

# ESTIMATED WATER WITHDRAWALS AND USE IN PENNSYLVANIA, 1995

## HOW DO WE USE WATER?

In practical terms, water use is divided into two basic types: instream use and offstream use. **Instream use** is water used in its natural channel, basin, or behind a dam and includes activities such as fishing, boating, and other recreational activities. Instream use also includes hydroelectric power generation. **Offstream use** is water pumped or diverted from its natural channel, basin, or aquifer. Offstream uses are divided into the following categories: public supply, domestic, commercial, industrial, thermoelectric power, mining, livestock, and irrigation. This fact sheet provides an overview of offstream and hydroelectric power water use in Pennsylvania. It describes water withdrawals by source, water withdrawals and deliveries by category, changes in water use over time, and water-management responsibilities in the State.

## HOW DO WE GET WATER?

Water users obtain water from ground-water or surface-water sources. Those who withdraw water for their own use are classified

as self-supplied. Water used for mining, livestock, irrigation, and thermoelectric power and hydroelectric power generation is typically self-supplied. Other water users obtain water from deliveries by public suppliers; these users are classified as public-supplied. Domestic, commercial, and industrial water users can be self-supplied, public-supplied, or both.

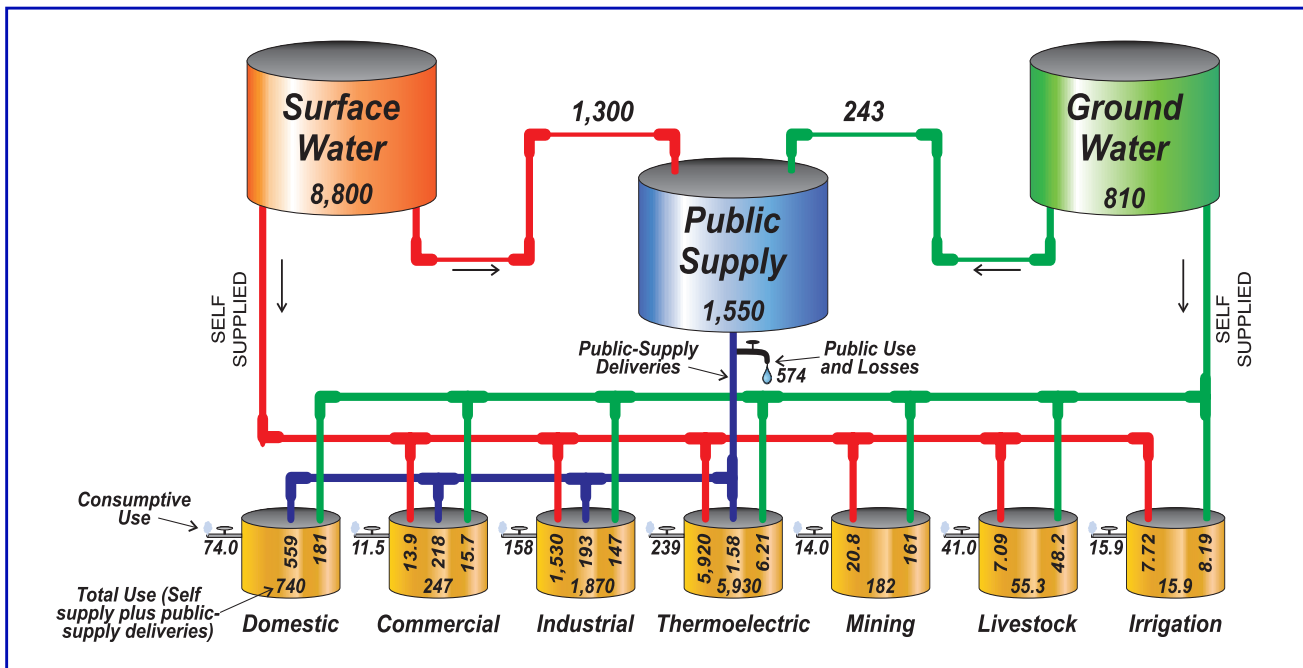
commercial, and irrigation withdrawals were 181, 55.3, 29.6, and 15.9 Mgal/d, respectively.

The largest overall use of water was for hydroelectric power generation, an instream use. The amount of water used for hydroelectric power generation, 55,900 Mgal/d, was more than five times greater than all offstream uses combined.

