

ANNUAL REPORT
of the
*GREAT LAKES REGIONAL WATER USE
DATA BASE REPOSITORY*

REPRESENTING 1998 WATER USE DATA

Prepared by

**The Great Lakes Commission and
The Water Withdrawal and Use Technical Subcommittee
Under**

***Project Element 3 of
A Great Lakes Water Resources Decision Support System***

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PREFACE

The Great Lakes Water Use Data Base Repository, housed at the Great Lakes Commission, provides a centralized source of information on withdrawals, diversions, and consumptive uses of water in the Great Lakes Basin in both United States and Canada. The Commission prepares an annual report, based upon the data submitted by the eight Great Lakes states and the two Canadian Great Lakes provinces.

- An introduction, which provides background on the Water Use Data Base Repository, describes the database management system, and presents issues associated with data reporting and analysis.
- A Great Lakes Basin Summary, which provides an overview of basin water use: After providing basin wide statistics, this section gives a detailed graphical representation of water use by jurisdiction.
- Two appendices comprised of printouts generated by the Water Use Data Base, the first of which presents the water use data in millions of gallons, the second of which presents the water use data in millions of liters.
- The Great Lakes Commission welcomes all inquiries concerning the Great Lakes Regional Water Use Data Base Repository. Please call 734-665-9135, or e-mail Tom Crane at tcrane@glc.org, for further information.

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I. INTRODUCTION

Background on the Great Lakes Regional Water Use Data Base Repository

The Great Lakes Regional Water Use Data Base provides a common base of data and information on water use in the Great Lakes basin as called for in the Great Lakes Charter of 1985. Housed at Great Lakes Commission offices, the database uses a modified Microsoft Access7 software package using Visual Basic for Applications. A customized program, first prepared in 1987 by Acres International, Ltd. and revised in 1999/2000 by Eastern Michigan University's Center for Environmental Information, Technology and Application (CEITA), performs routine database operations and includes standard data entry, retrieval and report generation options.

The Regional Water Use Data Base has been operational since the summer of 1988, following a multi-year cooperative effort in the design and development of the data base system. This included input from and involvement of many state, provincial, and federal agencies. The U.S. Geological Survey provided much of the leadership on this effort.

The operation and use of this data base system represents one of several ongoing activities on behalf of the Great Lakes states and provinces to fulfill obligations of the Great Lakes Charter. Continued state and provincial interest in refining and expanding the data base is necessary to ensure that the data base can support other ongoing Charter initiatives, such as improving consumptive use information, developing uniform and consistent demand forecasting applications and promoting regional water conservation programs.

Data Base Management System

The Great Lakes Water Use Data Base Management System (DBMS) is the user interface for the Great Lakes Regional Water Use Data Base Repository. The Great Lakes Commission has served as the repository since 1988.

The Data Base was established by the Great Lakes states and provinces to address a recommendation of the Great Lakes Charter that calls for a uniform, consistent base of data of water withdrawals, diversions and consumptive uses in the Great Lakes Basin. Water use data is provided to repository on an annual basis and data is compiled and reports provided to assist the jurisdictions in water resources planning and management. The Data Base catalogs the set of annual data on withdrawals and consumptive uses of Great Lakes water by water use category, sub-basin, and jurisdiction, as specified by the Water Resources Management Committee in its 1987 report, *Managing the Waters of the Great Lakes Basin*.

The original version of the DBMS was developed on the MS/DOS platform using a modified version of the DbaseIII ® commercial software package. With the rapid advancement of computer hardware and software and the evolving needs of the Great Lakes state and provincial water resources management programs, the old system soon became outdated.

In July 1998, the Great Lakes Commission and CEITA began work on the revised DBMS. The new system was developed by CEITA using Visual Basic for Applications, based on Microsoft Access®.

The new DBMS contains all of the functions of the old system (including data entry, a data check facility and report generation), but also has new features such as a flexible data interface, automatic data checking and graphing capability for data visualization.

The 1998 water use data report is the first report to utilize the improved DBMS. Data presented in this report were submitted to the Regional Water Use Data Base Repository by the Great Lakes states and provinces in 2001. All data are submitted in two different unit measures: millions of U.S. gallons per day (mgd) or millions of litres per day (mld). Each jurisdiction is required to select one of these measurements on a consistent basis for all data submissions. The Data Base records corresponding to the jurisdictions are maintained in the selected units.

All values in the Data Base are initially set to zero. Numeric values are required for all active categories of use. A zero value indicates either zero water use or water use not meeting the Charter trigger level of 100,000 gallons per day (380,000 litres per day) average over a 30-day period. All non-zero values in the summary tables are positive except for incoming diversion values which are negative.

The quality of data for each entry is rated as a 1, 2 or 3 indicating the level of accuracy (measured, partially measured, or estimated) and a 1 or 2 indicating the level of aggregation (originating from site-specific sources or from higher level aggregate sources such as county or census databases.) Both measures of quality are shown as percentages and are based on volume.

Data Base Definitions

Each water use category includes three withdrawal/discharge types:

- **Great Lakes Surface Water (GLSW)** – defined as water from the Great Lakes, their connecting channels (the St. Clair River, the Detroit River, the Niagara River and the St. Mary's River), and the St. Lawrence River.
- **Other Surface Water (OSW)** – defined as tributary streams, lakes, ponds, and reservoirs within the Great Lakes Basin.
- **Groundwater (GW)** – defined as all subsurface water distinct from surface water.

The following list includes other important definitions pertaining to the use of the Great Lakes Regional Water Use Data Base summary tables:

- **Withdrawal Amount** – The amount of water removed or taken from surface or groundwater.
- **Intrabasin Diversion** – The amount of water transferred from the watershed of one of the Great Lakes into that of another.
- **Interbasin Diversion** – The amount of water transferred from the Great Lakes Basin into another watershed.
- **Consumptive Use** – That portion of water withdrawn or withheld from the Great Lakes and assumed to be lost or otherwise not returned to the Great Lakes due to evapotranspiration, incorporation into products, or other processes.

Categories of Use for the Regional Water Use Database

The following list of nine categories reflects original definitions from the February 1987 Water Resources Management Committee Report, *Managing the Waters of the Great Lakes Basin*. These definitions were revised and expanded through discussion with the Great Lakes states and provinces. The descriptions appearing in normal type represent the original definitions. Italicized type shows the agreed-to revisions and expansions.

1. **Public Water Supply:** Water withdrawn for all uses by public and private water suppliers and delivered to users that do not supply their own water. (Water suppliers provide water for a variety of uses such as residential, commercial, industrial, and public water use.)
2. **Self-Supply – Domestic** (residential, commercial, institutional): Water used for normal household purposes. Also referred to as residential water use, this category includes water used for drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns. *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, fire fighting, 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. The coefficients for domestic per capita water use is 75 gallons a day (U.S.) unless otherwise indicated by the reporting state or province.*
3. **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.
4. **Self-Supply – Livestock:** *Water used by horses, cattle, sheep, goats, hogs, poultry, and other commercially important animals. Water used in fish hatchery operation is also included under this category.*
5. **Self-Supply – Industrial** (manufacturing and mining): Industrial water includes water used in the manufacture of metals, chemicals, paper, and allied 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. Water uses in a closed cycle (recirculation) will not be reported as a withdrawal. Other situations should be evaluated on a case-by-case basis.*
6. **Self-Supply – Thermoelectric Power** (fossil fuel plants): Water used by plants fueled by fossil fuels such as coal, oil or natural gas. *Withdrawals and consumptive uses already recorded under another category (e.g., public supply) will not be reported here.*
7. **Self-Supply – Thermoelectric Power** (nuclear plants): *Water used by plants fueled by nuclear generation. Withdrawals and consumptive uses already recorded under another category (e.g., public supply) will not be reported here.*
8. **Self-Supply – Hydroelectric Power:** Water used to drive turbines that generate electric power. This category includes both “instream use” where water is used on a once-through

basis and “offstream use” where water is recycled through pumped-storage systems. Neither use is considered a consumptive use.

9. **Other** – Water used for purposes not reported in categories one through nine. Examples include, but are not limited to, withdrawals for fish/wildlife, environmental, recreation, navigation, and water quality purposes. Specifically, water used to maintain levels for navigation, for recreation, for fish and wildlife habitat creation and enhancement (excluding fish hatchery operations included under Category 5), 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 such as field drainage are included. Water used in temporary or immediate emergency situations (e.g., fighting forest or peat fires) is also reported here.

Principal Facilities: Definition

The question was raised by the Water Resources Management Committee’s Technical Work Group in 1989 as to whether principal facilities should be defined by single source withdrawals (i.e., Great Lakes surface water) in excess of the Charter trigger level of 100,000 U.S. gallons per day, or 380,000 litres per day, over a 30-day period, or whether total withdrawal (all sources combined) should determine a principal facility.

