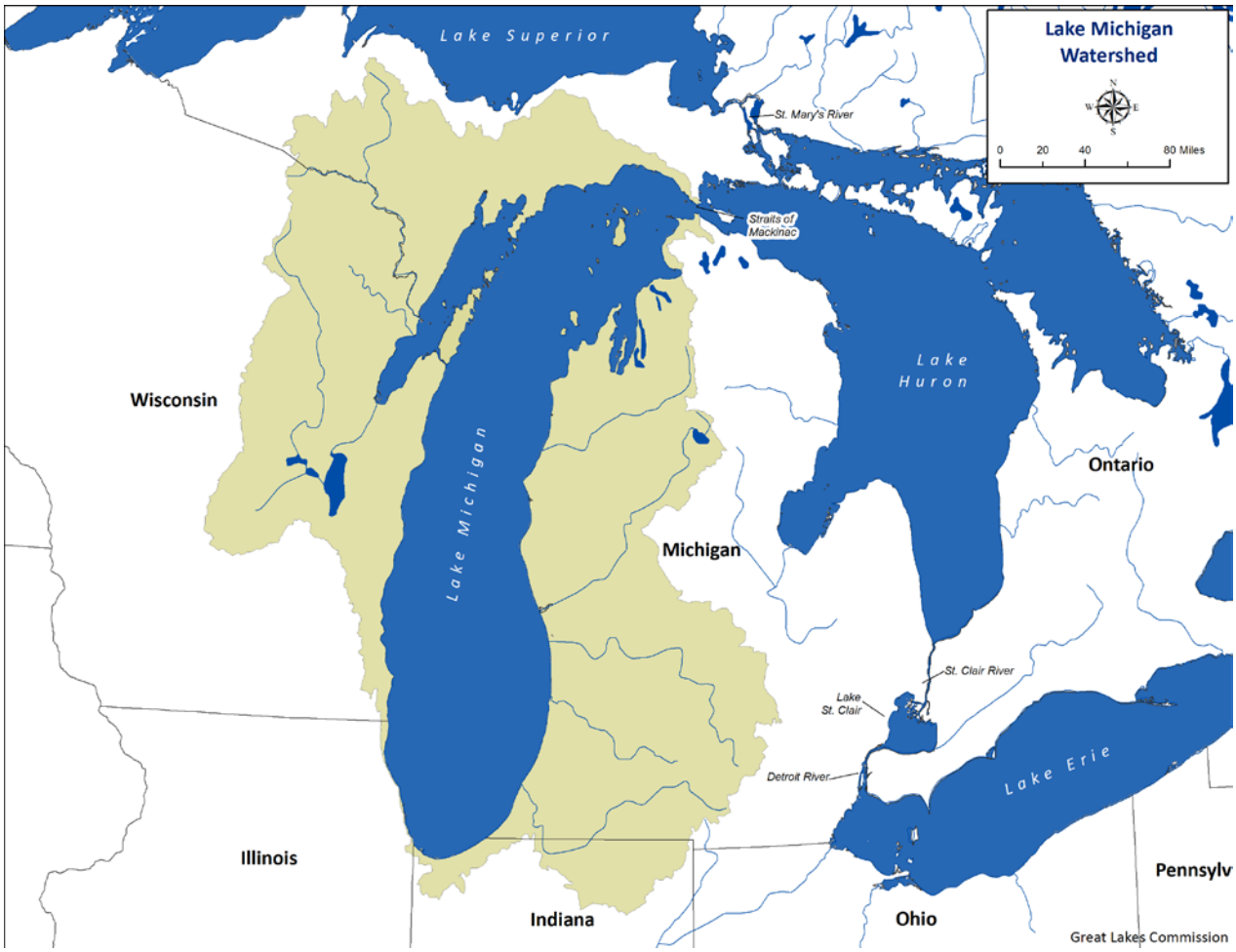

Figure 6. Lake Michigan Watershed

Overview of Watershed Characteristics

Lake Michigan is the only one of the Great Lakes entirely within the United States. It is the second largest of the Great Lakes by volume, holding about 1,180 cubic miles (4,918 cubic kilometers) of water. Its surface area is roughly the size of West Virginia, approximately 22,300 square miles (57,753 square kilometers). More than 12 million people call the Lake Michigan watershed home; about a third of the entire population of the Great Lakes-St. Lawrence River Basin lives in the Lake Michigan watershed.

Water Withdrawals

Four jurisdictions share the Lake Michigan watershed – Illinois, Indiana, Michigan, and Wisconsin – and collectively used 11,526 mgd. This amount is a 2.5 percent decrease from the 2013 total withdrawal amount of 11,830 mgd. The primary water uses were thermoelectric power,

Basic Stats of Lake Michigan

Length: 307 mi / 494 km

Breadth: 118 mi / 190 km

Elevation: 577.5 ft / 176 m

Depth: 279 ft / 85 m average, 923 ft / 281 m maximum

Volume: 1,180 cubic mi / 4,918 cubic km

Lake Surface Area: 22,300 square mi / 57,753 square km

Watershed Drainage Area: 45,600 square mi / 118,095 square km

Outlet: Straits of Mackinac to Lake Huron

Retention / Replacement Time: 62 years

Population in the Watershed: 12,052,743

both once-through and recirculated cooling (7,365 mgd), industrial use (1,971 mgd) and public water supply (1,576 mgd). Lake Michigan (86% of total withdrawals or 9,919 mgd) was the primary source of water withdrawals in the watershed.

Water Diversions and Consumptive Uses

Reported water loss in the Lake Michigan watershed, totaling 2,265 mgd, represents 17 percent of total withdrawals. Total water loss was comprised mainly of the Illinois diversion (1,121 mgd for public water supply and other purposes), additional small diversion totaling 97 and the total consumptive use of the four jurisdictions (1,047 mgd). Industrial use (379 mgd), irrigation (256 mgd) and public water supply (79 mgd) were the water use sectors that contribute the majority of the consumptive uses in the watershed.

Table 7. Lake Michigan Watershed 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	1,325	21	230	1,576	0	933	79
Self-Supply Commercial & Institutional	4	5	9	17	0	2	2
Self-Supply Irrigation	0	50	243	293	0	0	256
Self-Supply Livestock	0	17	27	44	0	0	8
Self-Supply Industrial	1,598	302	70	1,971	0	22	379
Self-Supply Thermoelectric Power Production (Once-through cooling)	6,597	597	2	7,195	0	0	287
Self-Supply Thermoelectric Power Production (Recirculated cooling)	142	22	5	170	0	13	36
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	253	1	6	260	0	248	0
Total	9,919	1,015	591	11,526	0	1,218	1,047

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Huron

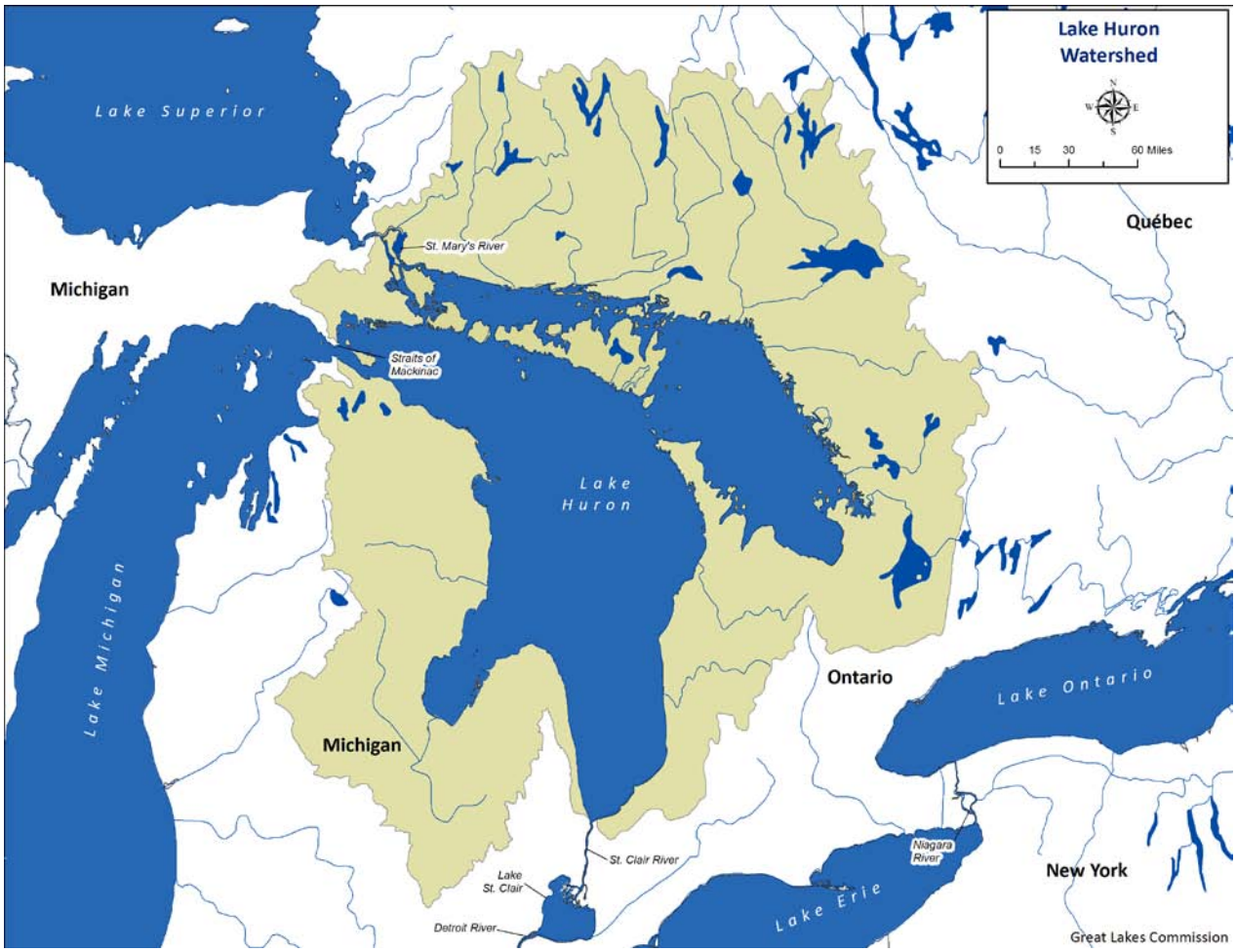

Figure 7. Lake Huron Watershed

Overview of Watershed Characteristics

By surface area, Lake Huron is the second-largest of the Great Lakes. It covers 23,000 square miles (59,600 square kilometers), making it the third-largest fresh water lake on Earth. By volume however, Lake Huron is only the third largest of the Great Lakes.

Water Withdrawals

Two jurisdictions – Michigan and Ontario – share the watershed and collectively used 8,586 mgd of the water, excluding in-stream hydroelectric water use (16,265 mgd). This is a 6 percent increase from the 2013 water withdrawal amount of 8,076 mgd.

The primary water uses were industrial use (377 mgd), thermoelectric power, once-through cooling (7,905 mgd) and public water supply (233 mgd). Excluding in-stream

Basic Stats of Lake Huron

Length: 206 mi / 332 km

Breadth: 183 mi / 295 km

Elevation: 577.5 ft / 176 m

Depth: 195 ft / 59 m average, 750 ft / 229 m maximum

Volume: 849 cubic mi / 3,538 cubic km

Lake Surface Area: 23,000 square mi / 59,565 square km

Watershed Drainage Area: 50,700 square mi / 131,303 square km

Outlet: St. Clair River to Lake Erie

Retention / Replacement Time: 21 years

Population in the Watershed: United States 1,483,872; Canada 1,476,487. Total: 2,960,359

hydroelectric water use, Lake Huron surface water was the source of 82 percent of the total withdrawals in the watershed.

Water Diversions and Consumptive Uses

Reported water loss to the Lake Huron watershed was 183 mgd, which represented nearly two percent of the total withdrawal amount. This total includes an intrabasin transfer of 42 mgd for public water supply in Ontario. While hydrologically this intrabasin transfer remained in the Great Lakes-St. Lawrence River Basin, it represented a loss to the Lake Huron watershed and a net gain to the Lake Erie watershed. Public water supply (28 mgd) and thermoelectric power production (66 mgd) made up the majority (67%) of the consumptive uses in the watershed.