## HOW MUCH WATER IS USED IN PENNSYLVANIA?

In 1995, Pennsylvania ranked 12th among the states with a total freshwater withdrawal of 9,610 Mgal/d (fig. 1). Of this amount, 91 percent (8,800 Mgal/d) was from surface water and 9 percent (810 Mgal/d) was from ground water. Withdrawals for thermoelectric power generation totaled 5,930 Mgal/d, the largest offstream use of water in Pennsylvania. Industrial (1,680 Mgal/d) and public supply (1,550 Mgal/d) were the fourth and sixth largest withdrawals of their type in the nation (Solley and others, 1998). Mining withdrawals were 182 Mgal/d. Domestic, livestock, com-

*Mgal/d, or million gallons per day, and gpcd, or gallons per capita per day, are units of measure applied to water-use data. **Withdrawals** are the removal of water, through pumping or diversion, from ground-water or surface-water sources. **Public-supply deliveries** are the transfer of water to a point of use.*



**Figure 1.** Self-supplied withdrawals and public-supply deliveries in Pennsylvania, by water source and category of use, 1995. (All values in million gallons per day. Values may not add up to totals because of independent rounding.)

## PUBLIC SUPPLY—

### Water Withdrawn, Treated, and Delivered to Other Uses

Pennsylvania has about 2,160 public suppliers or community water systems. A public supplier is any water system that serves 25 or more people at their primary residence or has 15 or more service connections. Public suppliers withdrew about 1,550 Mgal/d in 1995 (fig. 1), 16 percent from ground-water sources and 84 percent from surface-water sources. More than nine million Pennsylvania residents were served by public suppliers in 1995. Statewide, increased deliveries for domestic and commercial uses since 1985 (52.3 Mgal/d) have offset decreased deliveries for industrial use (-53.2 Mgal/d). Per-capita withdrawals<sup>1</sup> by public suppliers have decreased from 196 gpcd in 1985 to 189 gpcd in 1990 and to 171 gpcd in 1995. Public suppliers delivered nearly half of the water used for domestic, commercial, and industrial uses in the Delaware and Susquehanna River Basins (fig. 2). A comparison of public-supply data since 1985, by river basin, showed total deliveries increased 5 to 6 percent in the Delaware and Susquehanna River Basins due to increased deliveries for domestic and commercial uses, and decreased about 15 percent in the Ohio River Basin because of reduced deliveries for domestic and industrial uses.