The following represents a revised definition of a principal facility as developed by the state and provinces through the Technical Work Group:

Principal Facilities – *Facilities withdrawing (or consuming) in excess of the Great Lakes Charter uniform trigger level of 100,000 U.S. gallons/day (380,000 liters/day) average over a 30-day period. A principal facility is determined by the total withdrawal (or consumption) of all sources combined (Great Lakes surface water, other surface water, and groundwater) rather than a single source. The combined withdrawals (or consumption) of separate wells or operations undertaken by the same facility or company will be evaluated separately for the purpose of determining principal facility status unless those operations are covered under the same registration (or permit) or are physically contiguous.*

In 1991, the Great Lakes Commission was asked to undertake an analysis of reported consumption based on data submitted to the Repository versus the anticipated consumption derived from the use of uniform estimation procedures developed by the states and provinces through the Technical Work Group in 1988-89. The consumptive use coefficients for the nine categories of use are represented in Table 3. Numerical comparison of reported consumption versus anticipated estimated consumption for each jurisdiction and category of use is shown in Table 4.

In 2001, the Water Withdrawal and Use Technical Subcommittee began a process for reviewing and either reaffirming or revising the consumptive use coefficients based on the best information available. This process will be completed in 2002.

Current State and Provincial Activities

The Great Lakes Protection Fund is providing financial support to the Great Lakes Commission to develop a framework for a comprehensive decision support system to provide the data, information and process required to ensure timely and well informed public policy decisions concerning the use and management of surface and groundwater in the Great Lakes system. The Commission is

working with multiple agencies, stakeholders and collaborators on this effort, which will strengthen water quantity decisionmaking, and management processes in the Great Lakes-St. Lawrence region.

The project titled *A Great Lakes Water Resources Decision Support System* is founded upon seven premises that are guiding project methodology and outcomes:

- All project activities and outcomes will be state and province driven; representatives of these jurisdictions will have a role in all project elements and in shaping all project deliverables.
- The project is ensuring that Great Lakes Protection Fund support is leveraged to the greatest extent possible, through significant direct and in-kind contributions from project partners.
- Access to and use of existing and planned initiatives by project partners and other collaborators is being maximized.
- A number of interim products with immediate applicability to the water resources management needs of the states and provinces have recently been completed.
- The assembly and synthesis of existing data and information is a priority, and will be complemented by the identification of gaps, unmet needs and means to address them.
- Project outcomes will be practical, pragmatic and additive, providing a strong foundation for necessary follow-up work yielding the structural and operational characteristics of a water resources decision support system.
- All project activities and outcomes will be directed at ensuring the sustainability of data and information gathering, analysis, and application well beyond the conclusion of project funding.

A Project Management Team was established in late summer of 2000 and provides overall leadership and direction in the design and conduct of all project elements. It is comprised of representatives from all ten Great Lakes states and provinces (10); the Council of Great Lakes Governors; one representative each from the several U.S. and Canadian federal agencies with major roles in the primary project elements (i.e., U.S. Geological Survey; National Oceanic and Atmospheric Administration; U.S. Army Corps of Engineers; Environment Canada); and several Great Lakes Commission staff members who are providing secretariat support. All have a working familiarity with, and responsibility for, all aspects of water use monitoring, data analysis, management and policy in their jurisdiction. The eighteen member body, chaired by Richard S. Bartz, Assistant Chief, Division of Water, Ohio Department of Natural Resources, has been meeting quarterly to provide leadership and direction, guide project element implementation, advise the Project Secretariat and, generally, ensuring that project commitments are met fully and in a timely manner. Project Management Team members are also involved in ongoing regional discussions concerning water resources management policy and ensure that project activities and products are consistent with/contribute to these discussions.

A Stakeholders Advisory Committee (SAC) has also been formed to provide advice and guidance to the PMT, and the technical subcommittees (TSCs) working on the substantive project elements. The SAC includes representatives from an array of agencies, organizations and user groups

responsible for the acquisition, analysis, dissemination and/or application of water resources-related data and information. The SAC has met twice since project inception in August 2000 will meet formally one to two additional times during the upcoming year.

Commission staff and the project management team (PMT) have also been working closely with the Council of Great Lakes Governors (CGLG) on the implementation of the Great Lakes Charter Annex signed by the Governors at their annual meeting in June. The PMT has established a sub-committee structure to work on the varied and complex issues of this project and to help better incorporate work products into the framework of an overall decision support system. The three technical sub-committees (TSCs) are involved with: Status Assessment of Water Resources (TSC2); Water Withdrawal and Use (TSC3); and Ecological Impacts (TSC4). In addition to their prescribed work as outlined in detailed project element work plans, the PMT and the TSCs are working to define, scope, and answer questions associated with three priority issues identified by the Great Lakes Charter Annex; water conservation, resource improvement, and (as part of the improvement standard discussion) developing better consumptive use data to support a water resources management decision support system.

The TSCs have been working consistently to accomplish the following variety of project tasks:

- TSC2, working on the status assessment, has produced a draft Water Balance Report for PMT and Stakeholder Advisory Committee (SAC) review and comment at their September meetings. Work has begun on a white paper addressing the scope and impact errors may have on existing Great Lakes water quantity calculations. A compilation and listing of all sources and locations of water resources data for the Great Lakes and St. Lawrence River have been initiated. The project web site continues to be updated and will begin being developed along the lines of the decision support system framework as addition project products are completed.
- TSC3, involved with water withdrawal and use information, has completed this 1998 water use report, a draft summary of state and provincial water use data collection and reporting programs and a draft summary of the analysis of three water withdrawal, diversion and consumptive use scenarios and resulting recommendations for water use data needs.
- TSC4, working on ecological impacts, has completed a draft and revised draft of the literature search and analysis, which were reviewed, by the PMT and SAC. An inventory of descriptive models was prepared by the USACE and augmented by a project consultant, Limno-Tech, Inc. An Ecological Impacts Experts' Workshop, was held November 13 and 14, 2001 and identified specific needs and to assist in the development of descriptive questions to help frame the eventual decision support system. A proceedings document will be available in 2002 describing the outcomes of the workshop.

II. GREAT LAKES BASIN SUMMARY

Overview

The following tables and figures represent 1998 Great Lakes water use data submitted to the Regional Water Use Data Base Repository from the ten Great Lakes jurisdictions for the nine active categories of use. In total, water withdrawals in the Great Lakes Basin for 1998 were 989.97 billion gallons per day, or 3,747.5 billion litres per day. Of this total, 52% was withdrawn directly from the Great Lakes, their connecting channels, or the St. Lawrence River.

For purposes of this report, it is important to note the term “withdrawal” is used broadly and encompasses hydroelectric water use, more typically defined as “instream” use. Instream use as defined by the U.S. Geological Survey is water that is used but not withdrawn from a ground or surface source for such purposes as hydroelectric power generation, navigation, water quality improvement, fish propagation, and recreation. In the Great Lakes Basin (and in the U.S. and Canada as a whole), fresh surface water provides nearly all of the water for hydroelectric power; virtually all of this water is returned to Great Lakes Basin rivers and streams (U.S.G.S., Estimated Use of Water in the U.S. in 1985, circular 1004).

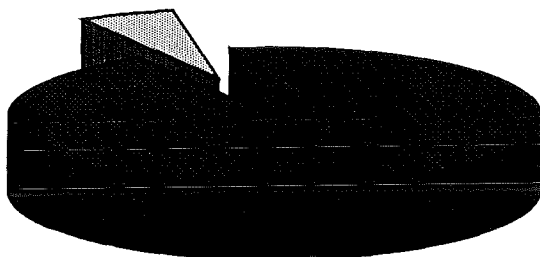
Hydroelectric Power Summary

For this report, “withdrawal” refers to any water removed from the ground or diverted from a surface water source, while “water use” refers to the specific category of use, such as domestic, irrigation, or industrial. Self-supply – hydroelectric, as noted in all previous annual reports of the repository, continues to be the largest single category of use and represents 98% of the total amount of water withdrawn per day.

