

Water Withdrawals and Use in Illinois, 2010

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In Illinois, water is used for domestic purposes (such as drinking and bathing), transportation, power generation, industrial (manufacturing) purposes, commercial (non-manufacturing) purposes, golf course irrigation, agricultural irrigation, recreation, fire protection, and conservation (such as wildlife habitat maintenance). Much of this water is potable water that is treated and conveyed from its source by public water systems. Water is obtained from sources that are either underground (i.e., from aquifers) or on the surface. Groundwater is pumped from aquifers through wells, and surface water is withdrawn through intakes in rivers, streams, lakes, and ponds.

The historical and current priority of the Illinois Water Inventory Program (IWIP) at the Illinois State Water Survey (ISWS) since 1979 has been to develop and maintain a database of water withdrawals by community water supply systems (CWS) and self-supplied industrial-commercial facilities through an annual census. The long-term goals of IWIP include accounting for all major uses of water in Illinois, either through an expanded census or by estimation. This fact sheet provides an overview of water withdrawals by community water supply systems and self-supplied industrial-commercial facilities in Illinois during 2010 based on IWIP data.

Public Water Systems

In this fact sheet, the term *public water system* refers to a system that furnishes potable water for drinking or general domestic use year-round. This definition is equivalent to the Illinois Environmental Protection Agency (IEPA) definition of a community water supply, in contrast to a non-community water supply, which serves individuals for a lesser period (more than 60 days but not year-round). In 2010, 1,748 public water systems were active in Illinois. Public water systems ranged considerably in scale. One of the smallest public water systems in Illinois was a mobile home park in Will County serving 25 people, and the largest public water supply was the city of Chicago, which served about 2.9 million people within Chicago city limits and sold water wholesale for use outside of the city limits by about 2.7 million people. The mobile home park obtained its water from a single well, while Chicago withdrew water from Lake Michigan through four large intakes. Of the public water systems in Illinois, 1,174 (67 percent) primarily used groundwater—either pumped from their own wells or purchased from another system that had wells. The remaining 574 (33 percent) public water systems used surface water, either

withdrawn directly from a lake or stream or purchased from another system that had a direct surface water source (Figure 1).

Public water system withdrawals reported to IWIP in 2010 totaled about 550 billion gallons, or about 1,500 million gallons per day (mgd). This number represents a decrease of about 200 mgd from the comparably reported 2005 total of 1,700 mgd. Of the 550 billion gallons withdrawn in 2010, 24 percent was pumped from groundwater sources by 981 self-supplied public water systems, and 76 percent was pumped from surface water sources by 93 self-supplied public water systems (Figure 2). From those self-supplied systems, treated or “finished” water was delivered to 674 other systems that distributed potable water to their own communities and often to other communities.

Lake Michigan supplies about 60 percent of the water used by public water systems in Illinois and is the source of water

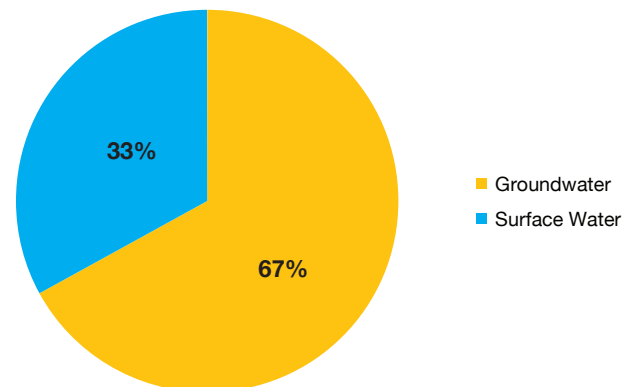


Figure 1. Percentage of public water systems that use surface water as compared to systems that use groundwater.