Table 8. Lake Huron Watershed 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	148	43	42	233	42	0	28
Self-Supply Commercial & Institutional	1	3	0	5	0	0	1
Self-Supply Irrigation	1	15	11	26	0	0	24
Self-Supply Livestock	0	12	22	33	0	0	5
Self-Supply Industrial	241	119	17	377	0	0	18
Self-Supply Thermoelectric Power Production (Once-through cooling)	6,617	1,288	0	7,905	0	0	66
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	1	1	0	0	1
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	16,265	0	16,265	0	0	0
Other Self Supply	0	6	0	6	0	0	0
Total	7,010	17,749	92	24,851	42	0	141

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Erie

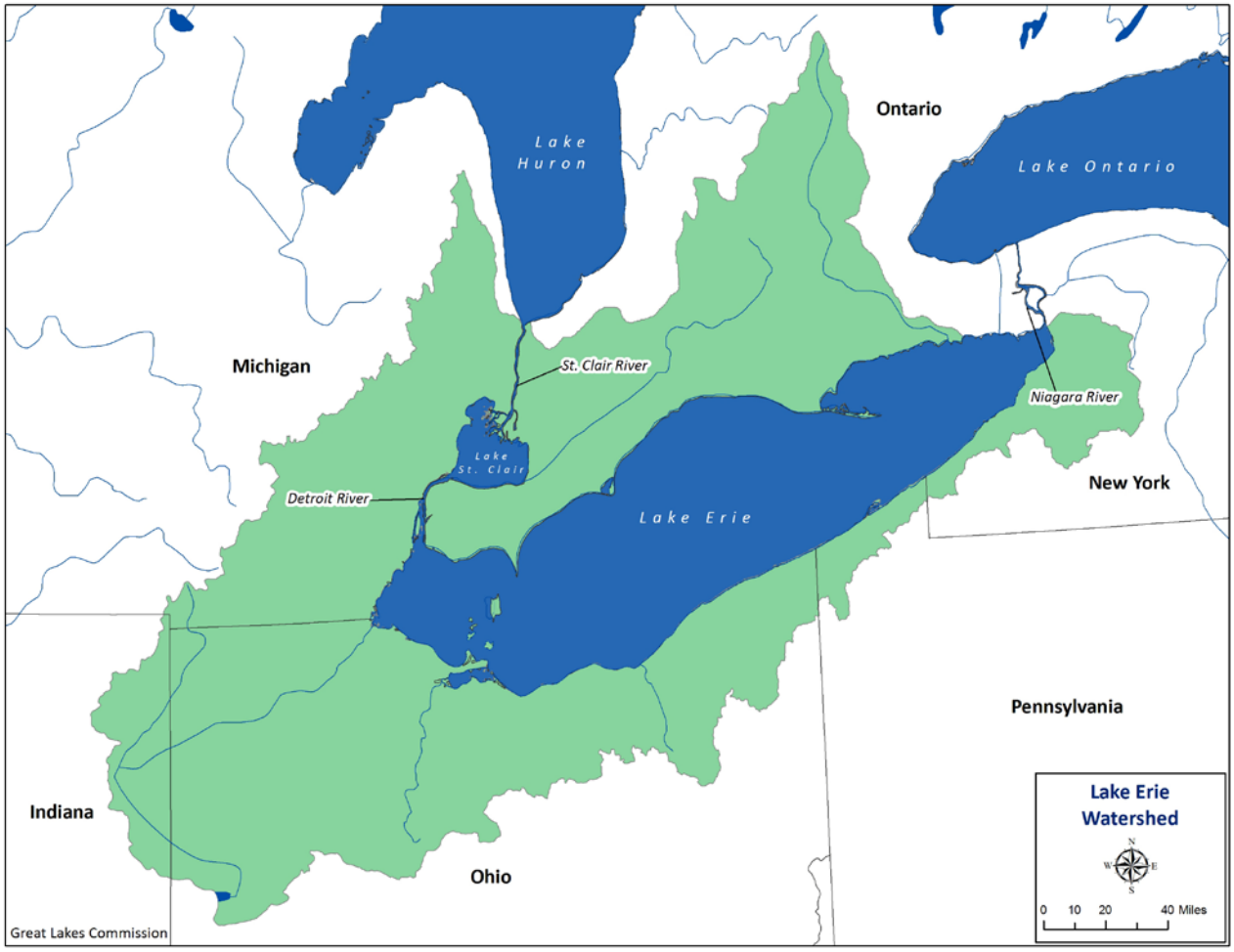

Figure 8. Lake Erie Watershed

Overview of Watershed Characteristics

By surface area, Lake Erie is the 12th largest freshwater lake in the world. The shallowest of the Great Lakes, it has an average depth of 62 feet and a maximum depth of 210 feet. The lake holds about 116 cubic miles (4,863 cubic kilometers) of water. Lake Erie is warmer than the other Great Lakes, which also helps make it the most productive. However, its size also makes it more ecologically sensitive than the other Great Lakes.

The watershed is home to more than 12.5 million people, representing more than one-third of the entire population of the Great Lakes-St. Lawrence River Basin.

Water Withdrawals

Six jurisdictions – Indiana, Michigan, New York, Ohio, Ontario and Pennsylvania – share the watershed and

Basic Stats of Lake Erie

Length: 241 mi / 388 km

Breadth: 57 mi / 92 km

Elevation: 569.2 ft / 173.5 m

Depth: 62 ft / 19 m average, 210 ft / 64 m maximum

Volume: 116 cubic mi / 483 cubic km

Lake Surface Area: 9,910 square mi / 25,655 square km

Watershed Drainage Area: 22,700 square mi / 58,788 square km

Outlets: Niagara River and Welland Canal

Retention/Replacement Time: 2.7 years

Population in the Watershed: United States, est. 10,640,671; Canada est. 1,892,306. Total: est. 12,532,977

collectively used 8,999 mgd of the water, excluding in-stream hydroelectric water use, which accounted for 44,756 mgd. This amount is a four percent decrease from the 2013 total withdrawal amount of 9,330 mgd. Aside from water used for hydroelectric power generation purposes, the primary water uses were thermoelectric power, both once-through and recirculated cooling (6,231 mgd), public water supply (1,586 mgd) and industrial use (1,096 mgd).

Lake Erie surface water was the source of 88 percent of the total withdrawals in the watershed. However, other surface water and groundwater were the only sources of Indiana's water use, primarily supporting the public water supply sector.

Water Diversions and Consumptive Uses

Reported water loss in the Lake Erie watershed totaled 4,619 mgd. This amount includes an aggregate diversion (going into the Lake Erie watershed) of 22 mgd, an aggregate intrabasin diversion of 4,181 mgd, and a total consumptive use of 440 mgd. The largest intrabasin diversion is the Welland Canal for other self supply, navigation purposes (4,221mgd). The Welland Canal was constructed in 1830 as a ship canal in Ontario, Canada, connecting Lake Erie to Lake Ontario. The major consumptive uses were for public water supply (205 mgd) and industrial uses (91mgd).

Table 9. Lake Erie Watershed 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	1,302	178	106	1,586	-40	9	205
Self-Supply Commercial & Institutional	0	3	2	5	0	0	1
Self-Supply Irrigation	1	36	14	51	0	0	46
Self-Supply Livestock	0	7	6	13	0	0	3
Self-Supply Industrial	722	247	127	1,096	0	0	91
Self-Supply Thermoelectric Power Production (Once-through cooling)	5,728	337	0	6,065	0	0	62
Self-Supply Thermoelectric Power Production (Recirculated cooling)	165	0	0	165	0	0	31
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	44,180	576	0	44,756	0	0	0
Other Self Supply	4	9	4	16	4,221	-22	2
Total	52,103	1,393	259	53,755	4,181	-13	440

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Lake Ontario

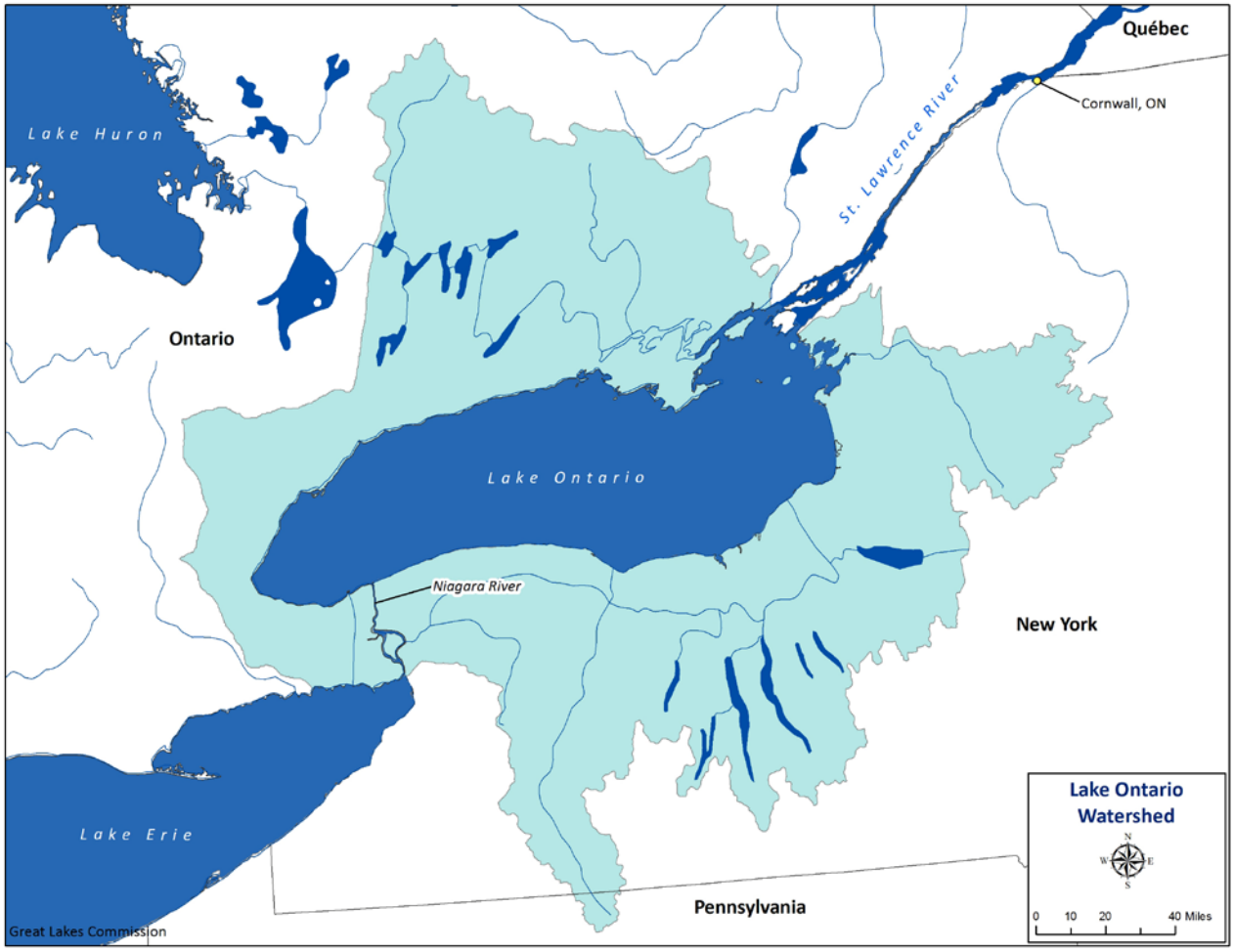

Figure 97. Lake Ontario Watershed

Overview of Watershed Characteristics

Lake Ontario is the easternmost of the Great Lakes and the smallest in surface area (covering 7,340 square miles, 18,960 square kilometers). It is extremely deep (e.g., 802 ft at maximum) in some areas and exceeds Lake Erie in volume (393 cubic miles, 1,639 cubic kilometers). By surface area, it is the 14th largest lake in the world.