1998 Great Lakes Basin Water Use Hydroelectric Versus Other Categories

OTHER CATEGORIES

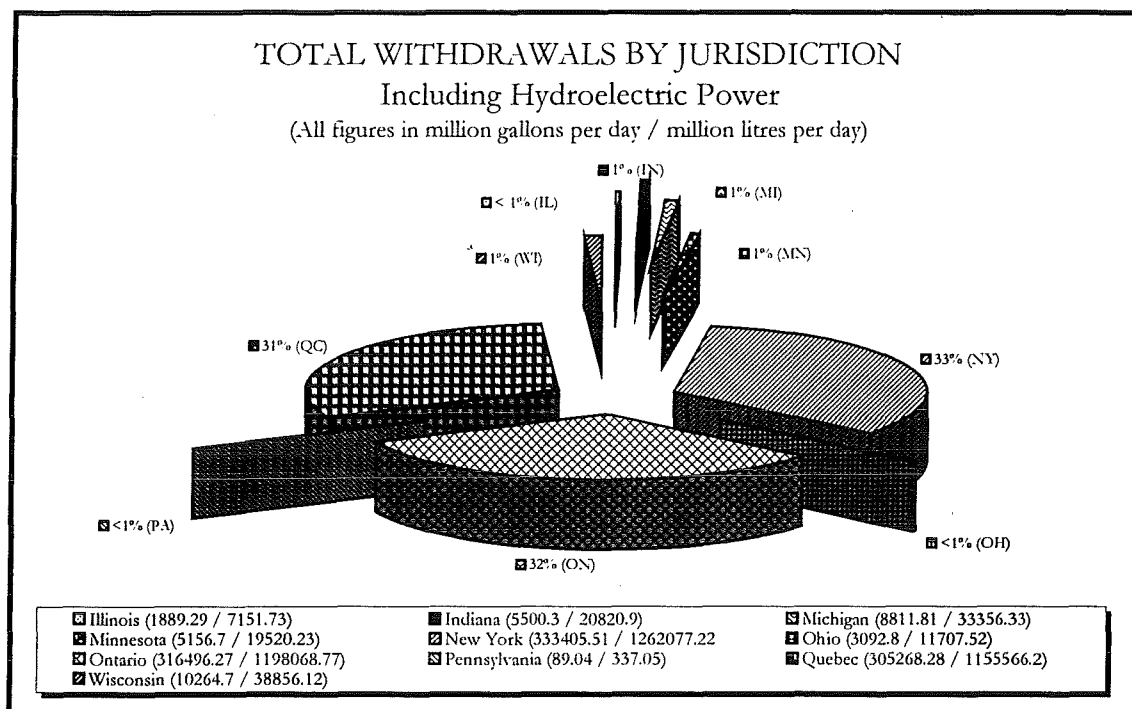
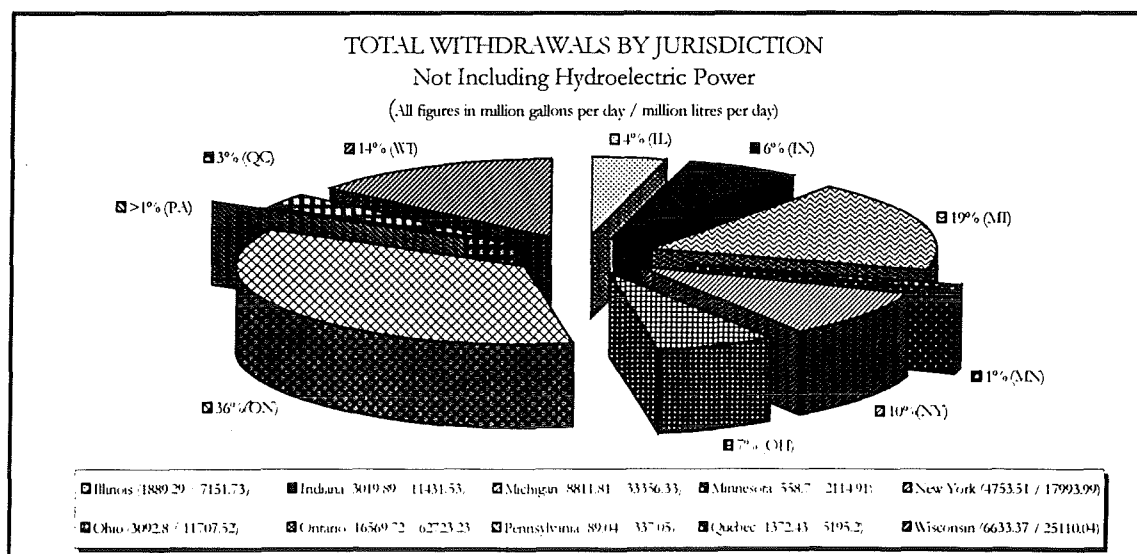
46.79 bgd
177.12 bld
(2% of
withdrawals)



HYDROELECTRIC

943.18 bgd
3,570.34 bld
(98% of
withdrawals)

Each of the ten jurisdiction's water uses are represented in the following charts. The first chart shows the overall water use of all nine reported categories. However, the second chart more accurately reflects the true water use within the basin, as it excludes hydroelectric uses. Water withdrawals from the eight categories remaining totaled 46.79 billion gallons per day, or 177.1 billion litres per day. Given the basin's current population of approximately 33.4 million, roughly 1,401 gallons per day for every person in the basin were withdrawn, compared to 1,779 gallons per day in 1993.



The table on page ten presents the consumptive use coefficients for the nine categories of use of the Regional Water Use Data Base. These coefficients were established by the Technical Work Group of the Great Lakes Water Resources Management Committee in 1990.

The table on page 11 compares the reported consumptive uses within each water category by jurisdiction, with the estimated range of consumptive use using the coefficients from page ten. The reported total consumptive use of 2168.13 mgd (8207.25 mld) in 1998 was similar to the total consumptive use of 2639.23 mgd (9990.56 mld) in 1993.

Water Use Category	Illinois	Indiana	Michigan	Minnesota	New York	Ohio	Ontario	Pennsylvania	Quebec	Wisconsin	USGS (NY District)
Public Supply	Range for all states and provinces is 10-15%										
Domestic	Range for all states and provinces is 10-15%										
Irrigation*	90%	90%	90%	90%	90%	90%	78%	90%	90%	70%	100%
Livestock	Coefficient for all states and provinces is 80%										
Industrial	For both mfg. & mining varies by plant and SIC code	6%	10%	For both mfg. & mining varies by plant and SIC code	10% for mfg. and mining, except salt mines at 90%	10%	6.8% calculated from reported water losses by individual plant	For both mfg. & mining varies by plant and SIC code	10% for pulp and paper industry	10.20% for both mfg. and mining	10%
Thermoelectric (Fossil Fuel)	Varies by individual plant; est. using makeup water for each system.	2%	1% for plants using once-through cooling; plant by plant analysis for wet cooling towers.	Measured; varies by individual plant.		Negligible; estimates based on indiv. plant reports of withdrawals, return flows.	0.9% based on reports of increased local lake evaporation due to discharge of heated water to lakes.	Varies with individual plants.	10%; estimates obtained from USGS report	0.5% - 1%	10%
Thermoelectric (Nuclear)	Varies by individual plant; est. using makeup water for each system.	2%		Measured; varies by individual plant.		14%; based on reports of increased local lake evaporation due to discharge of heated water to lakes.	0.9% based on reports of increased local lake evaporation due to discharge of heated water to lakes.	Varies with individual plants.	10%; estimates obtained from USGS report	0.5% - 1%	10%
Hydroelectric	Coefficient for all states and provinces is 0%										
Other	Varies among states and provinces; based on individual evaluations and best information available										

	Illinois		Indiana		Michigan		Minnesota		New York		Ohio		Ontario		Pennsylvania		Quebec		Wisconsin	
Water Use Category	Rep	Est	Rep	Est	Rep	Est	Rep	Est	Rep	Est	Rep	Est	Rep	Est	Rep	Est	Rep	Est	Rep	Est
Public Supply	0	114-171	27.23	14.25-21.37	123	122.4-183.6	9.06	4.31-6.47	59.8	59.8-89.7	89.98	59.9-89.9	205.23	136.9-205.27	4.44	4.43-6.65	109.9	110-165	52.52	35-52.5
Domestic	0	1.8-2.7	7.73	5.15-7.73	nr	na	0.33	0.4-0.61	45.8	45.6-68.4	8.96	5.97-8.95	20.04	13.36-20.04	0.21	0.2-0.3	7.13	7.15-10.74	4.62	3.1-4.7
Irrigation	0	0	18.54	18.54	225	213.3	0.21	0.2	9.5	9.6	9.97	9.98	148.07	146.06	0.32	0.31	8.3	8.3	376.25	376.25
Livestock	0	0	7.4	7.39	nr	na	0	0.19	6.8	9.72	10.5	10.5	42.91	42.91	0	0	15.28	15.28	0.53	0.53
Industrial	2.06	Varies by plant, SIC code	99.62	99.62	132	131.8	35.1	Varies by plant, SIC code	35.1	35.1	20.52	20.52	261.03	164.45	8.04	Varies by plant, SIC code	12.55	12.5	48.13	32.8
Thermo-- fossil fuels	0	Varies by plant	20.66	20.65	80.94	62.3	2.93	Varies by plant	9	na	0.08	Varies by plant	44.47	45.02	0	Varies by plant	4.7	4.7	12.32	6.3-12.5
Thermo-- nuclear	0	Varies by plant	0	0	na	0	0	Varies by plant	9	na	20.15	16.59	112.36	112.37	0	0	0	0	49.44	24.7-49.4
Hydroelectric	0	0	0	0	0	0	0	0	0	0	0	0	1.06	0	0	0	0	0	0	0
Other	0	Varies by jurisdiction	0.03	Varies by jurisdiction	0	Varies by jurisdiction	0	Varies by jurisdiction	0	Varies by jurisdiction	0	Varies by jurisdiction	0	Varies by jurisdiction	0	Varies by jurisdiction	0	Varies by jurisdiction	0	Varies by jurisdiction
TOTAL	2.06	115.8-173.7	181.21	165.6-175.3	589.04	557.9-619.1	62.53	5.1-7.5	169	159.8-212.5	160.16	123.5-156.5	833.17	680.97-738.12	13.01	4.94-7.26	157.86	157.93-216.52	543.81	445.88-528.68

III. JURISDICTION REPORT ANALYSIS

The following summaries of individual state and provincial water uses for 1998 include:

- data on overall water use;
- total water use compared to 1993 figures;
- consumptive use, comparing 1998 to 1993;
- diversions, comparing 1998 to 1993; and
- basin specific data for states with more than one Great Lakes shoreline.