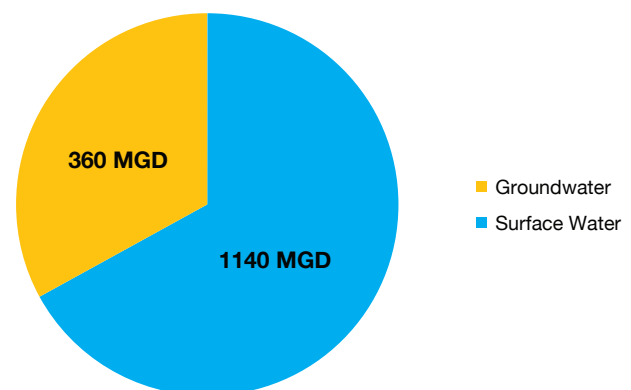


Figure 2. Volume of potable water provided by surface water systems as compared to that provided by groundwater systems.

for over 200 public water systems in the Chicago metropolitan area. Withdrawals are regulated by Illinois' Lake Michigan Water Allocation Program to maintain compliance with a U.S. Supreme Court decree limiting Illinois' total diversion from Lake Michigan. Although only 13 public water systems withdraw water directly from Lake Michigan, 8 of these systems sell large amounts of water to other public water systems, with the water being conveyed through pipelines across the region. Illinois' use of Lake Michigan water for public water systems has declined fairly steadily since the mid-1990s (Figure 3), a result primarily of increased water rates, increased water conservation, and infrastructure improvements by the City of Chicago (James Casey, Illinois Department of Natural Resources, personal communication).

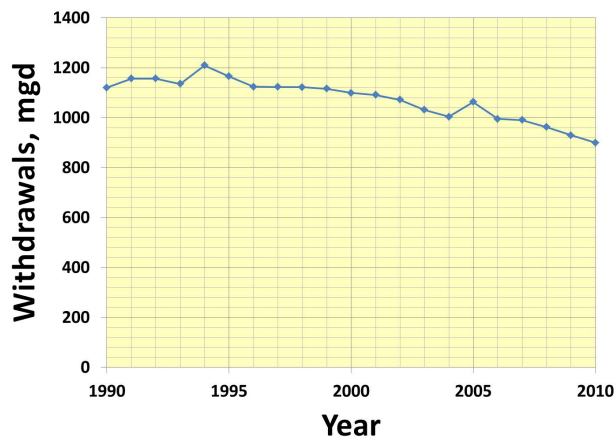


Figure 3. Lake Michigan withdrawals by Illinois public water systems (1990-2010).

The distributions of groundwater and surface water withdrawals in Illinois (Figure 2) reflect significant withdrawals by large public water systems in the Chicago metropolitan area. Systems in outer suburban communities pump heavily from groundwater sources, and these withdrawals appear in Figure 4 as an L-shaped belt of heavy groundwater pumping in the northeastern corner of Illinois. Outside this northeastern corner, large groundwater withdrawals for public supply occur at Rockford, in the Peoria area, in the Champaign-Urbana area, and in the East St. Louis Metro area.

Outside of northeastern Illinois, surface water sources predominate in the southern two-thirds of the state, where only a few productive aquifers of high quality are present. Large down-state surface withdrawals for public supply mark the locations of intakes on major rivers and on reservoirs such as Lake Springfield, Lake Decatur, Carlyle Lake, and Rend Lake (Figure 5).

Self-Supplied Industrial-Commercial Withdrawals

Water withdrawals for self-supplied industrial (manufacturing) and commercial (non-manufacturing) facilities totaled about 20.5 trillion gallons (about 56,000 mgd) in 2010. Over 99 percent of this total was used for electrical power generation. Because much more water is used for power generation than for all other industrial-commercial uses, this fact sheet will first look at water withdrawals for power generation,

then follow with a discussion of all other uses classified as industrial-commercial.

Surface Water and Groundwater in Power Generation.