Water Withdrawals

Three jurisdictions – New York, Ontario and Pennsylvania – share the watershed and collectively used 10,594 mgd of the water, excluding in-stream hydroelectric water use, which accounted for 138,759 mgd. This amount is a 0.7 percent increase from the 2013 withdrawal amount of 10,519 mgd. Aside from withdrawals for hydroelectric power generation purposes, the primary water uses were for public water supply (973 mgd), other self-supply uses (777 mgd) and

Basic Stats of Lake Ontario

Length: 193 mi / 311 km

Breadth: 53 mi / 85 km

Elevation: 243.3 ft / 74.2 m

Depth: 283 ft / 86 m average, 802 ft / 244 m maximum

Volume: 393 cubic mi / 1,639 cubic km

Lake Surface Area: 7,340 square mi / 19,009 square km

Watershed Drainage Area: 23,400 square mi / 60,601 square km

Outlet: St. Lawrence River to the Atlantic Ocean

Retention / Replacement Time: 6 years

Population in the Watershed: United States, est. 2,856,360; Canada est. 2,835,818. Total: est.5,692,178

thermoelectric power generation, both once-through and recirculated cooling (8,198 mgd).

Lake Ontario surface water was the source for 85 percent of the total withdrawals in the watershed. It was the source for most of the water use sectors, except for irrigation and livestock where other surface water in the watershed was the predominant source.

Water Diversions and Consumptive Uses

Reported water loss in the Lake Ontario watershed totaled 413 mgd. This amount includes diversions totaling 41 mgd, an intrabasin diversion of 1 mgd and a combined consumptive use amount of 373 mgd. The major consumptive uses were from public water supply (120 mgd), thermoelectric power production (106 mgd) and industrial uses (71 mgd).

Water gained (4,221 mgd) in the Lake Ontario watershed came from the Welland Canal, which diverts water from the Lake Erie watershed for navigation purposes.

Table 10. Lake Ontario Watershed 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	763	194	17	973	1	9	120
Self-Supply Commercial & Institutional	53	38	1	91	0	0	17
Self-Supply Irrigation	0	26	1	27	0	0	24
Self-Supply Livestock	0	21	2	23	0	0	2
Self-Supply Industrial	296	139	43	478	0	0	71
Self-Supply Thermoelectric Power Production (Once-through cooling)	7,431	336	0	7,768	0	0	84
Self-Supply Thermoelectric Power Production (Recirculated cooling)	429	0	0	430	0	0	22
Off-Stream Hydroelectric Power Production	0	26	0	26	0	0	0
In-Stream Hydroelectric Water Use	41,396	97,363	0	138,759	0	0	0
Other Self Supply	0	777	0	777	-4,221	32	33
Total	50,369	98,919	65	149,353	-4,220	41	373

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

St. Lawrence River

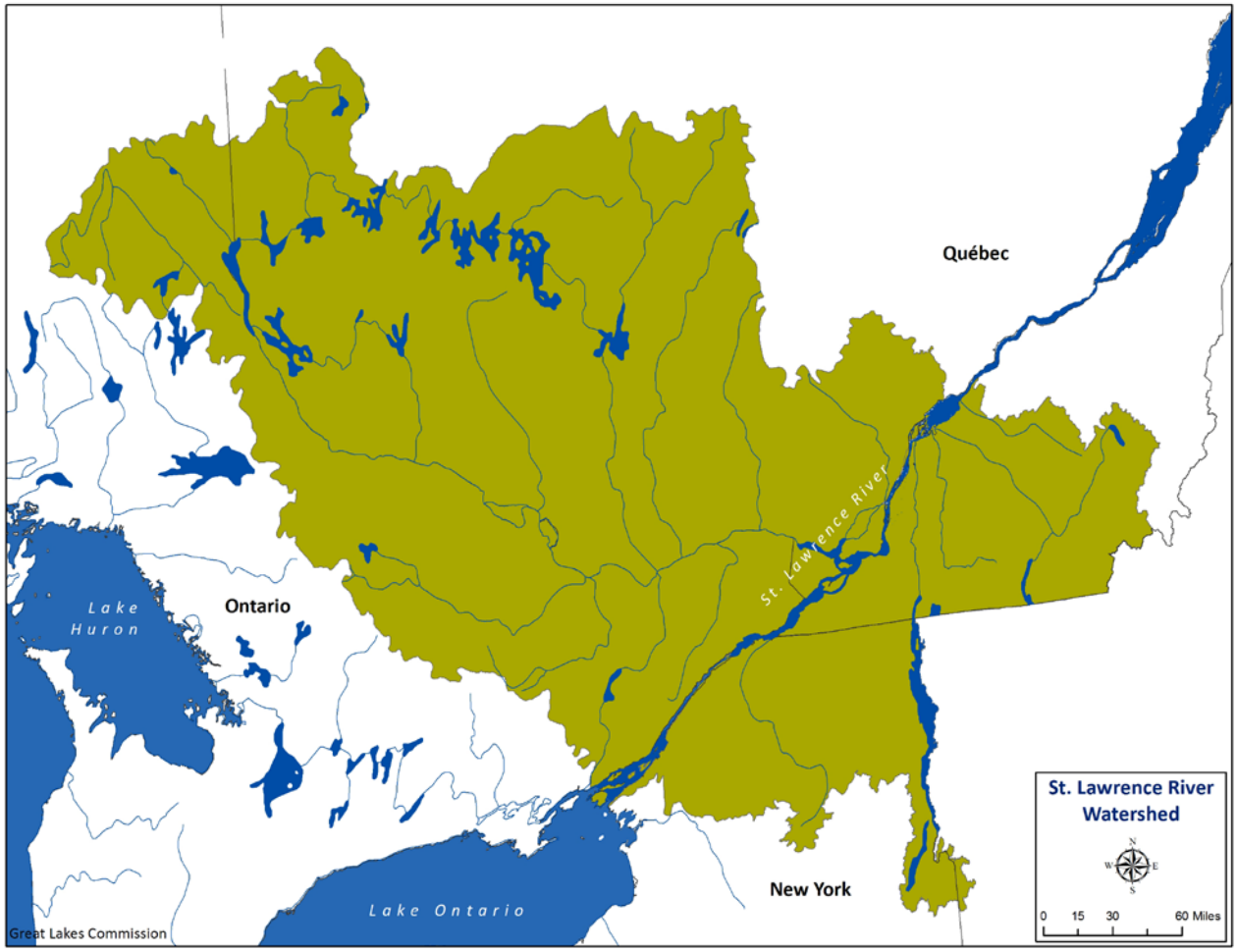

Figure 10. St. Lawrence River Watershed

Overview of Watershed Characteristics

Running 744 miles (1,198 kilometers) in length, the St. Lawrence River is considered a major river of North America. Mostly located in the province of Québec, it links the Great Lakes to the Atlantic Ocean.

Basic Stats of the St. Lawrence River

Length: 744 mi / 1,197 km

Elevation: 245 ft/74.7 m at the source and 0 ft/0 m at the mouth

Average Annual Flow (Montréal): 7,660 cubic meters/second

Volume: 393 cubic mi / 1,639 cubic km

Watershed Drainage Area: 519,000 square mi / 1,344,200 square km

Outlet: Gulf of St. Lawrence/ Atlantic Ocean

Water Withdrawals

Three jurisdictions – New York, Ontario and Québec – share the watershed and collectively used 1,717 mgd of the water, excluding in-stream hydroelectric water use, which accounted for 212,172 mgd. This amount is a 6 percent increase from the 2013 withdrawal total of 1,621 mgd. Aside from hydroelectric, the primary water uses were public water supply (1,044 mgd), and industrial use (440 mgd).

St. Lawrence River surface water was the source for over half (54%) of the watershed's total withdrawal amount. Other surface water within the St. Lawrence River watershed accounted for 40 percent of the total. The remaining portion of the total withdrawal amount (6%) came from groundwater sources.

Water Diversions and Consumptive Uses

Water loss in the St. Lawrence River watershed totaled 449 mgd. This total includes a diversion amount of 7 mgd for public supply purposes in New York and Québec and a combined consumptive use amount of 442 mgd. The largest consumptive uses were the public water supply sector at 280 mgd and industrial at 148 mgd.

Table 11. St. Lawrence River Watershed 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	673	311	59	1,044	0	7	280
Self-Supply Commercial & Institutional	0	7	1	8	0	0	2
Self-Supply Irrigation	0	5	1	6	0	0	5
Self-Supply Livestock	0	8	5	13	0	0	1
Self-Supply Industrial	181	216	43	440	0	0	148
Self-Supply Thermoelectric Power Production (Once-through cooling)	53	2	0	55	0	0	1
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	159,995	52,177	0	212,172	0	0	0
Other Self Supply	11	139	1	152	0	0	5
Total	160,914	52,865	109	213,888	0	7	442

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Jurisdiction Reports

Illinois

The Illinois portion of the Lake Michigan watershed is only about 100 square miles, which accounts for less than 0.2 percent of the total area of the state. The Lake Michigan coastline of Illinois is 63 miles long, which is a small fraction of the 1,640 miles that make up the total Lake Michigan shoreline. Despite its relatively small size, the Illinois Lake Michigan service area is home to half of the total population of Illinois and the lake itself is the largest public drinking water supply in the state, serving nearly 7 million people.

The total withdrawal amount from the Basin for Illinois in 2014 was 1,611 mgd, an 8 percent decrease from 2013 (1,768 mgd). The largest uses of reported water were public water supply at 873 mgd (nearly half of the total withdrawal amount) and thermoelectric power production, once-through cooling at 460 mgd (29% of the total withdrawal amount). The primary source for all withdrawals was Lake Michigan.

The Illinois Diversion, which takes water from Lake Michigan and discharges it into the Mississippi River watershed, is comprised of three elements: public water supply; stormwater runoff; and support for control structures for navigation and discretionary diversion for other purposes such as low flow augmentation and water quality enhancement. The amount of water diverted for public water supply and self-supply commercial and institutional was 875 mgd. The diversion amount supporting other uses (i.e., discretionary diversion) was 248 mgd. Due to rounding, the consumptive use for the industrial sector appears to be zero, but it was reported to the database as 0.34 mgd.

Data collected for this report came from multiple sources: Illinois Department of Natural Resources, Illinois State Water Survey and the Metropolitan Water Reclamation District of Greater Chicagoland. These data were generated with a 100 percent reporting compliance from permitted water withdrawal facilities.

Table 12. Illinois 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	873	0	0	873	0	873	0
Self-Supply Commercial & Institutional	2	0	0	2	0	2	0
Self-Supply Irrigation	0	0	0	0	0	0	0
Self-Supply Livestock	0	0	0	0	0	0	0
Self-Supply Industrial	28	0	0	28	0	0	0
Self-Supply Thermoelectric Power Production (Once-through cooling)	460	0	0	460	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	248	0	0	248	0	248	0
Total	1,611	0	0	1,611	0	1,123	0

In millions of gallons per day
Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Indiana

The state of Indiana relies on the water resources of the Lake Michigan and Lake Erie watersheds. Indiana's portion of Lake Michigan encompasses a total of 241 square miles. Four Indiana counties lie partially within the Lake Michigan watershed, but three of these four counties (Lake, Porter and LaPorte) constitute more than 99.5 percent of the land area in the watershed. Abundant freshwater from Lake Michigan has promoted the development of an extensive urban and industrial belt along the Indiana coast of Lake Michigan. Water supplies in Indiana's non-coastal counties in the Lake Michigan watershed are drawn primarily from groundwater sources.

Indiana shares a portion of the Maumee River watershed that flows into Lake Erie. The Maumee River watershed encompasses a total of 1,283 square miles of northeast Indiana. Six Indiana counties lie partially within this watershed. The largest withdrawals come from the surface waters of the St. Joseph (a major tributary within the Maumee watershed) and the Maumee River, used for public supply and industrial purposes. Groundwater withdrawals in the Maumee River watershed are used primarily for public and domestic water supply and dewatering for industrial purposes.[6]

In 2014, the total reported water withdrawal amount from the Basin for Indiana was 2,012 mgd. The largest uses were industrial (1,542 mgd), thermoelectric power (248 mgd) and public water supply (169 mgd).