Questions on individual data collection and reporting programs should be directed to the member of the Technical Work Group for the appropriate jurisdiction (page III).

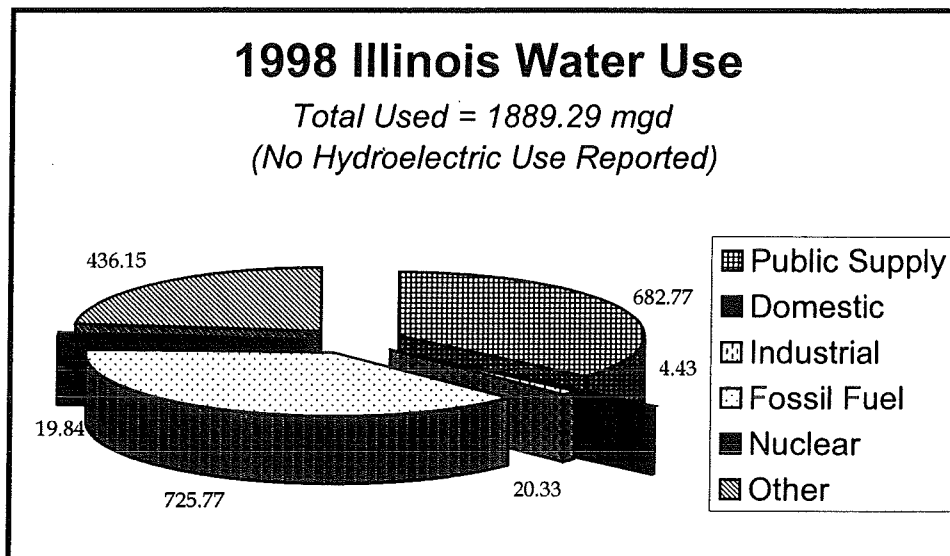
Abbreviations

mgd = million gallons per day
mld = million litres per day
bgd = billion gallons per day
bld = billion litres per day
tgd = trillion gallons per day
tld = trillion litres per day

Illinois

Data Source: Water use data for Illinois was provided by the Department of Natural Resources- Office of Water Resources, and the State Water Survey.

Total withdrawals: Water withdrawals from Lake Michigan in 1998 totaled 1889.29 mgd, a significant decrease from 4193.67 mgd in 1993. Shut down of the nuclear power plant in Zion, Illinois accounted for a drop in nuclear power withdrawals (from 1726.11 mgd in 1993 to 19.84 mgd in 1998). Public supply withdrawals were 60% lower, down 457.51 mgd from 1993.



Consumptive Uses: As in 1993, there was no reported consumption in public supply or in domestic uses. Estimated consumptive use using coefficients would be between 68 mgd-102 mgd for public supply, and 0.4 -0.7 mgd for domestic uses.

Diversions: Total diversions from the Lake Michigan basin in 1998 were 1126.33 mgd, reduced from 1993 figure of 1481.79 mgd. Sixty percent of these diversions were for public supply. All diversions for Illinois are outgoing interbasin diversions—water transferred from the Great Lakes Basin into another watershed.

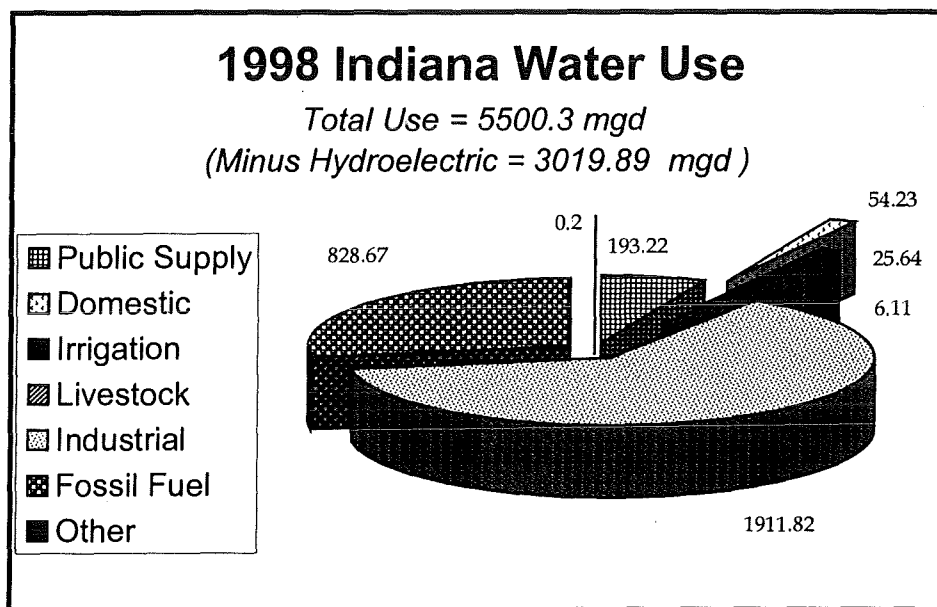
The withdrawal data submitted by the Illinois DNR to the repository were 100 percent measured and 100 percent site-specific.

Indiana

Data Source: The Indiana Department of Natural Resources—Division of Water compiled the 1998 data for the Regional Water Use Database for the Lake Erie and Lake Michigan basins.

Indiana Business Research Center at Indiana University provides population estimates for counties used in calculating self-supply domestic withdrawals. Indiana Agricultural Statistics service at Purdue University provides livestock estimates by county. The local office of USGS Water Resources Division provides estimates of percent of population by county on domestic wells.

Withdrawals: In 1998 total withdrawals were 5.5 bgd, exceeding 1993 figures by .18 bgd. Again, more than 99% of the water withdrawn was from Lake Michigan. Hydroelectric use was responsible for 46% of Indiana's Lake Michigan withdrawals, with two plants on the St. Joseph River accounting for 99.5%. The primary use of Lake Erie withdrawals was public supply, which accounted for more than 69% of withdrawals in this basin.



Consumptive Use: The total consumptive use of water in Indiana's portion of the Great Lakes Basin was 196.39 mgd, up slightly from 1993 figures of 181 mgd. Industrial uses consume the most water in the Lake Michigan basin (114.05 mgd), and in the Lake Erie basin public supply accounts for just over 65% of all consumptive use (6.72 mgd of a total of 10.27 mgd).

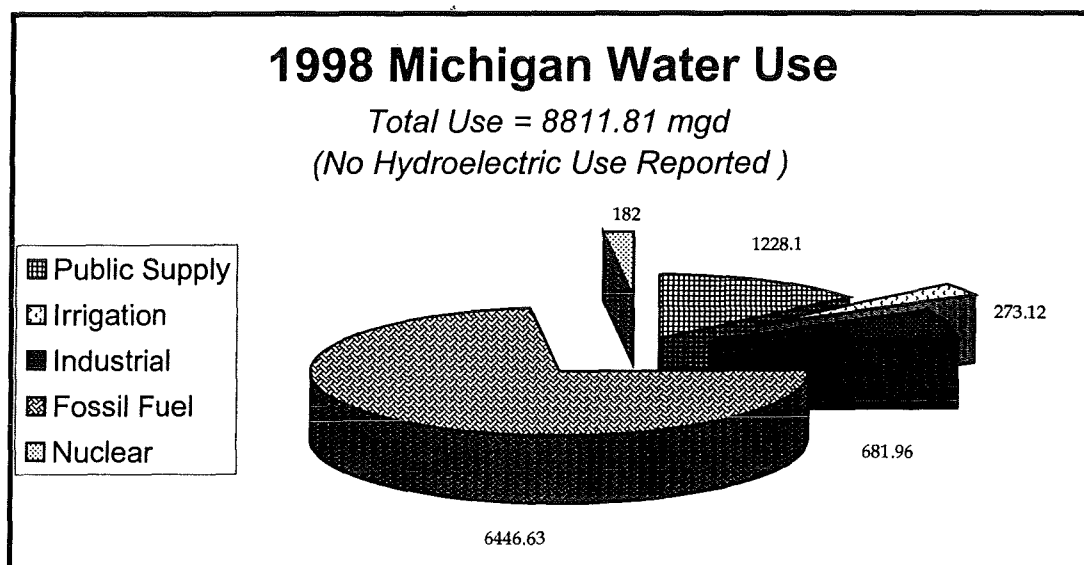
Diversions: Diversions by public water suppliers into Lake Michigan totaled 2.08 mgd.