Surface water accounts for over 99 percent of the water used in power generation. About 72 percent of the total was diverted

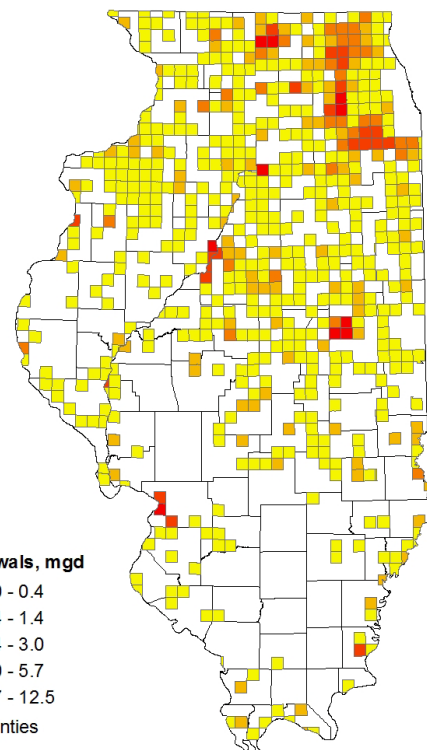


Figure 4. Groundwater withdrawals by public water systems in Illinois, by township (2010).

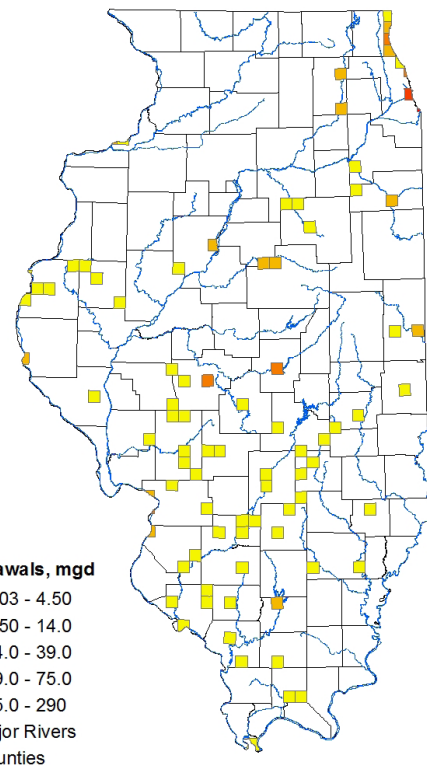


Figure 5. Surface water withdrawals by public water systems in Illinois, by township (2010).

from surface waters to generate hydroelectric power. Very little water is lost, or *consumed*, in this process. The remaining 28 percent was withdrawn principally for non-contact cooling by thermoelectric power plants, that is, plants fueled by nuclear fission or fossil fuels. Withdrawals for electrical power generation principally mark the locations of power plants sited along major rivers, associated cooling ponds maintained by the plants, and reservoirs (Figure 6). The withdrawals depicted in Figure 6 also include a small amount of groundwater used in support roles (e.g., employee-sanitary use and water that is purified for use in generating steam).

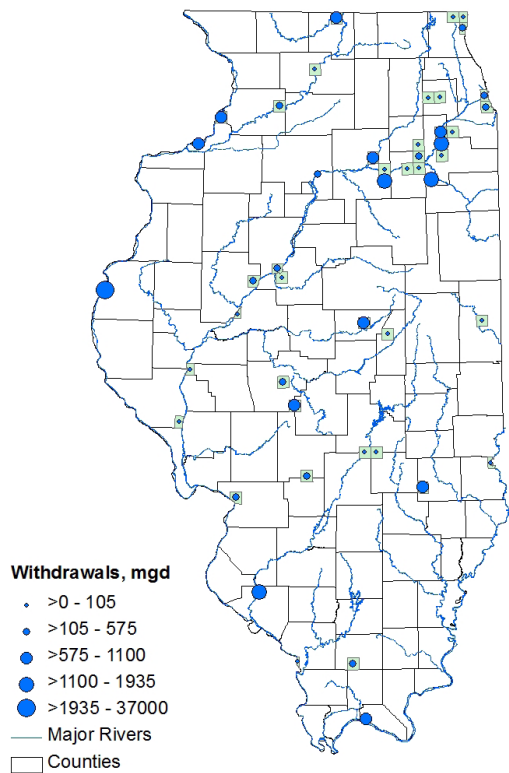


Figure 6. All groundwater and surface water industrial-commercial withdrawals related to power generation (2010). A *graduated-symbols display* is used here rather than a *graduated-color display* because the size of a particular township may not reflect the very large volume of water used within the township.