The total reported diversion amount for Indiana was 82 mgd. Because a small, 65 square mile portion of Indiana drains into the Illinois River (as a result of the Illinois Diversion), water transferred from the Lake Michigan watershed into this area is considered a diversion of water from the Great Lakes-St. Lawrence River Basin. The majority of reported diversions for Indiana (53 mgd) were distributed for public supply purposes from Lake Michigan surface water and discharged to the "Illinois Diversion" area, with about 1 mgd reported as a diversion from groundwater for public supply. The industrial sector was responsible for about 22mgd of the reported diversion from the Lake Michigan watershed to the Illinois River.

For the Lake Erie watershed, a portion of the town of Fort Wayne's public water supply distribution system is located in the Upper Wabash watershed. The amount of water (about 7 mgd primarily from other surface water with a small portion from groundwater) distributed through that portion of the system was reported as a diversion from the Lake Erie watershed. Consumptive use totaled 422 mgd, with the industrial sector in the Lake Michigan watershed (341 mgd or 81%) as the primary contributor to the total.

Data collected for this report came from the Indiana Department of Natural Resources. These data were generated with reporting compliance rates from permitted water withdrawal facilities ranging from 75 to 100 percent depending on the water use sector. Withdrawals and consumptive uses are not estimated for facilities that did not report.

[6] Indiana Dept. of Natural Resources. 1996. http://www.in.gov/dnr/water/files/lakemich_basinsums.pdf
http://www.in.gov/dnr/water/files/maumee_basinsums.pdf

Table 13. Indiana 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	91	33	46	169	0	61	21
Self-Supply Commercial & Institutional	0	0	1	1	0	0	0
Self-Supply Irrigation	0	6	40	46	0	0	41
Self-Supply Livestock	0	1	3	4	0	0	2
Self-Supply Industrial	1,525	7	11	1,542	0	22	343
Self-Supply Thermoelectric Power Production (Once-through cooling)	210	0	0	210	0	0	4
Self-Supply Thermoelectric Power Production (Recirculated cooling)	14	21	3	38	0	0	11
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	0	1	1	0	0	0
Total	1,840	68	105	2,012	0	82	422

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Michigan

Home to more than 9.8 million people, Michigan borders four of the Great Lakes (Superior, Michigan, Huron and Erie). Some unique features of Michigan include:

- 57,022 square miles of land area in two peninsulas (40,583 square miles in the Lower Peninsula and 16,439 square miles in the Upper Peninsula);
- Virtually the entire land area of the state lies within the Great Lakes basin;
- 38,575 square miles of Great Lakes water area; and
- 3,126 miles of Great Lakes shoreline (more fresh water coastline than any other state).[7]

In 2014, the total reported water withdrawal amount from the Basin for Michigan was 9,905 mgd, a decrease of 2 percent from the 2013 total water withdrawal amount of 10,110 mgd. The largest use was thermoelectric power production, once-through and recirculated cooling, totaling 7,910 mgd or nearly 80 percent of the total withdrawal amount. The Great Lakes proper were the largest source for withdrawals at 80 percent of the total. Nearly half of the total water withdrawal amount (4,814 mgd, 49%) came from the Lake Erie watershed, mainly used for thermoelectric power production. Forty one percent of total withdrawal amount (4,028 mgd) came from the Lake Michigan watershed, followed by the Lake Huron watershed at 827 mgd (8%) and the Lake Superior watershed at 235 mgd (2%).

Michigan reported no diversions. The total amount of consumptive use was 516 mgd (5% of the total withdrawal amount), with self-supply irrigation being the largest contributor to consumptive use at 229 mgd.

Data collected for this report came from multiple sources: Michigan Department of Environmental Quality and the Michigan Department of Agriculture and Rural Development. These data were generated with estimated reporting compliance rates ranging from 85 to 99 percent of total water use reporters, depending on the water use sector. Withdrawals and consumptive uses are not estimated for facilities not in compliance with reporting for most water use sectors except for self-supply livestock which was partially estimated by the state agency. This sector had 40 percent reporting compliance rate due to a lag in reporting within the agricultural community and the omission of aquaculture facilities from agency reporting.

[7] Michigan Dept. of Transportation. http://www.michigan.gov/mdot/0,4616,7-151-9622_11033_11151-67959--,00.html

Table 14. Michigan 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	776	18	199	993	0	0	124
Self-Supply Commercial & Institutional	0	3	6	9	0	0	1
Self-Supply Irrigation	0	63	192	255	0	0	229
Self-Supply Livestock	0	22	20	43	0	0	7
Self-Supply Industrial	320	282	83	686	0	0	69
Self-Supply Thermoelectric Power Production (Once-through cooling)	6,702	1,037	2	7,741	0	0	49
Self-Supply Thermoelectric Power Production (Recirculated cooling)	164	2	3	169	0	0	37
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	4	5	9	0	0	0
Total	7,964	1,431	510	9,905	0	0	516

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Minnesota

The Minnesota part of the Lake Superior watershed encompasses approximately 6,200 square miles. Major river watersheds in the basin include the Cloquet, Nemadji and St. Louis River systems, as well as the north shore tributaries to Lake Superior.[8]

Excluding in-stream hydroelectric water use (2,311 mgd), the total withdrawal amount from the Basin for Minnesota was 571 mgd, a decrease of 2 percent from the total withdrawal amount for 2013 (582 mgd). The major water use sectors include industrial at 217 mgd and thermoelectric power production, once-through cooling at 300 mgd. These water use sectors were about equally supplied by Lake Superior and other surface water within the Lake Superior watershed.

The total reported diversion amount of 8 mgd was for industrial purposes. Total consumptive use was 32 mgd, which is relatively constant compared to the 2013 total consumptive use of 33 mgd. The majority of that amount (22 mgd) was for industrial purposes.

The water use data was provided by the Minnesota Department of Natural Resources which collected measured water use data from water withdrawal permit holders with a 100 percent reporting compliance from permitted water withdrawal facilities.

Table 15. Minnesota 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	29	2	6	37	0	0	4
Self-Supply Commercial & Institutional	1	1	0	1	0	0	0
Self-Supply Irrigation	0	0	0	0	0	0	0
Self-Supply Livestock	1	0	0	1	0	0	1
Self-Supply Industrial	125	91	1	217	0	8	22
Self-Supply Thermoelectric Power Production (Once-through cooling)	172	128	0	300	0	0	6
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	15	0	15	0	0	0
In-Stream Hydroelectric Water Use	0	2,311	0	2,311	0	0	0
Other Self Supply	0	0	0	0	0	0	0
Total	327	2,548	6	2,882	0	8	32

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

[8] Minnesota Pollution Control Agency. 2013. http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/basins/lake-superior-basin/index.html

New York

Approximately 80 percent of New York State's fresh surface water, over 700 miles of shoreline and nearly 48 percent of New York lands are contained in the drainage watersheds of Lake Erie, Lake Ontario and the St. Lawrence River, which includes the Lake Champlain/Lake George watersheds. More than four million New Yorkers depend on the fresh water of these watersheds for drinking water, and hundreds of miles of waterways and border waters for navigation.[9]

Excluding in-stream hydroelectric water use (208,112 mgd), the total withdrawal amount from the Basin for New York was 3,686 mgd, a 4 percent decrease from 2013 (3,847 mgd). The Lake Ontario watershed was the source of the majority of New York's water withdrawals at 2,922 mgd or 79 percent of the total withdrawal amount. Thermoelectric power production (both once-through and recirculated cooling) at 2,042 mgd represented nearly 55 percent of the total withdrawal amount; public water supply (474 mgd) represented nearly 13 percent of the total; and industrial (296 mgd) represented 8 percent of the total. For the Lake Erie and Lake Ontario watersheds, Great Lakes surface water was the primary source of water, when in-stream hydroelectric is excluded. For the St. Lawrence River watershed, other surface water was the primary source of water, when in-stream hydroelectric is excluded.

The 2014 total diversion amount for New York was 45 mgd of which 13 mgd was for public supply and 32 mgd for other self-supply purposes. The total consumptive use amount was 249 mgd. The largest consumptive use was attributed to industrial purposes at 64 mgd.

The water use data was provided by the New York State Department of Environmental Conservation. The data collected was metered and estimated water use. Reporting compliance varies among the water use sectors from 56 percent for the irrigation sector to 100 percent for the hydroelectric power sector. New York State does not estimate the water use for facilities that did not report their use.

Table 16. New York 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	294	162	19	474	0	13	59
Self-Supply Commercial & Institutional	0	42	2	44	0	0	10
Self-Supply Irrigation	0	29	1	30	0	0	27
Self-Supply Livestock	0	23	0	23	0	0	3
Self-Supply Industrial	159	131	6	296	0	0	64
Self-Supply Thermoelectric Power Production (Once-through cooling)	1,395	218	0	1,613	0	0	32
Self-Supply Thermoelectric Power Production (Recirculated cooling)	429	0	0	430	0	0	22
Off-Stream Hydroelectric Power Production	0	26	0	26	0	0	0
In-Stream Hydroelectric Water Use	127,204	80,908	0	208,112	0	0	0
Other Self Supply	0	749	1	750	0	32	33
Total	129,481	82,287	29	211,798	0	45	249

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

[9] Great Lakes Basin Advisory Council. 2013. Our Great Lakes Water Resources: Conserving and Protecting Our Water Today for Use Tomorrow Final Report. http://www.dec.ny.gov/docs/regions_pdf/glbacfrpt.pdf

Ohio

Ohio's portion of the Lake Erie watershed drains 11,649 square miles and is home to 4.65 million people. Toledo, Sandusky and Cleveland are some of the communities that dot Ohio's 312 mile-long shoreline. Agricultural row crops account for 59 percent of the land use in the Ohio watersheds draining to Lake Erie, followed by urban residential and commercial land use at a combined 16 percent. Another 16 percent were from forested lands and wetlands, combined with pasture land making up 5 percent of total land use.[10]

The 2014 total reported withdrawal amount from the Basin for Ohio was 1,875 mgd, a 3 percent decrease from the total withdrawal amount for 2013 (1,931 mgd). Primary water use sectors included thermoelectric power production (once-through and recirculated cooling) at 1,100 mgd, representing 59 percent of total withdrawal amount; public water supply (527 mgd), representing 28 percent; and industrial (211 mgd), representing 11 percent. The source for 74 percent of the total withdrawal amount was Lake Erie. However, within the irrigation and industrial water use sectors, other surface water was the primary source at 90 percent and 52 percent of the total withdrawal amount, respectively.

Overall, 13 mgd was diverted out of the Lake Erie watershed, all for public water supply purposes, of which 11 mgd was returned to the watershed after use, resulting in a net diversion of 2 mgd. This was offset by incoming diversions totaling 22 mgd, primarily for other self-supply purposes, resulting in a net diversion of 20 mgd into the Lake Erie watershed. Total consumptive use was 134 mgd. Fifty nine percent of the total consumptive use was attributed to the public water supply sector.

The water use data was provided by the Ohio Department of Natural Resources, Division of Water Resources with a 100 percent reporting compliance from every water use sector.

Table 17. Ohio 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	402	99	27	527	0	2	79
Self-Supply Commercial & Institutional	0	0	0	0	0	0	0
Self-Supply Irrigation	0	27	2	30	0	0	27
Self-Supply Livestock	0	0	1	1	0	0	0
Self-Supply Industrial	51	110	50	211	0	0	4
Self-Supply Thermoelectric Power Production (Once-through cooling)	815	168	0	983	0	0	10
Self-Supply Thermoelectric Power Production (Recirculated cooling)	116	0	0	116	0	0	12
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use*							
Other Self Supply	1	4	1	7	0	-22	2
Total	1,387	408	80	1,875	0	-20	134

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

**No data was provided for this sector.*

[10] Ohio Environmental Protection Agency. 2010. Ohio Lake Erie Phosphorus Task Force Final Report. http://www.epa.ohio.gov/portals/35/lakeerie/ptaskforce/Task_Force_Final_Report_April_2010.pdf

Ontario

More than 98 percent of Ontario residents (more than 12 million people) live within the Great Lakes-St. Lawrence River Basin. Most live along the coast in eight of Canada's 20 largest cities, which include Toronto, Hamilton, Windsor and Sarnia.[11] Ontario's portion of the Great Lakes forms the longest freshwater coastline in the world stretching more than 6,800 miles (11,000 kilometers)[12] across five major watersheds in the Great Lakes-St. Lawrence River system: Lake Superior, Lake Huron, Lake Erie, Lake Ontario and the St. Lawrence River watersheds.