Indiana data for 1998 were 4% measured, 50% partially measured, and 46% calculated or estimated. The level of aggregation was 99% site-specific and 1% aggregated.

Michigan

Data Source: 1998 water use data for Michigan was submitted by the Michigan Department of Environmental Quality. All data are reported to the Michigan DEQ by the facilities within each category except Irrigation, which is divided into agricultural and nonagricultural (golf course, park, etc.) irrigation. Agricultural irrigation is estimated using federal Agricultural Census data and a water use estimation model developed for Michigan. Nonagricultural irrigation facilities report directly to the DEQ

Withdrawals: Reported water withdrawals for the Lake Superior, Lake Michigan, Lake Huron, and Lake Erie Basins of Michigan were approximately 8.81 bgd. Withdrawals from the Lake Erie basin accounted for about 59% of total withdrawals. Thermoelectric uses for fossil fuel plants was the single largest use, responsible for 47% of the total use.



Consumptive Use: Consumptive uses in the Michigan Great Lakes Basin were approximately 548 mgd; irrigation accounted for more than 45% of the total consumptive use. The total reported consumptive use falls slightly below the estimated range of 557.9 mgd-619.1 mgd if coefficients were applied.

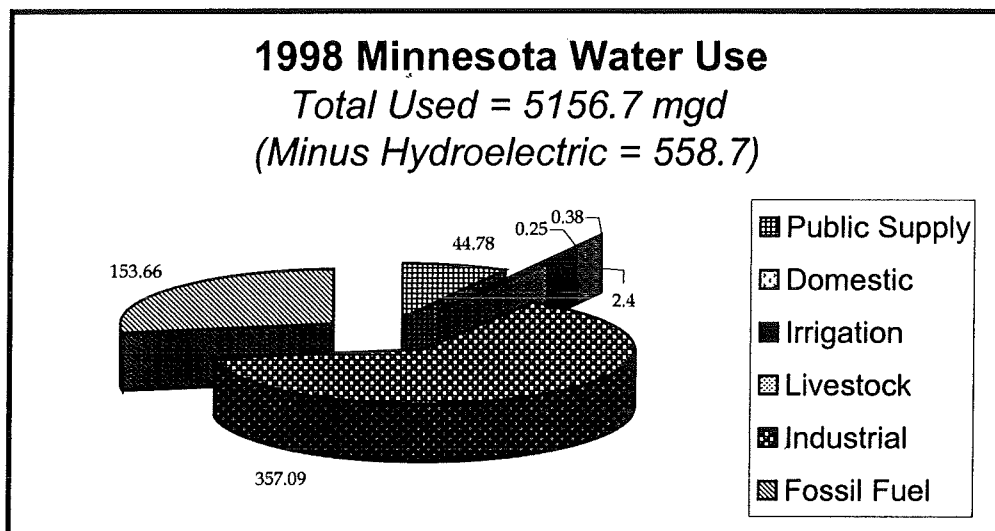
Diversions: NA

Michigan data of base year 1998 was 90% measured, 8% partially measured, 2% estimated, and 100% site-specific.

Minnesota

Data Source: The Division of Waters in the Minnesota Department of Natural Resources provides the data on the Lake Superior Basin to the Regional Water Use Database.

Withdrawals: Withdrawals from the Lake Superior Basin in 1998 were 5.16 bgd, showing a slight increase from 5.03 bgd in 1993. Hydroelectric water use accounts for 89% of Minnesota's total water withdrawals. Of the remainder, industrial uses account for more than half of the water withdrawn.



Consumptive Use: Industrial consumptive uses was 75 mgd, or about 21% of the industrial withdrawals. Public supply consumptive uses were 21% of public supply withdrawals (9.3 mgd).

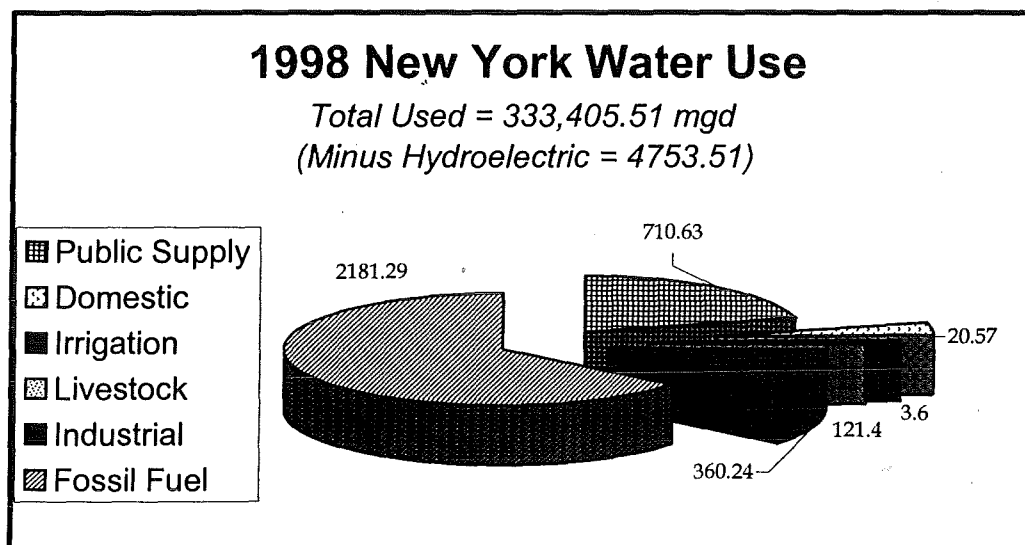
Diversions: NA

Minnesota water use data was 11% measured and 89% calculated or estimated. The level of aggregation was 11% site-specific and 89% aggregated.

New York

Data Source: Water use data collection in New York is performed by the Departments of Environmental Conservation and Health, and the U.S. Geological Survey.

Withdrawals: In 1998, withdrawals from the Great Lakes totaled 333.4 bgd, an increase from 308.3 bgd in 1993. Excluding hydroelectric withdrawals, the total was 4.75 bgd compared to 5.34 bgd in 1993. Withdrawals from the St. Lawrence River accounted for 57% of total New York withdrawals (190 bgd); withdrawals from Lake Ontario and Lake Erie were 83.8 bgd and 59.6 bgd respectively. Withdrawals for hydroelectric power supply were by far the largest water use by New York State, at 328.7 bgd, up from 302.9 bgd in 1993.



Consumptive Use: New York reported total consumptive uses of 306.3 mgd. Consumptive uses were 119.27 mgd from Lake Erie, 170.4 mgd from Lake Ontario, and 306.3 mgd from the St. Lawrence River. The largest categories of consumptive use were industrial (90.07 mgd) and public water supply (71.06 mgd).

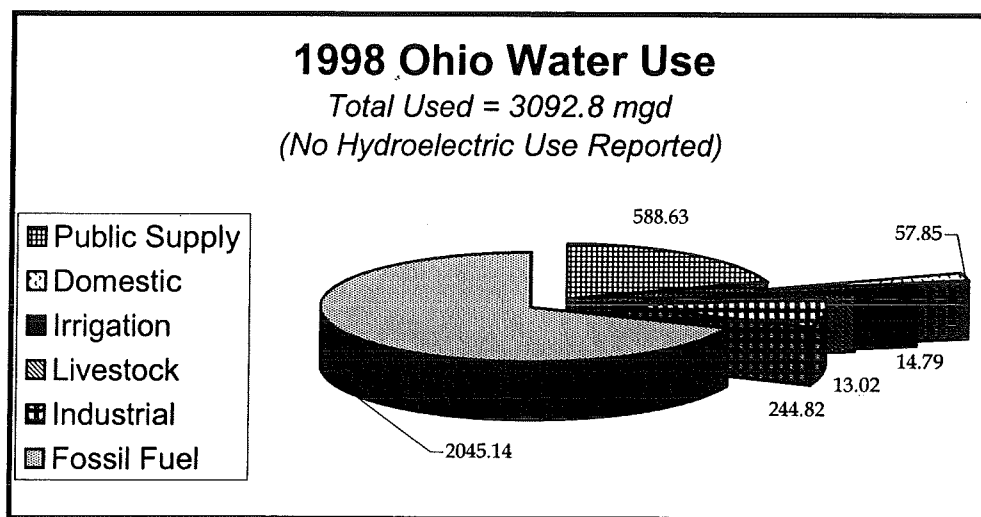
Diversions: NA

For New York, the data reported were 100% partially measured. The level of aggregation was 100% site-specific.

Ohio

Data Source: Water use data for Ohio is collected by the Ohio Department of Natural Resources-Division of Water, the Ohio Environmental Protection Agency, and the U.S. Geological Survey.