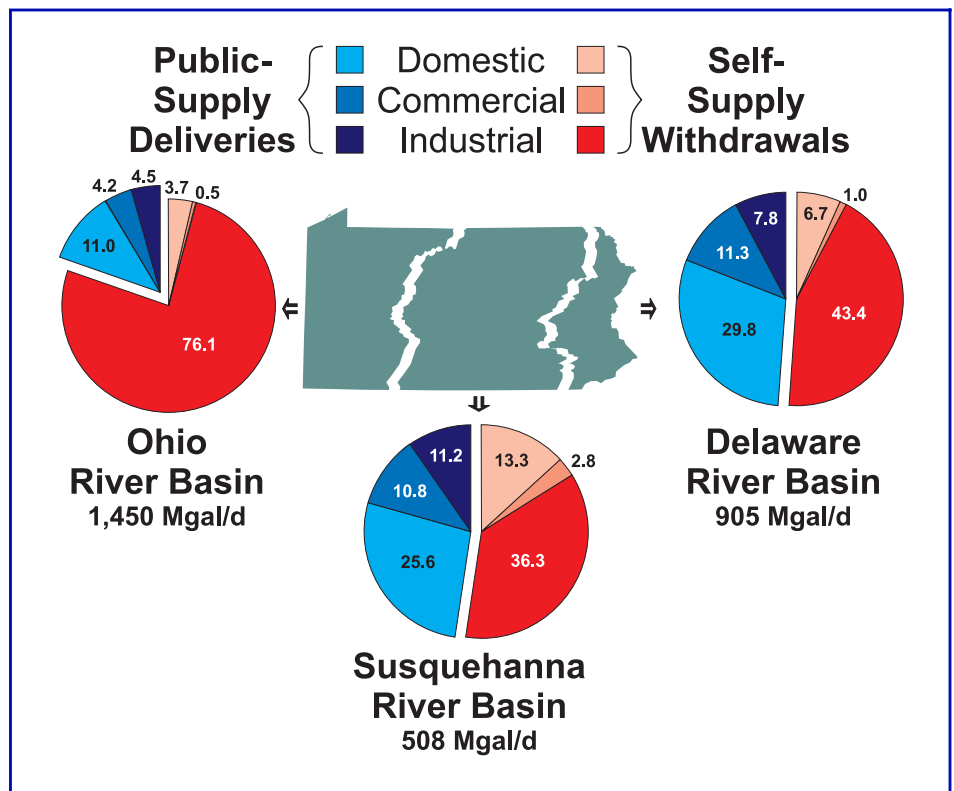
## DOMESTIC—

### Water Use in and Around Your Home

Domestic water use includes water used for cooking, bathing, laundry, toilet flushing, lawn watering, pool filling, car washing, and other residential uses. Water used for domestic purposes is either self-supplied or is delivered by public suppliers, or both. Self-supplied domestic withdrawals in 1995 were estimated to be 181 Mgal/d (fig. 1). In Pennsylvania, self-supplied domestic water is entirely from ground water and constitutes the third largest domestic withdrawals among the states (Solley and others, 1998). Public-supply deliveries for domestic uses (559 Mgal/d) were triple that of self-supplied withdrawals. Statewide, domestic per-capita use (public-supplied)<sup>2</sup> decreased from 66 to 62 gpcd between 1985 and 1995. Domestic per-capita use (public-supplied) rose from 56 to 67 gpcd in the Delaware River

<sup>1</sup> Total withdrawals made by public suppliers, divided by the public suppliers' total population served.

<sup>2</sup> Deliveries by public suppliers to domestic use divided by the public suppliers' total population served.



**Figure 2.** Public-supply deliveries and self-supplied withdrawals in Pennsylvania's three major river basins. The amounts include deliveries and withdrawals in adjacent river basins to the extent the basins are within the borders of the Commonwealth. Pie charts indicate percentages of water use within each area.

Basin, decreased from 76 to 57 gpcd in the Ohio River Basin, and decreased from 76 to 58 gpcd in the Susquehanna River Basin.

The self-supplied population was estimated to be the difference between the 1995 census population data and the population reported to be served by public suppliers, county by county. Domestic use was estimated at 60 gpcd for the self-supplied population<sup>3</sup> (William Gast, Pennsylvania Department of Environmental Protection, oral commun., 1998) and averaged 62 gpcd (statewide) for public-supplied population (unpub. data on file, Lemoyne, Pa., U.S. Geological Survey, 1998). The national averages for domestic use for self-supplied and public-supplied populations were 80 and 101 gpcd, respectively (Solley and others, 1998, p. 27).

## COMMERCIAL & INDUSTRIAL—

### Water Use at Your Workplace

Water used in retail stores and malls, educational institutions, health care and correctional facilities, business and government

<sup>3</sup>The 60 gpcd value used for the 1995 estimation was an increase from 50 gpcd used in the 1985 and 1990 estimates.

offices, public and private parks and recreational facilities, and military bases constitutes commercial and institutional water use. In 1995, self-supplied commercial withdrawals were 29.6 Mgal/d; public-supply deliveries to commercial activities were 218 Mgal/d (fig. 1). Statewide, commercial use increased from 214 to 247 Mgal/d between 1985 and 1995. A comparison of commercial use since 1985 by river basin showed little net change in the Delaware River Basin between 1985 and 1995 because decreases in withdrawals were offset by public-supply deliveries. During the same period, commercial use in the Ohio River Basin increased from 49.3 to 67.2 Mgal/d, and commercial use in the Susquehanna River Basin increased from 54.4 to 68.8 Mgal/d.

Industrial water use is water used for manufacturing processes, especially washing and cooling. In 1995, industrial withdrawals were about 1,680 Mgal/d and public-supplied deliveries to industry were about 193 Mgal/d. Statewide, industrial use decreased from 2,300 to 1,870 Mgal/d between 1985 and 1995. In the Delaware River Basin, industrial use was 464 Mgal/d or a little more than half the 1985 amount of 899 Mgal/d. Public-supply deliveries to industry in the Ohio River Basin have decreased from 86.0 to 65.5 Mgal/d. In the Susquehanna River Basin, industrial use

decreased from 256 Mgal/d in 1985 to 241 Mgal/d in 1995. Industrial **consumptive use** (water incorporated into a product or evaporated to the atmosphere) totaled about 158 Mgal/d in 1995, about 28 Mgal/d less than in 1985.

### HYDROELECTRIC & THERMOELECTRIC— *Water for Power*

Water use for hydroelectric power is distinct from other water use because water flowing through a dam is considered an instream use rather than a withdrawal. In 1995, water use for hydroelectric power generation was 84 percent of total use or about 55,900 Mgal/d. The 1995 hydroelectric water use is lower than the 60,700 Mgal/d used in 1985 and the 68,000 Mgal/d used in 1990. Pumped storage, a variation of hydroelectric power generation, generates power during hours of peak power demand. Pumped storage facilities are typically considered an instream use of water, although there are exceptions. Pennsylvania has eight hydroelectric sites; two are pumped storage hydroelectric power-generation sites. Hydroelectric power facilities generated less than 1 percent of all electric power generated in the state in 1995.