For this report, 2013 data was used for most all water use sectors except for the diversion amounts related to the public water supply sector for which 2009 data were used. Excluding in-stream hydroelectric water use (reported amount of 234,330 mgd, or 887,035 million liters per day [mld]), the total water withdrawal amount from the Basin was approximately 17,506 mgd (66,267 mld). The three largest water use categories were thermoelectric power (once-through cooling) at 14,905 mgd (56,422 mld) or 85 percent of the total withdrawal amount; public supply at 1,154 mgd (4,370 mld); and industrial at 1,158 mgd (4,382 mld). Except for the Lake Superior and St. Lawrence River watersheds, where other surface water was the primary source for withdrawals, the primary source for withdrawals came from Great Lakes surface water.

No diversions from the Great Lakes-St. Lawrence River Basin were reported for Ontario, while diversions into the basin were approximately 3,382 mgd (12,802 mld). The total consumptive use amount was approximately 361 mgd (1,366 mld). Three water use sectors, representing the largest consumptive uses, included thermoelectric power at 134 mgd (508 mld), public water supply at 139 mgd (525 mld) and industrial at 76 mgd (289 mld). Ontario reported intrabasin diversions totaling 4,263 mgd (16,138 mld) as summarized in Table 17.

These data were collected primarily through the provincial water taking and reporting system. Additional estimates were provided by water use sector to capture water use that was not reported. Reporting data varied among water use sectors from 88 percent for the industrial sector to 100 percent for thermoelectric power production (once-through cooling).

[11] Ontario Ministry of Natural Resources. 2012. http://www.mnr.gov.on.ca/en/Business/GreatLakes/2ColumnSubPage/STEL02_173888.html
[12] Ontario Ministry of the Environment. 2012, http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_096933.pdf

Table 18. Ontario 2013[13] Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	893	192	70	1,154	3	0	139
Self-Supply Commercial & Institutional	54	5	2	61	0	0	9
Self-Supply Irrigation	2	1	0	3	0	0	2
Self-Supply Livestock	0	26	24	50	0	0	0
Self-Supply Industrial	838	207	113	1,158	0	0	76
Self-Supply Thermoelectric Power Production (Once-through cooling)	13,937	968	0	14,905	0	0	134
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	118,367	115,962	0	234,330	0	-3,382	0
Other Self Supply	3	171	2	175	0	0	0
Total	134,093	117,532	210	251,836	3	-3,382	361

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Table 19. Ontario 2013[14] Intrabasin Diversion Summary

Sector	Watershed		Intrabasin Diversion
	Source	Receiving	
Public Water Supply	Lake Huron		42
Public Water Supply	Lake Ontario		1
Public Water Supply		Lake Erie	-40
Other Self Supply	Lake Erie		4,221
Other Self Supply		Lake Ontario	-4,221

In millions of gallons per day

[13] 2013 water use data was used for the 2014 report.
[14] 2009 water use data was used for the intrabasin transfers for public supply purposes and 2013 water use data was used for the intrasbasin transfer for other supply purposes.

Pennsylvania

The Pennsylvania Lake Erie watershed spans 508 square miles. The largest land uses in Pennsylvania's portion of the Basin are agriculture and forest.[15] While it is the smallest watershed in the state, it is home to more than 240,000 people with the majority concentrated along the 76.6 miles of Lake Erie coastline.

The total withdrawal amount from the Basin for Pennsylvania was 36 mgd. The majority (30 mgd or 83% of the total withdrawal amount) was used for public water supply purposes.

No diversions were reported in 2014. The total consumptive use was 6 mgd. The public water supply sector made up the majority (51%) of the total consumptive use amount.

The water use data were provided by the Pennsylvania Department of Environmental Protection (DEP). Reporting compliance varied among water use sectors from 21 percent for the irrigation sector to 100 percent for the self-supply commercial and institutional sector. Pennsylvania DEP did not include estimated water use for the facilities that failed to report their water use to the state.

Table 20. Pennsylvania 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	28	0	2	30	0	0	3
Self-Supply Commercial & Institutional	0	0	0	0	0	0	0
Self-Supply Irrigation	0	0	0	0	0	0	0
Self-Supply Livestock	0	2	1	3	0	0	3
Self-Supply Industrial	3	0	0	3	0	0	0
Self-Supply Thermoelectric Power Production (Once-through cooling)	0	0	0	0	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	0	0	0	0	0	0	0
Total	31	2	3	36	0	0	6

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

[15] Email communications with David Skellie, Pennsylvania Sea Grant. 2013.

Québec

The majority of Québec's population lives in the Great-Lakes St. Lawrence River watershed. The portion of the St. Lawrence River included in the Great Lakes – St. Lawrence Basin Agreement territory includes the Montreal metropolitan area that represents nearly 50 percent of Québec's population. Some of the tributaries with the greatest flow within that portion are the Outaouais (Ottawa) River, the Richelieu River and the St. François River.

The total withdrawal amount from the Basin for Québec was 1,255 mgd (4,751 mld) – a 1.9 percent decrease from the 2013 withdrawal total of 1,232 mgd (4,663 mld). The majority (72%) of this amount was used for public water supply purposes at 908 mgd (3,437 mld). The next major water use, industrial sector, made up a quarter of the total withdrawals at 324 mgd (1,228 mld).

The total diversion amount was 3 mgd (12 mld) for public supply purposes. The total consumptive use amount was 413 mgd (1,565 mld), representing 33 percent of the total withdrawal amount. The primary water use sectors contributing to the total consumptive use were public supply at 261 mgd (988 mld) and industrial at 143 mgd (541 mld).

Starting with 2012 water use data, the province of Québec began its water use data collection program which gathers estimated or metered water use data reported by water users. Being rather new, this program has made progress in identifying and correcting reporting errors, and increasing reporting compliance for all the water use sectors. Québec will begin to collect water use reports from the irrigation (agricultural users) and livestock users in 2016. Therefore, the 2014 data for this sector should be considered as incomplete and unrepresentative of this water use sector in Québec.

Table 21. Québec 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	632	223	53	908	0	3	261
Self-Supply Commercial & Institutional	0	4	1	5	0	0	2
Self-Supply Irrigation	0	3	0	3	0	0	2
Self-Supply Livestock	0	0	0	0	0	0	0
Self-Supply Industrial	142	159	23	324	0	0	143
Self-Supply Thermoelectric Power Production (Once-through cooling)	0	0	0	0	0	0	0
Self-Supply Thermoelectric Power Production (Recirculated cooling)	0	0	0	0	0	0	0
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	12	3	0	15	0	0	5
Total	786	392	77	1,255	0	3	413

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

Wisconsin

About 10,000 square miles of Lakes Michigan and Superior lie within Wisconsin's borders.[16] The state has more than 1,000 miles of Great Lakes shoreline and more than 20 percent of the state's land area lies within the Basin where half the population of the state also lives. More than 1.6 million Wisconsin citizens get their drinking water from Lake Michigan or Lake Superior.[17]

The total reported water withdrawal amount from the Basin for Wisconsin was 3,960 mgd, a five percent decrease from the 2013 water withdrawal total of 4,174 mgd. The majority (99%) of the withdrawals came from the Lake Michigan watershed. The primary water use sectors were thermoelectric power production (once-through and recirculated cooling) at 3,391 mgd (86% of the total withdrawal amount), public water supply at 312 mgd, and industrial at 177 mgd.

The total reported diversion was 20 mgd from the Lake Michigan watershed, mainly for thermoelectric power production (recirculated cooling) purposes. The total consumptive use was 356 mgd. The primary consumptive uses came from the thermoelectric power (279 mgd), irrigation (26 mgd) and public water supply (31 mgd) sectors.

The water use data were provided by the Wisconsin Department of Natural Resources. Reporting compliance varied among water use sectors from 94 percent for the industrial sector to 100 percent for the public supply sector. Data was not estimated for the facilities that did not report water use.

Table 22. Wisconsin 2014 Water Use Data Summary

Sector	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Water Supply	241	21	49	312	0	7	31
Self-Supply Commercial & Institutional	1	2	2	6	0	0	1
Self-Supply Irrigation	0	3	34	37	0	0	26
Self-Supply Livestock	0	15	15	30	0	0	4
Self-Supply Industrial	0	162	16	177	0	0	15
Self-Supply Thermoelectric Power Production (Once-through cooling)	3,110	244	0	3,354	0	0	271
Self-Supply Thermoelectric Power Production (Recirculated cooling)	37	0	0	37	0	13	8
Off-Stream Hydroelectric Power Production	0	0	0	0	0	0	0
In-Stream Hydroelectric Water Use	0	0	0	0	0	0	0
Other Self Supply	5	1	1	7	0	0	0
Total	3,394	449	117	3,960	0	20	356

In millions of gallons per day

Water Sources: Great Lakes surface water (GLSW), other surface water (OSW) and groundwater (GW)

[16] Wisconsin Sea Grant. 2013. http://seagrant.wisc.edu/Home/AboutUsSection/PressRoom/Details.aspx?PostID=796
[17] Wisconsin Department of Natural Resources. 2013. http://dnr.wi.gov/topic/greatlakes/learn.html

Appendices

Appendix A. Revised protocols for the collection and reporting of water use data

The 2013 regional water use data set is the first to be completed under the new data reporting protocols. The new database and this annual report are expanded and enhanced with the inclusion of new and reformatted water use data and information. Summarized below are the main changes to the database, which are reflected in this report.

1. Water use sectors – The number of sectors increased from 9 to 10. The Self-Supply Domestic sector is replaced with Self-Supply Commercial and Institutional. The Hydroelectric Power sector is broken down into Off-stream Hydroelectric Power Production and In-stream Hydroelectric Water Use.
2. Diversions - Three new fields (diversion return flow, net diversion change and diversion return) were added to meet the standards set forth in the new protocols.
3. Intrabasin transfers – Two additional fields, intrabasin return flow and intrabasin consumptive use, were added to meet the standards set forth in the protocols.
4. Two new consumptive use (CU) data fields – These fields now more accurately describe how the CU amounts are calculated. The first field documents the percentage of reported consumptive uses that were determined through actual measurement. The second field documents the coefficient or the range of coefficients used to calculate CU. Under the old database regime, a summary chart of the range of CU coefficients was inserted in the annual reports for reference.
5. Aggregation – The level of aggregation of data was dropped since the protocols do not call for such a field. In its place a “methods” field describes the method used to determine withdrawal amount.

Appendix B. General Definitions from the Compact and Agreement

Basin or Great Lakes-St. Lawrence River Basin means the watershed of the Great Lakes and the St. Lawrence River upstream from Trois-Rivières, Québec.

Consumptive Use means that portion of the water withdrawn or withheld from the basin that is lost or otherwise not returned to the basin due to evaporation, incorporation into products or other processes.

Diversion means a transfer of water from the basin into another watershed, or from the watershed of one of the Great Lakes into that of another by any means of transfer, including but not limited to a pipeline, canal, tunnel, aqueduct, channel, modification of the direction of a water course, a tanker ship, tanker truck or rail tanker but does not apply to water that is used in the basin or a Great Lake watershed to manufacture or produce a product that is then transferred out of the basin or watershed.

Divert has a corresponding meaning.

Withdrawal means the taking of water from surface water or groundwater.

Source Watershed means the watershed from which a withdrawal originates. If water is withdrawn directly from a Great Lake or from the St. Lawrence River, then the Source Watershed shall be considered to be the watershed of that Great Lake or the watershed of the St. Lawrence River, respectively. If water is withdrawn from the watershed of a stream that is a direct tributary to a Great Lake or a direct tributary to the St. Lawrence River, then the Source Watershed shall be considered to be the watershed of that Great Lake or the watershed of the St. Lawrence River, respectively, with a preference to the direct tributary stream watershed from which it was withdrawn.

Appendix C. Water Use Sector Definitions

Public Water Supply

Water distributed to the public through a physically connected system of treatment, storage and distribution facilities serving a group of largely residential customers that may also serve industrial, commercial and other institutional operators. Water withdrawn directly from the basin and not through such a system shall not be considered to be used for Public Water Supply purposes.