Withdrawals: Total withdrawals from the Ohio Lake Erie Basin for 1998 were just over 3.09 bgd, lower than the 1993 totals of 3.36 bgd. As in 1993, fossil fuel plants and public supply were the two primary withdrawal sectors; thermoelectric-fossil fuels accounted for 2.05 bgd or 66% of withdrawals, and public supply accounted for 588.63 mgd or about 19%.



Consumptive Use: Consumptive uses from the Lake Erie Basin were 166.2. Public supply was the largest at 88.29 mgd, accounting for more than 50% of the total consumptive use. Consumptive uses from nuclear plants and industrial facilities were 24 mgd and 20 mgd respectively.

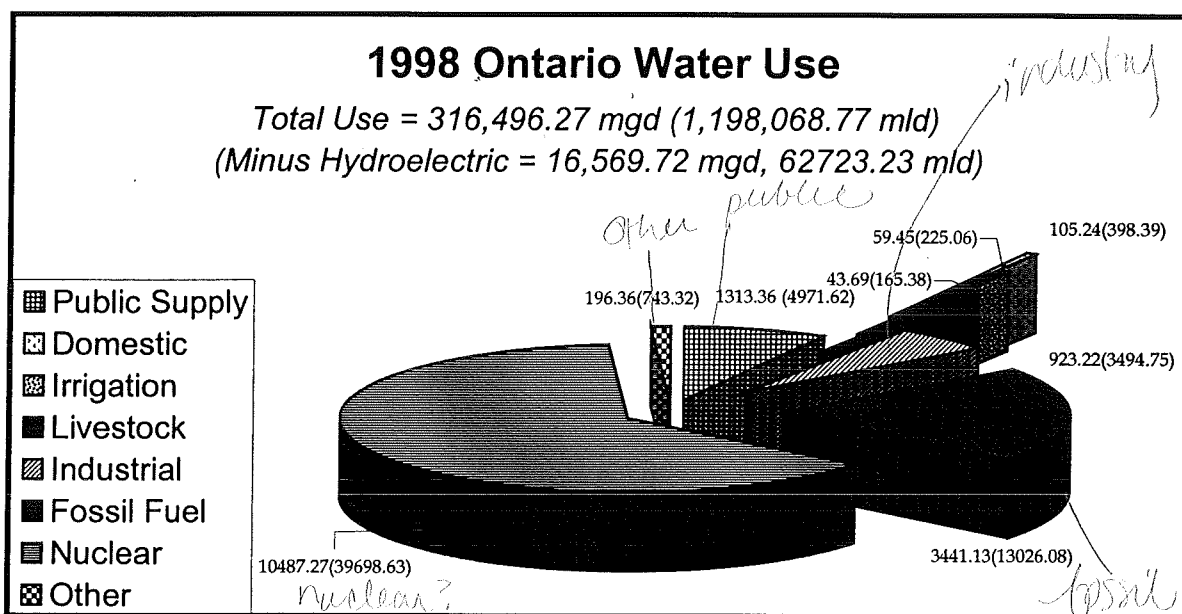
Diversions: Diversions by public water suppliers out of Lake Erie totaled 0.3 mgd; diversions into the Lake Erie Basin totaled 9.18 mgd.

The 1993 water use data for Ohio were 100% partially measured while the level of aggregation was 100% site-specific.

Ontario

Data Source: The 1998 water use data for the Ontario Great Lakes Basin, which includes Lakes Superior, Huron, Erie, Ontario, and the St. Lawrence River, were provided by the Ontario Ministry of Natural Resources, the Ontario Ministry of the Environment, and Environment Canada.

Withdrawals: Total 1998 Great Lakes water withdrawals for Ontario were approximately 1.2 tld, or 316.5 bgd. Of this, hydroelectric uses represented more than 95% of the total (1.15 tld, or 299.9 bgd). Of the remainder, thermoelectric—nuclear plant withdrawals were the second largest at .03% (39.7 bld, or 10.49 bgd).



Consumptive Use: The reported industrial consumptive use was 220 mld (58.16 mgd). Ontario's total reported consumptive use of 1.81 bld (477.63 mgd) is less than the estimated range of 660.97 to 736.12 mgd, if coefficients were applied.

The following table shows the consumptive uses for all basins utilized by Ontario for 1998.

<i>Basin</i>	<i>Consumptive Uses (bld)</i>	<i>% of Total Use</i>
Superior	.06	4%
Huron	.38	21%
Erie	.37	20%
Ontario	.82	45%
St. Lawrence	.17	10%
TOTAL	1.80	100%

Diversions: Ontario reported incoming interbasin diversions for Lake Superior and intrabasin diversions (incoming or outgoing) for Lakes Huron, Erie, and Ontario. These values are represented in the following table; incoming diversion values are negative.

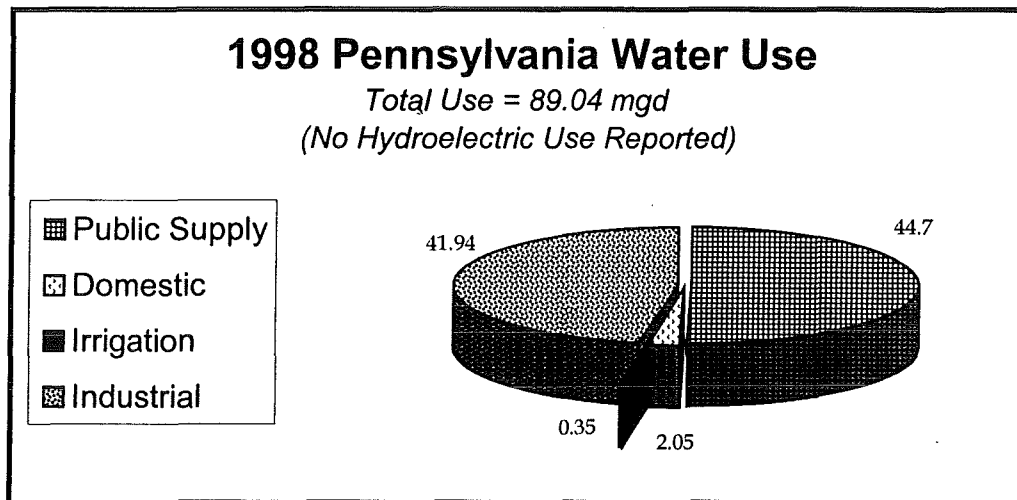
<i>Basin</i>	<i>Interbasin Diversion (bld)</i>	<i>Intrabasin Diversion (bld)</i>
Superior	-6.21	na
Huron	na	-0.04
Erie	na	21.48
Ontario	na	-21.32
TOTAL	-6.21	.12

Ontario's withdrawal data for this report were 99.9% partially measured and the level of aggregation was 99.5% site-specific.

Pennsylvania

Data Source: Due to staffing and other constraints, this report utilizes 1994 data. The Department of Environmental Protection – Bureau of Water Supply and Community Health submitted water use data for the Lake Erie and Lake Ontario Basins of Pennsylvania.

Withdrawals: Total withdrawals from the two basins were 89.04 mgd, up from 86.32 mgd in 1993. Industrial uses, which account for more than 47% of withdrawals, increased from 39.6 mgd in 1993, to 41.9 mgd in 1998. Nearly 100% of withdrawals were from the Lake Erie Basin (88.87 mgd).



Consumptive Use: Consumptive use totaled 13.94 mgd, up from 13.01 mgd in 1993. The consumptive use from Lake Ontario was negligible at 0.02 mgd, in comparison to a consumptive use of 13.93 mgd from the Lake Erie Basin.

Diversions: NA

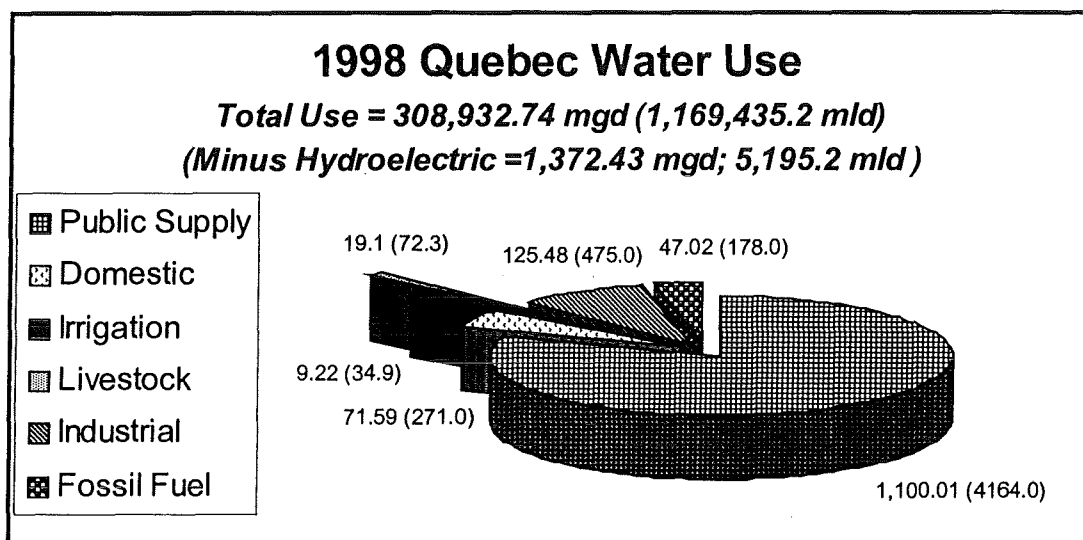
The Pennsylvania 1998 data were 50% measured and 50% estimated, with a 98% site-specific level of aggregation.