Consumptive versus Non-Consumptive Use in Thermoelectric Power Generation. Proximity to rivers or large lakes is especially important to the operation of power plants that use an “open-loop” or “once-through” type of cooling system. In this type of system, water is withdrawn from the source and circulated once through cooling jackets at the plant before being returned to the source. Typically less than 3 percent of the cooling water is consumed, mainly through evaporation (Solley et al., 1998). Other thermoelectric power plants use “closed-loop” systems, in which the cooling water is continuously recirculated through heat exchangers or cooling towers at the plant. Some of the water evaporates through the cooling towers, and other water is returned to the original source. Losses due to evaporation from closed-loop systems may be made up by periodic withdrawals from a river adjacent to the cooling lake. These *consumptive losses* are greater than in plants that use once-through cooling (Torcellini et al., 2003).

Withdrawals for closed-loop cooling are smaller than for open-loop systems, but evaporation losses are greater. In plants that use cooling towers, for example, the losses range from 30 percent in nuclear facilities to 70 percent in fossil fuel plants (Dziegielewski and Bik, 2006).

The total of 2010 withdrawals for cooling of thermoelectric power plants was so large (nearly 16,500 mgd) that even the small proportion lost to evaporation is significant. Assuming that, on average, evaporation equals about 1.05 gallons per kilowatt-hour of generated power (Torcellini et al., 2003), and that generated thermoelectric power in Illinois totaled 191,563 gigawatt-hours in 2010 (Patrick Mills, USGS Illinois Water Science Center, personal communication), total evaporation from thermoelectric power generation is estimated at about 550 mgd. This total exceeds 60 percent of all 2010 Illinois withdrawals from Lake Michigan for public water system use (see Figure 3).

Self-Supplied Industrial and Commercial Withdrawals Not Used in Power Generation. The remaining self-supplied industrial and commercial water withdrawals in 2010 (Figures 7 and 8) totaled about 520 mgd and mark locations of ethanol plants, petroleum refineries, grain processing facilities, steel mills, paper mills, chemical manufacturers, industrial machining facilities, and other entities. About 343 mgd of this total (66 percent) was withdrawn from surface water, and 177 mgd (34 percent) was groundwater. The water was commonly used by these facilities for non-contact cooling, and, generally, only a small proportion was lost to evaporation, although exceptions exist. The concentration of facilities reflects economic activity in the population centers of northeastern Illinois, and some

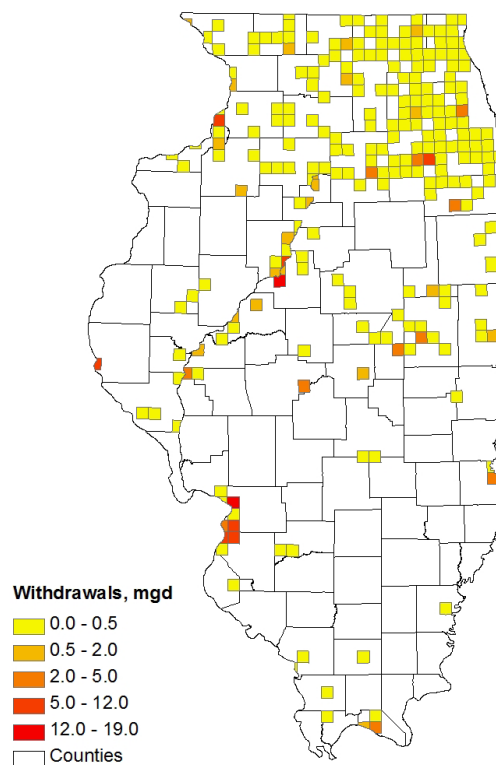


Figure 7. Groundwater withdrawals by self-supplied industrial-commercial facilities in Illinois, excluding withdrawals for power generation, by township (2010).