Self-Supply Commercial and Institutional

Commercial uses include water used by motels, hotels, restaurants, office buildings and institutions, both civilian and military. This category also includes water for mobile homes, hospitals, schools, air conditioning and other similar uses not covered under a public supply. In addition, this category includes amusement and recreational water uses such as snowmaking and water slides.

Self-Supply Irrigation

Water artificially applied on lands to assist in the growing of crops and pastures or in the maintenance of recreational lands, such as parks and golf courses.

Self-Supply Livestock

Water used by animals such as horses, cattle, sheep, goats, hogs and poultry. Water used in fish hatchery operations is also included under this category.

Self-Supply Industrial

Industrial water includes water used in the manufacture of metals, chemicals, paper, food and beverage and other products. Mining water use includes water used in the extraction or washing of minerals, for example solids, such as coal and ores, and liquids such as crude petroleum and natural gas. Water used in quarrying and milling is also included in the industrial category. Brine extraction from oil and gas operations is not included. Withdrawals and consumptive uses for industrial and mining purposes (including dewatering operations) recorded under another category (e.g., public supply) will not be recorded here. Once initially reported, water used in a closed cycle (recirculation) will not be reported as a withdrawal. "Make-up water[18]" will be reported once upon entering the system. Other situations should be evaluated on a case-by-case basis.

Self-Supply Thermoelectric Power Production (Once-through cooling)

Withdrawals and consumptive uses already recorded under another category (e.g., public supply) will not be reported here.

Self-Supply Thermoelectric Power Production (Recirculated cooling)

Withdrawals and consumptive uses already recorded under another category (e.g., public supply) will not be reported here. Once initially reported, water used in a closed cycle (recirculation) will not be reported as a withdrawal. "Make-up water" will be reported once upon entering the system.

[18] For industrial boiler systems, make-up water is the raw water, softened water or demineralized water required for steam generation. http://www.pdhcenter.com/courses/m165/m165content.pdf

Off-Stream Hydroelectric Power Production

Water removed from a stream channel and used to drive turbines that generate electric power. This category also includes "off-stream use" for pumped-storage systems [e.g., reservoir storage] that return water to the source.

In-Stream Hydroelectric Water Use

This category includes "run of the river" use, which is not considered a water withdrawal or consumptive use. Reporting for this category is voluntary.

Other Self Supply

Water used for purposes not reported in categories 1-9. Examples include, but are not limited to, withdrawals for fish/wildlife, environmental, navigation and water quality purposes. Specifically, water used to maintain levels for navigation, for fish and wildlife habitat creation and enhancement (excluding fish hatchery operations included in category four), for flow augmentation (or diversion), for sanitation, pollution confinement, and other water quality purposes, and agricultural activities (services) other than those directly related to irrigation.

Appendix D. Interim Cumulative Impact Assessment

Executive Summary

This interim cumulative impact assessment, as part of the 2014 Annual Water Use Report, covers the years 2013 and 2014. It is considered interim assessment and is the third in a series of cumulative impact assessments for the Great Lakes and St. Lawrence River basin (Basin).

1. *Cumulative Impact Assessment of Withdrawals, Consumptive Uses and Diversions*, published in 2013, covered 2006 to 2010 (2006-2010 Cumulative Impact Assessment).
2. *Interim Cumulative Impact Assessment of the 2013 Annual Water Use Report*, published in 2014, compared the years 2011 and 2012 (2011-2012 Interim Assessment).
3. *Interim Cumulative Impact Assessment of the 2014 Annual Water Use Report*, provided in this report (this interim assessment), covers the 2013 and 2014.

These cumulative impact assessments fulfill the requirements of the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement and the companion Great Lakes-St. Lawrence River Basin Water Resources Compact. While the 2006-2010 Cumulative Impact Assessment was the first full assessment covering a five year period, the subsequent, interim cumulative impact assessments have been prepared to track annual water loss to the Basin between full cumulative impact assessments. Water loss is defined as consumptive uses and diversions less return flow. It reflects water not being returned to the source watershed.

The approach used for this interim assessment is similar to that of the 2006-2010 Cumulative Impact Assessment. The analysis focuses on the hydrologic effects of consumptive uses and diversions on water supply and flow at the watershed (i.e., lake basin) scale as well as for the entire Basin.

For comparative purposes, longer data sets for flows, covering the period from 1948 to 2010, were presented to provide a historical context for the assessment. The Basin water budget was used to account for the water flows into and out of the Basin as outlined below.

1. *Accounting for Inflows*
   The inflows included precipitation on the surface of the Great Lakes, surface water runoff to the Great Lakes or the St. Lawrence River, diversions, and connecting channel flows into each of the Great Lakes or the St. Lawrence River, except for Lake Superior which is the headwater to the system.

2. *Accounting for Outflows*
   Outflows included evaporation from the surface of the Great Lakes, diversions from some Lake watersheds, connecting channel flows out of each of the Lakes, and consumptive uses. The St. Lawrence River is the outflow for Lake Ontario and for the entire Basin.

3. *Hydrologic Effect Assessment*
   Although withdrawals are a component of the water budget, the 2006-2010 Cumulative Impact Assessment considered only the hydrologic effect of consumptive uses and diversions. The hydrologic effect is defined as the consumptive uses plus net diversions. Consumptive use is defined as the portion of water withdrawn but not returned due to evaporation, incorporation into products, and other processes.

The following observations were made in the 2006-2010 Cumulative Impact Assessment:

- *Diversions and consumptive use were very small relative to inflows.*
  The cumulative hydrologic effect of consumptive uses and diversions were small relative to inflows. While inflows fluctuated from 2006-2010, the cumulative hydrologic effect of consumptive uses and diversions was fairly constant for this time period. The net effect of consumptive uses and diversions was positive for the Basin's water budget. In other words, more water was diverted into the Basin than the total combined amount of water diverted out of the Basin or withdrawn and not returned.
- *The uncertainty associated with estimated inflow and outflow data was significantly larger than total consumptive use for the Basin.*
  It is difficult to assess the cumulative impact of diversions and consumptive uses apart from the natural variability of inflows and outflows of the Great Lakes-St. Lawrence River system. Uncertainty in the Basin water budget components was more than twelve and a half times the total reported consumptive uses in 2008.To illustrate, total runoff to the Basin in 2008 was 259,888 cubic feet per second (cfs). Assuming a 15 percent uncertainty, the amount of calculated runoff may be off by over 38,000 cfs. In comparison, consumptive use in 2008 was only 3,016 cfs. As a result of this, the hydrologic effects of consumptive uses on flows and water levels are difficult to discern relative to uncertainties in the natural inflows and outflows.

The 2006-2010 Cumulative Impact Assessment includes detailed information on the definitions, methodology, assumptions, uncertainty, data sources used as well as specific factors affecting each watershed. Refer to that assessment for clarification of the methods used in this assessment. The full report, *Cumulative Impact Assessment of Withdrawals, Consumptive Uses and Diversions, 2006-2010,* is available at http://glslregionalbody.org/ or http://www.glslcompactcouncil.org/.

The most recent data submitted to the Great Lakes-St. Lawrence Regional Water Use Database indicate a reported increase in incremental water losses[19] to the Basin between 2012 to 2013 of 1,407 cubic feet per second [cfs] (909 mgd). From 2013 to 2014, the total reported water loss for Basin decreased by 722 cfs (467 mgd). A more detailed description of these water losses for 2013 and 2014 are provided in the diversion and consumptive uses section of the 2014 Annual Water Use Report.

For this interim assessment, the following observations are made:

- For 2013 and 2014, more water left the Basin (from consumptive uses and outgoing diversions) than entered the Basin from incoming diversions.
- For 2013 and 2014, diversions and consumptive uses remained very small relative to inflows. For example, diversions and consumptive uses reported for the Lake Superior watershed in 2014 made up 4.21 percent of the average total inflows (from 1948-2010) into the watershed. For the Lake Michigan-Huron watershed in 2014, diversions and consumptive uses made up 1.32 percent of the average total inflows into the watershed over this same period.

Approach

Similar to the approach of pervious assessments, this interim assessment focuses on the hydrologic effects of consumptive uses and diversions on water supply and flow at watershed and Basin scales. These hydrologic effects are presented in the context of watershed and Basin water budgets. The analysis focuses on the consumptive uses and diversions components of the water budget, instead of describing and analyzing all components of the water budget. Annual estimates of inflows and outflows are not provided for the years 2012, 2013 and 2014. Supplemental inflow data presented as a 62-year average (1948-2010)

[19] Incremental water loss is defined as new or increased outgoing diversions plus consumptive uses.

in the 2006-2010 Cumulative Impact Assessment are provided for each watershed and the Basin for comparative purposes.

Following standard scientific procedures, inflows are presented as positive numbers and outflows are presented as negative numbers. This convention is used to help relate different flows to one another and to supply. It is not intended to communicate the effect of these flows on the Basin. All flows are given in cubic feet per second (cfs).

Great Lakes-St. Lawrence River Basin

Figure 1 shows diversions and consumptive uses for the Basin by year for 2012-2014. Net diversions are shown as positive (or incoming) flows into the Basin, mainly due to the Long Lac and Ogoki diversions which divert water from the Hudson Bay watershed into Lake Superior for power generation purposes. These diversions have offset the consumptive uses (displayed as negative numbers in Figure 2) and outgoing diversions.

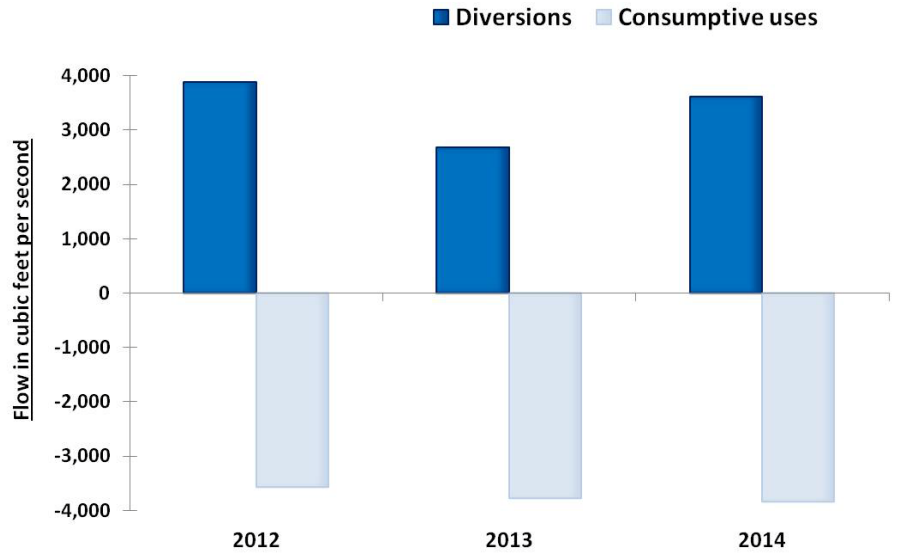

Figure 1. Diversions and Consumptive Uses for the Great Lakes – St. Lawrence Basin

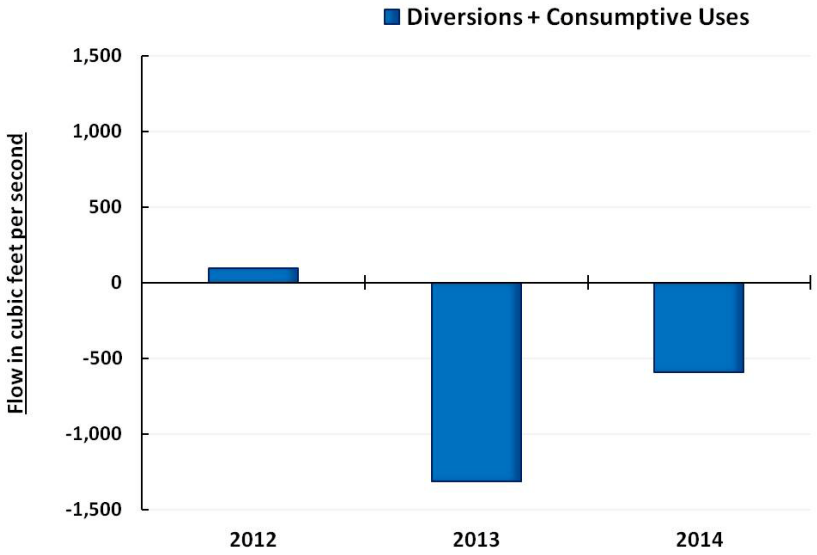

Figure 2. Net Diversions and Consumptive Uses for the Great Lakes – St. Lawrence River Basin.