Quebec

Data Source: The Ministre de l'Environnement—Centre d'expertise hydrique du Quebec provided Quebec water use data for 1998.

Withdrawals: Withdrawals in Quebec's St. Lawrence River Basin were approximately 1.17 tld (309 bgd) in 1998. Nearly 100% of the withdrawals were for hydroelectric power purposes. There continues to be an increase in industrial withdrawals, as reflected in the most recent figures from Quebec.

Because water processing occurs at eight provincial ministries, eight federal ministries and all municipalities in the Great Lakes Basin in Quebec, data collection is logistically difficult. Quebec's water reporting structure is also not currently designed to focus on water use and withdrawal; however, a new water management policy is under consideration.



Consumptive Use: Total consumptive use in 1998 was 597.55 mld (157.9 mgd). Public supply accounted for 416 mld (109.9 mgd), or nearly 70% of the total consumptive use.

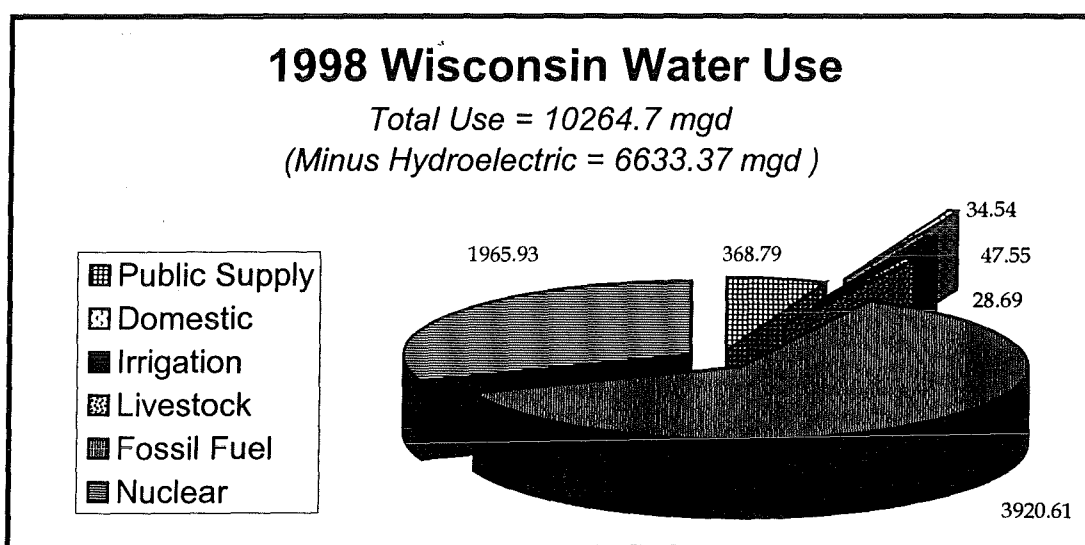
Diversions: NA

The Quebec water use data for 1998 were 99.5% measured and 0.5 % partially measured. The level of aggregation was 100% site-specific.

Wisconsin

Data Source: 1998 water use data for the Lake Michigan and Lake Superior Basins of Wisconsin were submitted by the Wisconsin Department of Natural Resources—Bureau of Water Resources Management.

Withdrawals: Withdrawals from Lake Michigan and Lake Superior Basins totaled 10.3 bgd, a decrease of 1.6 bgd from 1993 figures. More than 97% of the total withdrawals were from the Lake Michigan Basin; only 236.5 mgd were withdrawn from Lake Superior. Of the Lake Superior withdrawals, 209.4 mgd or 88% were for hydroelectric uses. Water withdrawn from the Lake Michigan Basin was used primarily for fossil fuel and hydroelectric power purposes—at 39% and 34% of total use respectively.



Consumptive Use: 98% of Wisconsin's 1998 consumptive uses were from the Lake Michigan Basin (208.8 mgd). Of this amount, consumptive uses from public supply, industrial, fossil fuel, and irrigation were 56.6 mgd, 40.1 mgd, 39.1 mgd, and 33.8 mgd respectively.

Diversions: 930,000 gallons per day were diverted out of the Lake Michigan Basin for public water supply purposes at Pleasant Prairie in 1998.

Wisconsin's 1998 water use data was 100% calculated or estimated. The level of aggregation was 100%.

III. APPENDIX

IN MILLION GALLONS PER DAY

- 1998 GREAT LAKES BASIN SUMMARY REPORTS
- JURISDICTION REPORTS

Illinois
Indiana
Michigan
Minnesota
New York
Ohio
Ontario
Quebec
Pennsylvania
Wisconsin

- BASIN REPORTS

Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario
St. Lawrence River

- WATER USE CATEGORY REPORTS

Public Supply
Self Supply – Domestic
Self Supply – Irrigation
Self Supply – Livestock
Self Supply – Industrial
Self Supply – Thermoelectric Power, Fossil Fuel
Self Supply – Thermoelectric Power, Nuclear
Self Supply – Hydroelectric Power
Other

- DATA QUALITY REPORTS

Level of Accuracy
Level of Aggregation

SUMMARY REPORT - GREAT LAKES BASIN

Units: Mgal(US)/d

Year Of Data: 1998

Water-Use by Jurisdiction - All Facilities

Jurisdiction	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Illinois	2327.03	0.00	0.00	2327.04	0.00	1562.80	0.00
Indiana	2405.26	2952.47	142.57	5500.30	0.00	-2.08	196.39
Michigan	7784.75	489.59	537.47	8811.81	0.00	0.00	548.36
Minnesota	317.31	4833.92	5.47	5156.70			88.00
New York	152895.00	180367.08	143.43	333405.51	0.00	0.00	306.34
Ohio	2663.70	275.70	153.40	3092.80	0.00	-8.88	166.18
Ontario	165077.77	151099.86	318.63	316496.27	32.62	-1639.38	477.63
Pennsylvania	81.65	2.90	4.49	89.04			13.94
Quebec	171588.19	133580.18	99.91	305268.28			157.86
Wisconsin	6133.01	3901.61	230.08	10264.70	0.00	0.93	213.43
Total:	511273.68	477503.31	1635.46	990412.44	32.62	-86.61	2168.13

Water-Use by Jurisdiction - Principal Facilities

Jurisdiction	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Illinois	2327.03	0.00	0.00	2327.03	0.00	1562.80	0.00
Indiana	2405.26	2952.00	110.82	5468.08	0.00	0.00	188.70
Michigan					0.00	0.00	
Minnesota	317.19	4833.26	4.50	5154.94			87.57
New York							
Ohio	2663.35	268.09	77.61	3009.05	0.00	-8.88	140.20
Ontario	164336.16	150992.81	147.34	315476.31	32.62	-1639.38	332.29
Pennsylvania	81.65	2.78	1.64	86.07			13.60
Quebec	171587.93	133575.95	48.61	305212.48			131.58
Wisconsin	6116.74	3896.18	125.30	10138.22	0.00	0.45	154.12
Total:	349835.30	296521.07	515.82	646872.19	32.62	-85.01	1048.06

SUMMARY REPORT - GREAT LAKES BASIN

Units: Mgal(US)/d

Year Of Data: 1998

Water-Use by Basin - All Facilities

Basin	Withdrawals				Diversions		Consumptive Use	
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	TOTAL	Use
Lake Superior	1080.62	20096.35	27.86	21204.84	0.00	-1639.38	-1639.38	116.02
Lake Michigan	12227.29	7016.79	754.05	19998.14	0.00	1561.65	1561.65	677.40
Lake Huron	24557.13	11443.65	138.80	36139.58	-9.25	0.00	-9.25	174.69
Lake Erie	70202.78	477.75	373.87	71054.40	5673.18	-8.88	5664.30	591.21
Lake Ontario	51269.86	90226.08	187.12	141683.06	-5631.31	0.00	-5631.31	388.09
St. Lawrence River	351936.00	348242.70	153.74	700332.43	0.00	0.00	0.00	220.72
Total:	511273.68	477503.31	1635.46	990412.44	32.62	-86.61	-53.99	2168.13