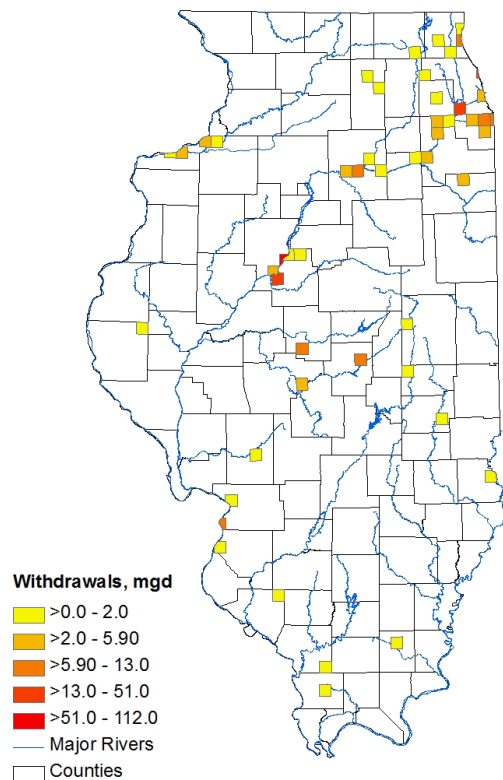


Figure 8. Surface water withdrawals by self-supplied industrial-commercial facilities in Illinois, excluding withdrawals for power generation, by township (2010).

facilities correspond roughly to the distributions of productive aquifers, such as the east-west trending Mahomet Aquifer in east-central Illinois and the sand and gravel aquifer underlying much of the Illinois River valley.

Reporting Requirements and Quality Control in the Illinois Water Inventory Program

Since its inception in 1979, the IWIP program has relied on voluntary submission of water withdrawal information. However, in 2009, through amendments to the Water Use Act of 1983, Illinois Public Act 096-0222 made the submission of public and self-supplied industrial and commercial withdrawals to the IWIP program mandatory beginning with the 2010 calendar year. One intention of the law was to encourage greater cooperation by facilities in submitting their annual reports. Since the program still does not receive 100 percent returns on the forms it sends to facilities, several methods are used to fill data gaps and to ensure data integrity.

Among these methods is the estimation of withdrawals for facilities on the basis of data submitted during previous years, as well as the use of alternative sources of data, such as that collected by the Lake Michigan Water Allocation Program and interpolation of data, so that a fairly complete water use picture for any one year can be achieved. Large changes in reported public water system water use (greater than 15 percent) trigger follow-up contact with the facility operator to verify the accuracy of reported data and to inquire about reasons for growth or decline.

Public Act 096-0222 also requires that withdrawals for row-crop agricultural irrigation be reported. However, to allow for

development of accurate methods of estimation by irrigators, counties, water authorities, and other regions, row-crop irrigation reporting does not become mandatory until the 2015 calendar year.

Other water withdrawals that are not reported or estimated at present include those from private domestic wells and, generally speaking, those of non-community public water systems, which supply water to parks, restaurants, schools, and other facilities that do not serve the same number of people year-round. The overall objective is to account for all major water withdrawals so as to enable more in-depth study of water resources throughout the state.

The Relation of the Illinois Water Inventory Program to the National Water Use Information Program

Every five years, the Illinois State Water Survey provides data in aggregated form to the U.S. Geological Survey (USGS) for use by the USGS National Water Use Information Program. These data mainly include those for public water supplies and industrial-commercial use. The USGS Illinois Water Science Center in Urbana estimates agricultural irrigation by county using a method developed by ISWS and USGS researchers, and the USGS estimates golf course irrigation through a similar method that is modified to accommodate considerable data submitted to IWIP from golf course superintendents. Other withdrawal totals, such as those for livestock operations, fisheries, and conservation, are estimated by the USGS using a combination of IWIP-submitted data and other approaches, such as satellite imagery analysis. Kenny et al. (2009) discuss 2005 water use in the U.S. as indicated by National Water Use Information Program data and estimates. The 2010 National Water Use Information Program report is scheduled for publication in the spring of 2014 (Patrick Mills, USGS Illinois Water Science Center, personal communication). The publication will be available online and will include county-wide download links for each state, including Illinois.

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