The numbers in Table A below (presented graphically in Figure 2), indicate for the Basin the cumulative hydrologic effect of consumptive uses and diversions (annual averages) are small relative to inflows (runoff plus precipitation). In general, the cumulative hydrologic effect of consumptive uses and diversions has fluctuated for 2012-2014. Between the years 2012 to 2013 consumptive uses and diversions increased by 1,407 cfs (96 cfs to -1,311 cfs). From 2013 to 2014, consumptive uses and diversions for Basin decreased by 741 cfs (from -1,311 cfs to -570 cfs).

For 2012, the net effect of consumptive uses and diversions was positive for the Basin. In other words, more water was diverted into the Basin than the total combined amount of water diverted out of the Basin or withdrawn and not returned. In 2013 and 2014 the net effect of consumptive uses and diversions was negative for the Basin. More water was consumptively used or diverted out of the Basin than the total combined amount of water diverted into the Basin.

Year	Runoff + Precipitation	Consumptive Uses + Diversions
2012	434,161*	96
2013	434,161*	-1,311
2014	434,161*	-570

Table A. Water budget values in cubic feet per second for the Great Lakes-St. Lawrence River Basin, 2012-2014.
*62-year flow average

Lake Superior Watershed

The data in Figure 3 and Table B summarize the hydrologic effects of consumptive uses and diversions for the Lake Superior watershed water budget. For purposes of comparison, Figure 3 depicts all components of the water budget (e.g., runoff, precipitation, evaporation and the flow of the St. Marys River) using the annual average for the years 1948-2010.

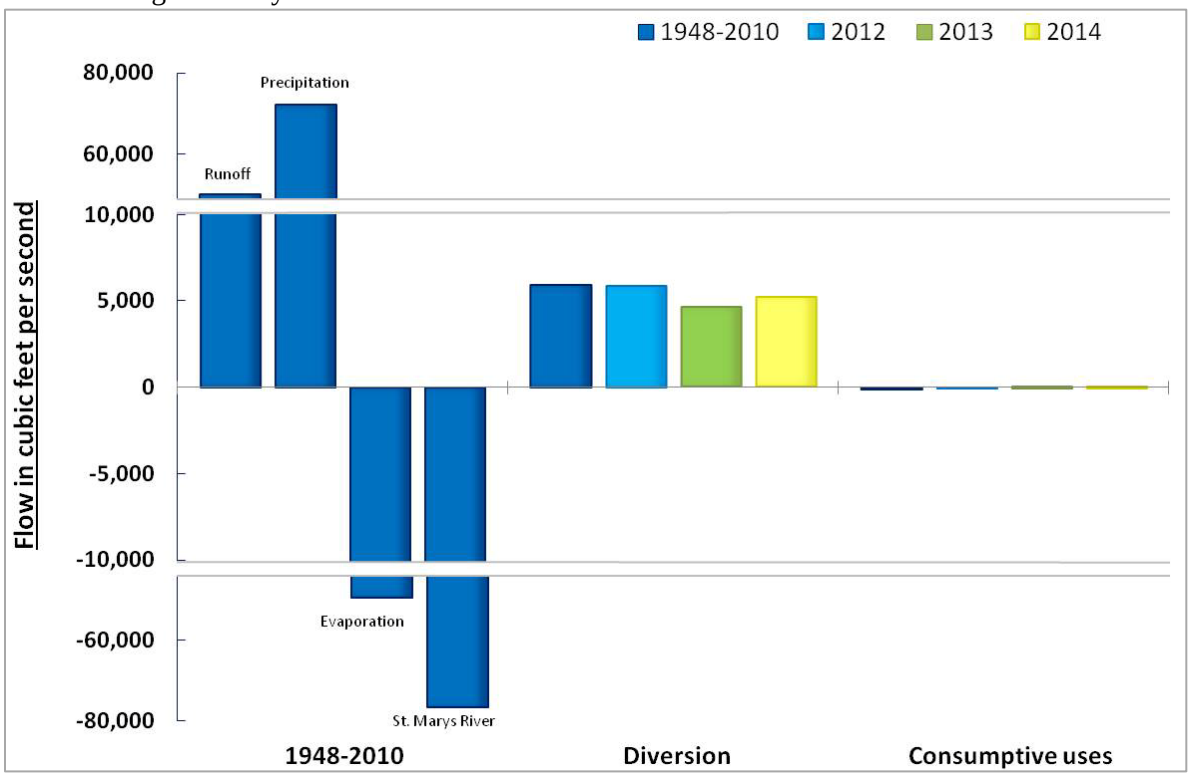

Figure 3. Water budget average flows for Lake Superior, comparing 2012-2014 a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	1948-2010 62-year Flow	2012	2013	2014
Diversions	5,950	5,863	4,651	5,220
Consumptive Uses	-117	-70	-73	-71

Table B. Diversions and consumptive uses for Lake Superior, comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: Consumptive uses in the Lake Superior watershed have remained relatively constant over the years from 2012 to2014.

Diversions: Diversions, mainly comprised of the Long Lac and Ogoki Diversions, fluctuate with the weather conditions of the watersheds. When conditions in the Long Lac and Nipigon (downstream of Ogoki) watersheds are wet, the diversions are often reduced, and water that otherwise would have been diverted into Lake Superior is instead directed through natural outlets that flow toward Hudson Bay. Conversely, when conditions are dry in the downstream watersheds, the diversion flow may be higher.

As illustrated in Table C below, for the Lake Superior watershed the hydrologic effect of consumptive uses and diversions (annual averages) are small relative to inflows. The estimated net volume of consumptive uses and diversions decreased by 34 percent from 2012 to 2013, and then increased from 2013 to 2014 by 12 percent.

Year	Total Inflow	Consumptive Uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	122,218*	5,833	4.77%
2012	122,218*	6,957	5.69%
2013	122,218*	4,578	3.75%
2014	122,218*	5,148	4.21%

Table C. Water budget values in cubic feet per second for Lake Superior, 62-year average for 1948-2010, 2012-2014. (in cfs)
*62-year flow average

Lakes Michigan-Huron Watershed

The data in Figure 4 and Table D summarize the hydrologic effects of the consumptive use and diversion components of the Lakes Michigan-Huron watershed water budget. For purposes of comparison, Figure 4 depicts the all components of the water budget using the annual average for the years1948-2010.

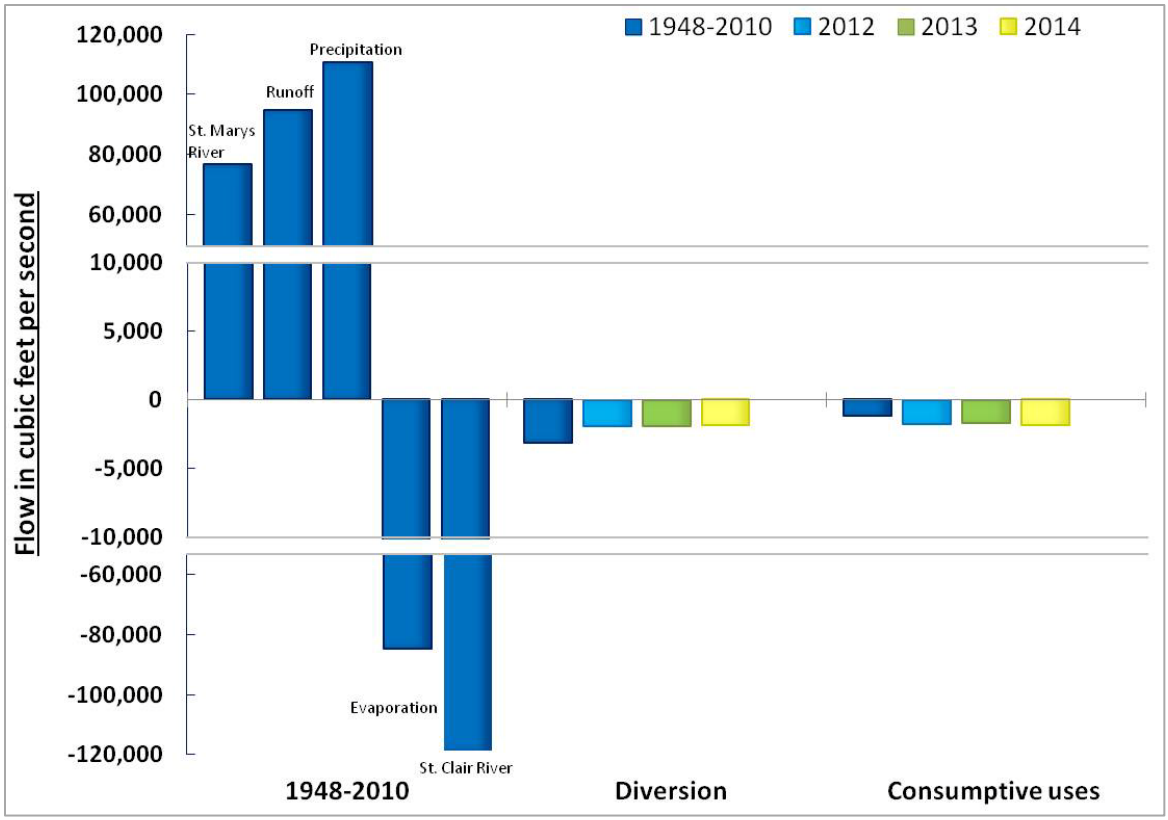

Figure 4. Water budget average flows for Lakes Michigan-Huron, comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	62-year Flow	2012	2013	2014
Diversions	-3,171	-1,894	-1,883	-1,885
Consumptive Uses	-1,166	-1,779	-1,701	-1,839

Table D. Diversions and consumptive uses for Lakes Michigan-Huron, comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: Consumptives use flows fluctuated from 2012 to 2014.

Diversions: Diversions remained relatively constant from 2012-2014. Diversions, mainly comprised of the Illinois Diversion which diverts water from Lake Michigan to the Chicago Sanitary and Ship Canal and the Illinois and Des Plaines Rivers, contributed to the flows out of the watershed.

As illustrated in Table E, for the Lakes Michigan-Huron watershed the hydrologic effect of consumptive uses and diversions (annual averages) were small relative to inflows (about 1.3% of the 62-year average for inflows into the watershed). The estimated net volume of diversions and consumptive uses decreased from 2012 to 2013 by 13 percent and remained relatively the same between 2013 and 2014.

Year	Total Inflow	Consumptive Uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	282,054*	-4,337	1.53%
2012	282,054*	-4,413	1.56%
2013	282,054*	-3,799	1.35%
2014	282,054*	-3,723	1.32%

Table E. Water budget values in cubic feet per second for Lakes Michigan-Huron, 62-year average for 1948-2010, 2012-2014. (in cfs)
*62-year flow average

Lake Erie Watershed

The data in Table F and used in Figure 5 summarize the hydrologic effect of the consumptive use and diversion components of the Lake Erie watershed water budget. For purposes of comparison, Figure 5 depicts all components of the water budget using the annual average for the years 1948-2010. In 2013 and 2014, these diversion and consumptive use flows were smaller than the 62-year average flows and the 2012 values.