Water-Use by Basin - Principal Facilities

Basin	Withdrawals				Diversions		Consumptive Use	
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	TOTAL	Use
Lake Superior	620.07	20094.87	5.54	20720.48	0.00	-1639.25	-1639.25	93.32
Lake Michigan	10832.45	6594.18	223.60	17650.23	0.00	1563.12	1563.12	333.75
Lake Huron	23366.79	11351.09	50.87	34768.74	-9.25	0.00	-9.25	59.39
Lake Erie	5391.95	330.89	163.94	5886.78	5673.18	-8.88	5664.30	217.22
Lake Ontario	48908.21	8653.81	18.17	57580.18	-5631.31	0.00	-5631.31	179.72
St. Lawrence River	260715.83	249496.23	53.71	510265.76	0.00	0.00	0.00	164.67
Total:	349835.30	296521.07	515.82	646872.19	32.62	-85.01	-52.39	1048.06

SUMMARY REPORT - GREAT LAKES BASIN

Units: Mgal(US)/d

Year Of Data: 1998

Water-Use by Category - All Facilities

Category	Withdrawals				Diversions		TOTAL	Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin		
Public Supply	4894.16	1175.59	641.95	6711.70	0.00	1118.62	1118.62	719.26
Domestic Supply	42.03	43.10	368.05	453.18	0.00	3.87	3.87	57.46
Irrigation	7.84	173.83	252.43	434.10	0.00	0.00	0.00	374.57
Livestock	7.24	5.56	118.62	131.43	0.00	0.00	0.00	103.02
Industrial	3548.50	1136.00	249.65	4934.15	0.00	2.99	2.99	492.18
Fossil Fuel Power	18931.65	855.89	3.66	19791.20	0.00	0.00	0.00	215.40
Nuclear Power	14132.91	0.00	0.13	14133.04	0.00	0.00	0.00	206.22
Hydroelectric Power	469271.73	473912.41	0.00	943184.14	0.00	-1639.38	-1639.38	0.00
Other	437.62	200.92	0.96	639.50	32.62	427.28	459.90	0.03
Total:	511273.68	477503.31	1635.46	990412.44	32.62	-86.61	-53.99	2168.13

Water-Use by Category - Principal Facilities

Category	Withdrawals				Diversions		TOTAL	Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin		
Public Supply	3565.72	865.02	327.52	4758.26	0.00	1120.09	1120.09	491.48
Domestic Supply	6.03	21.16	55.29	82.48	0.00	3.87	3.87	9.09
Irrigation	0.00	12.91	27.28	40.19	0.00	0.00	0.00	30.16
Livestock	0.00	2.07	1.73	3.80	0.00	0.00	0.00	3.03
Industrial	2045.42	972.30	103.31	3121.03	0.00	2.99	2.99	284.86
Fossil Fuel Power	10964.53	182.73	0.27	11147.53	0.00	0.13	0.13	94.40
Nuclear Power	12596.34	0.00	0.00	12596.34	0.00	0.00	0.00	135.03
Hydroelectric Power	320219.73	294312.40	0.00	614532.12	0.00	-1639.38	-1639.38	0.00
Other	437.53	152.48	0.42	590.44	32.62	427.28	459.90	0.01
Total:	349835.30	296521.07	515.82	646872.19	32.62	-85.01	-52.39	1048.06

SUMMARY REPORT - GREAT LAKES BASIN

Units: Mgal(US)/d

Year Of Data: 1998

Water-Use by Jurisdiction - All Facilities

Jurisdiction	Withdrawals				Diversions		Consumptive Use	
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	TOTAL	Use
Illinois	2327.03	0.00	0.00	2327.04	0.00	1562.80	1562.80	0.00
Indiana	2405.26	472.06	142.57	3019.89	0.00	-2.08	-2.08	196.39
Michigan	7784.75	489.59	537.47	8811.81	0.00	0.00	0.00	548.36
Minnesota	317.31	235.92	5.47	558.70				88.00
New York	3843.00	767.08	143.43	4753.51	0.00	0.00	0.00	306.34
Ohio	2663.70	275.70	153.40	3092.80	0.00	-8.88	-8.88	166.18
Ontario	15804.30	446.79	318.63	16569.72	32.62	0.00	32.62	477.63
Pennsylvania	81.65	2.90	4.49	89.04				13.94
Quebec	641.94	630.58	99.91	1372.43				157.86
Wisconsin	6133.01	270.28	230.08	6633.37	0.00	0.93	0.93	213.43
Total:	42001.95	3590.90	1635.46	47228.31	32.62	1552.77	1585.39	2168.13

Water-Use by Jurisdiction - Principal Facilities

Jurisdiction	Withdrawals				Diversions		Consumptive Use	
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	TOTAL	Use
Illinois	2327.03	0.00	0.00	2327.03	0.00	1562.80	1562.80	0.00
Indiana	2405.26	471.59	110.82	2987.67	0.00	0.00	0.00	188.70
Michigan					0.00	0.00	0.00	
Minnesota	317.19	235.26	4.50	556.94				87.57
New York								
Ohio	2663.35	268.09	77.61	3009.05	0.00	-8.88	-8.88	140.20
Ontario	15062.69	339.75	147.34	15549.78	32.62	0.00	32.62	332.29
Pennsylvania	81.65	2.78	1.64	86.07				13.60
Quebec	641.67	626.35	48.61	1316.63				131.58
Wisconsin	6116.74	264.85	125.30	6506.89	0.00	0.45	0.45	154.12
Total:	29615.58	2208.67	515.82	32340.07	32.62	1554.37	1586.99	1048.06

SUMMARY REPORT - GREAT LAKES BASIN

Units: Mgal(US)/d

Year Of Data: 1998

Water-Use by Basin - All Facilities

Basin	Withdrawals				Diversions		Consumptive Use	
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	TOTAL	Use
Lake Superior	1080.62	237.07	27.86	1345.56	0.00	0.00	0.00	116.02
Lake Michigan	12227.29	1114.49	754.05	14095.84	0.00	1561.65	1561.65	677.40
Lake Huron	5908.54	134.77	138.80	6182.11	-9.25	0.00	-9.25	174.69
Lake Erie	12353.78	477.75	373.87	13205.40	5673.18	-8.88	5664.30	591.21
Lake Ontario	9577.57	798.21	187.12	10562.90	-5631.31	0.00	-5631.31	388.09
St. Lawrence River	854.14	828.62	153.74	1836.51	0.00	0.00	0.00	220.72
Total:	42001.95	3590.90	1635.46	47228.31	32.62	1552.77	1585.39	2168.13

Water-Use by Basin - Principal Facilities

Basin	Withdrawals				Diversions		Consumptive Use	
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	TOTAL	Use
Lake Superior	620.07	235.59	5.54	861.20	0.00	0.13	0.13	93.32
Lake Michigan	10832.45	691.88	223.60	11747.93	0.00	1563.12	1563.12	333.75
Lake Huron	4718.21	42.21	50.87	4811.29	-9.25	0.00	-9.25	59.39
Lake Erie	5391.95	330.89	163.94	5886.78	5673.18	-8.88	5664.30	217.22
Lake Ontario	7215.91	133.94	18.17	7368.02	-5631.31	0.00	-5631.31	179.72
St. Lawrence River	836.98	774.15	53.71	1664.84	0.00	0.00	0.00	164.67
Total:	29615.58	2208.67	515.82	32340.07	32.62	1554.37	1586.99	1048.06

SUMMARY REPORT - GREAT LAKES BASIN

Units: Mgal(US)/d

Year Of Data: 1998

Water-Use by Category - All Facilities

Category	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Supply	4894.16	1175.59	641.95	6711.70	0.00	1118.62	719.26
Domestic Supply	42.03	43.10	368.05	453.18	0.00	3.87	57.46
Irrigation	7.84	173.83	252.43	434.10	0.00	0.00	374.57
Livestock	7.24	5.56	118.62	131.43	0.00	0.00	103.02
Industrial	3548.50	1136.00	249.65	4934.15	0.00	2.99	492.18
Fossil Fuel Power	18931.65	855.89	3.66	19791.20	0.00	0.00	215.40
Nuclear Power	14132.91	0.00	0.13	14133.04	0.00	0.00	206.22
Other	437.62	200.92	0.96	639.50	32.62	427.28	0.03
Total:	42001.95	3590.90	1635.46	47228.31	32.62	1552.77	2168.13

Water-Use by Category - Principal Facilities

Category	Withdrawals				Diversions		Consumptive Use
	GLSW	OSW	GW	TOTAL	Intrabasin	Interbasin	
Public Supply	3565.72	865.02	327.52	4758.26	0.00	1120.09	491.48
Domestic Supply	6.03	21.16	55.29	82.48	0.00	3.87	9.09
Irrigation	0.00	12.91	27.28	40.19	0.00	0.00	30.16
Livestock	0.00	2.07	1.73	3.80	0.00	0.00	3.03
Industrial	2045.42	972.30	103.31	3121.03	0.00	2.99	284.86
Fossil Fuel Power	10964.53	182.73	0.27	11147.53	0.00	0.13	94.40
Nuclear Power	12596.34	0.00	0.00	12596.34	0.00	0.00	135.03
Other	437.53	152.48	0.42	590.44	32.62	427.28	0.01
Total:	29615.58	2208.67	515.82	32340.07	32.62	1554.37	1048.06