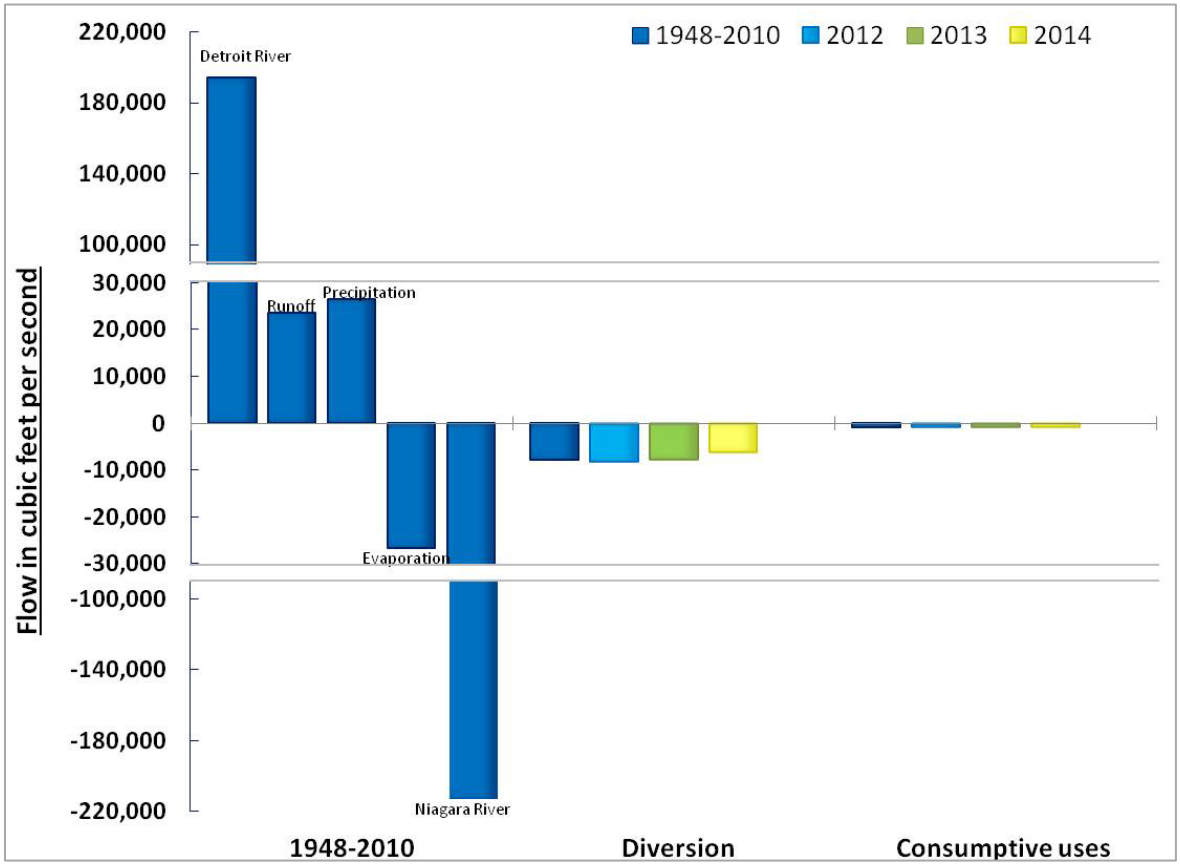

Figure 5. Water budget average flows for Lake Erie, comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	62-year Flow	2012	2013	2014
Diversions	-7,851	-8,017	-7,645	-6,164
Consumptive Uses	-763	-736	-689	-682

Table F. Diversions and consumptive uses for Lake Erie, comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: Consumptive uses have decreased from 2012 to 2014. The 2014 consumptive use amount of 682 cfs is about 10 percent less than the annual average for the years 1948-2010.

Diversions: Diversions[20] have contributed to the overall flows out of the watershed. Similar to the decreasing trend in consumptive uses, diversions have declined from 8,017 cfs in 2012 to 6,164 cfs in 2014.

As illustrated in Table G, for the Lake Erie watershed the hydrologic effect of consumptive uses and diversions (annual averages) was small relative to inflows. The estimated net volume of consumptive uses and diversions decreased significantly from 2012 to 2014.

Year	Total Inflow	Consumptive Uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	244,739*	-8,614	3.51%
2012	244,739*	-8,753	3.58%
2013	244,739*	-8,333	3.41%
2014	244,739*	-6,846	2.79%

Table G. Water budget values in cubic feet per second for Lake Erie, 62-year average for 1948-2010, 2012-2014. (in cfs)
*62-year flow average

Lake Ontario Watershed

The data in Table H and used in Figure 6 summarize the hydrologic effects of the consumptive use and diversion components of the Lake Ontario watershed water budget. For purposes of comparison, Figure 6 depicts all components of the water budget using the annual average for the years 1948-2010.

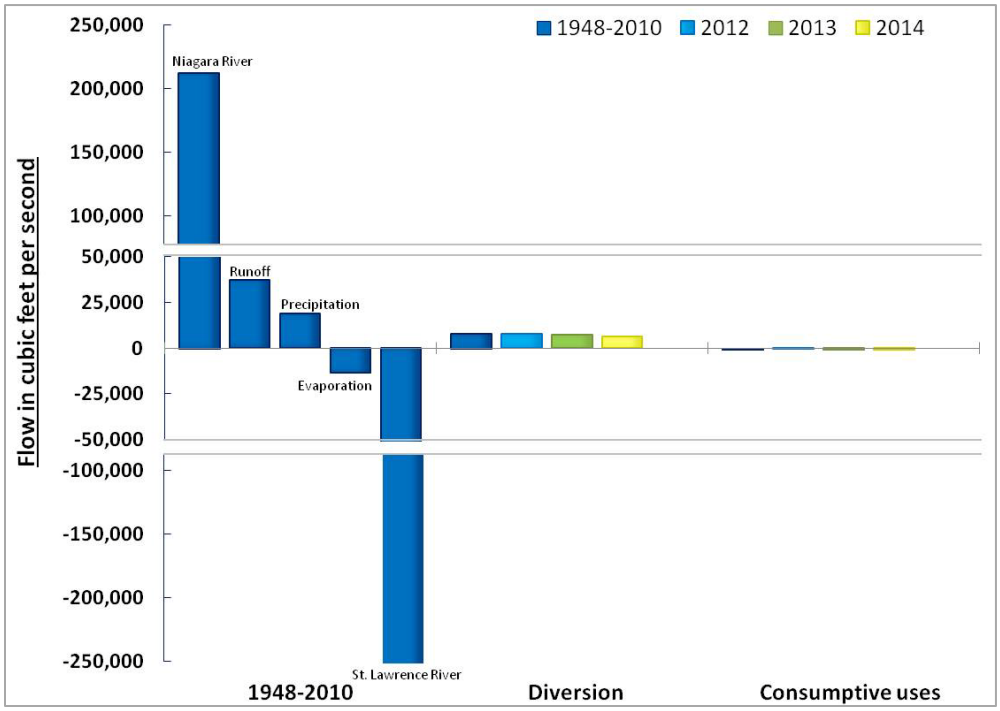

Figure 6. Water budget average flows for Lake Ontario, comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

[20] Diversion data for the Lake Erie watershed include an intrabasin diversion at Welland Canal.

Water Budget Component	62-year Flow	2012	2013	2014
Diversions	7,851	7,942	7,575	6,465
Consumptive Uses	-561	-375	-567	-576

Table H. Diversions and consumptive uses for Lake Ontario, comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: These consumptive use flows appear to have increased from the 2012 to 2014 reported amounts.

Diversions: There was a notable decrease in diversion flows from 7,942 cfs in 2012 to 6,465 cfs in 2014.

As illustrated in Table I, for the Lake Ontario watershed the cumulative hydrologic effect of consumptive uses and diversions (annual averages) were small relative to inflows. The estimated net volume of diversions and consumptive uses decreased by 7 percent from 2012 to 2013 and remained relatively constant from 2013 to 2014.

Year	Total Inflow	Consumptive Uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	269,041*	7,290	2.71%
2012	269,041*	7,567	2.81%
2013	269,041*	7,009	2.61%
2014	269,041*	7,041	2.61%

Table I. Water budget values in cubic feet per second for Lake Ontario, 62-year average for 1948-2010, 2012-2014. (in cfs)
*62-year flow average

St. Lawrence River Watershed

The water budget for the St. Lawrence River watershed is different than those for the Lakes. Inflow consists of the St. Lawrence River flow measured at Cornwall, Ontario. Outflow mainly consists of the river's flow modeled at Trois Rivières, Québec and consumptive uses throughout the watershed.

As illustrated in Table K and Figure 7, for the St. Lawrence River watershed the hydrologic effect of consumptive use and diversions was small relative to inflows. From 2012 to 2013, the net estimated volume of consumptive uses and diversion increased by 21 percent (from 632 cfs to 765 cfs), then decreased to 694 cfs in 2014[21].

[21] The implementation of the 2009 Water Use Data Protocols and the corresponding jurisdictional data collection and reporting programs began with the collection of 2012 water use data. Therefore, the increase of the net estimated volume of consumptive uses and diversions between 2012 and 2014 may reflect the improvements in data collection.

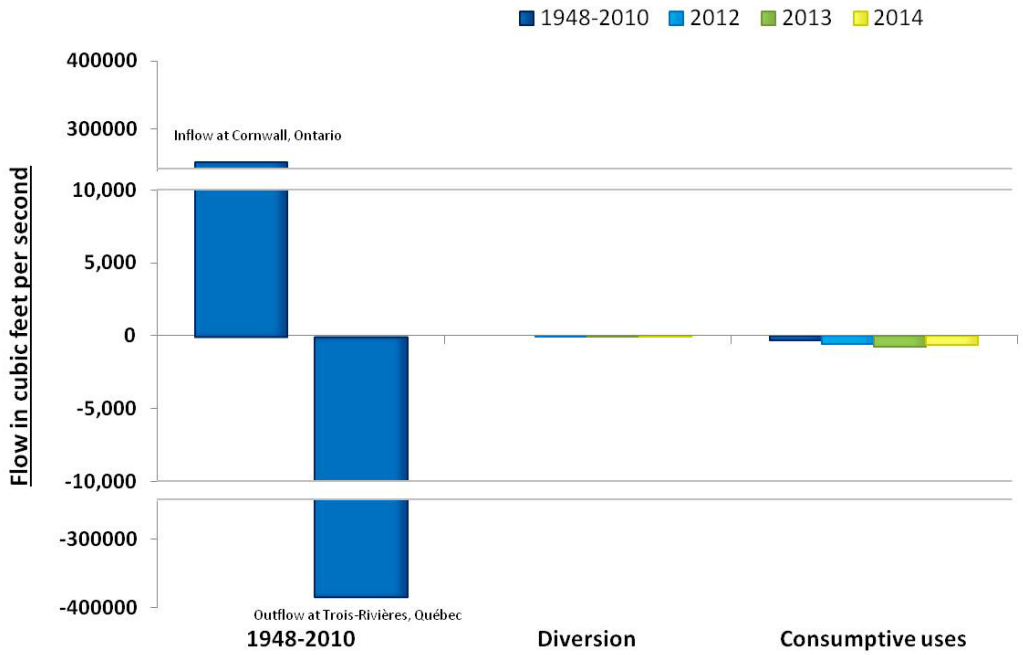

Table 7. Water budget values in cubic feet per second for the St. Lawrence River comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

Water Budget Component	62-year Flow	2012	2013	2014
Diversions	N/A	-7	-9	-9
Consumptive Uses	-313	-625	-756	-685

Table J. Diversions and consumptive uses for St. Lawrence River, comparing 2012-2014 to a historical 62-year period (1948-2010). (in cfs)

Consumptive Uses: As summarized in Table J, consumptive uses have fluctuated, increasing from 625 cfs in 2012 to 756 cfs in 2013, and then decreasing to 685 cfs in 2014.

Diversions: Diversions have made up about 1 percent of the total annual water loss from the St. Lawrence River watershed. Starting in 2012, both Québec and New York reported diversions totaling 7 cfs in 2012, 9 cfs in 2013 and 9 cfs in 2014 for public supply purposes. For previous years (1948-2010), diversions have not been reported.

As illustrated in Table K, for the St. Lawrence River watershed the cumulative hydrologic effect of consumptive uses and diversions (annual averages) were small relative to inflows.

Year	Total Inflow	Consumptive uses +Diversions	Consumptive Uses + Diversions (as a percentage of total inflow)
62-year avg.	256,797*	-313**	0.12%
2012	256,797*	-632	0.25%
2013	256,797*	-765	0.30%
2014	256,797*	-694	0.27%

Table K. Water budget values in cubic feet per second for the St. Lawrence River, 62-year average for 1948-2010, 2012-2014. (in cfs)

*62-year flow average

**This figure only is consumptive use only. No diversions were reported.