In contrast, water used for thermoelectric power generation is an offstream use because water is either pumped or diverted from a ground-water or surface-water source. In 1995, fossil-fuel power plants withdrew 6.21 Mgal/d of ground water and 3,870 Mgal/d of surface water. Nuclear power plants withdrew 2,050 Mgal/d of surface water. Thermoelectric (combined fossil-fuel and nuclear) power withdrawals were 42 percent less than in 1985 (10,200 Mgal/d). Consumptive use by thermoelectric power increased from 193 Mgal/d in 1985 to 239 Mgal/d in 1995.

### MINING— *Water to Process Raw Materials*

Mining water use includes water used for the extraction of coals and ores, crude petroleum, and gases; it also includes water use associated with quarrying, especially milling (crushing, screening, washing, and flotation), equipment cleaning, and dust control. Water use in this category does not include dewatering, unless the water is put to a specific use before it is discharged. In 1995, mining ground-water withdrawals were 161 Mgal/d, and mining surface-water withdrawals were 20.8 Mgal/d (fig. 1). Statewide, mining use increased from 148 Mgal/d in 1985 to 252 Mgal/d in 1990 and decreased to 182 Mgal/d in 1995. A comparison of mining-use data since 1985, by river basin, showed the Delaware, Ohio, and Susquehanna River Basins had large increases in withdrawals

between 1985 and 1990. Since 1990, withdrawals in the Delaware and Ohio River Basins decreased to about 9 percent below the 1985 withdrawal amounts. In the Susquehanna River Basin, mining use increased from 50.0 to 108 Mgal/d between 1985 and 1990 and decreased to 93.0 Mgal/d in 1995.

### LIVESTOCK & IRRIGATION— *Water to Raise Food*

Livestock water use includes water used in two sub-categories: stock (production of red meat, milk, poultry, eggs, and wool) and animal specialties (fur-bearing animals, horses and other equines, and animal aquaculture). Withdrawals for livestock water use were estimated by multiplying the number of animals (U.S. Bureau of Census, 1994a, 1994b; Pennsylvania Department of Agriculture, 1996) by the coefficients of water use per animal unit in the state water plan (Pennsylvania Department of Environmental Resources, 1975). For 1995, freshwater withdrawals for livestock were estimated to be 55.3 Mgal/d (fig. 1). Ground-water withdrawals for livestock were estimated to be 48.2 Mgal/d, and surface-water withdrawals were estimated to be 7.09 Mgal/d. Livestock use was estimated to be 70.4 Mgal/d in 1985 and 53.1 Mgal/d in 1990, a decrease of 24 percent. Since 1985, withdrawals of water for livestock in the Susquehanna River Basin increased from 66 to 73 percent of statewide withdrawals for livestock. Withdrawals for livestock in the Delaware River Basin decreased from 13 to 11 percent and in the Ohio River Basin from 21 to 16 percent of statewide withdrawals for livestock.

Irrigation water use includes water applied to crops to promote plant growth or to provide protection from freezing. Sprinkler (spray) irrigation is the predominant method of water application in Pennsylvania, although other methods are available. Micro-irrigation is becoming more widely utilized for horticultural specialties and selected fruit and vegetable crops. Irrigation water use in 1995 was estimated to be about 15.9 Mgal/d (fig. 1). Irrigation data (U.S. Bureau of Census, 1994a) were utilized to make estimates of the amount of water applied, method of application, water source, and acres irrigated. Irrigated acreage accounted for only 0.6 percent of total harvested acreage in the state. Irrigation withdrawals were about 10.7 Mgal/d in 1985 and increased to 14.3 Mgal/d by 1990. A comparison of irrigation water-use data, by river basin, showed that between 1985 and 1990, withdrawals in the Delaware River Basin increased from 2.31 to 3.12 Mgal/d, and withdrawals in the Ohio River Basin increased from 1.68 to 2.37 Mgal/d. Between 1990 and 1995, withdrawals in the Delaware River Basin increased to 3.56 Mgal/d; withdrawals in the Ohio River Basin returned to 1.64 Mgal/d. Irrigation with-

drawals in the Susquehanna River Basin increased from 6.75 to 10.7 Mgal/d between 1985 and 1995 or from 63 to 67 percent of statewide irrigation withdrawals.

## **WATER MANAGEMENT IN PENNSYLVANIA**

The monitoring of water withdrawals in Pennsylvania is shared among the state and two river-basin commissions formed as federal-state compacts. The Pennsylvania Department of Environmental Protection (DEP) regulates surface-water withdrawals for public supply and provides overall supervision of all public suppliers in Pennsylvania. The federal-state compact agencies are the Delaware River Basin Commission (DRBC) and the Susquehanna River Basin Commission (SRBC). The DRBC and SRBC have authority in their respective basins to register all ground-water withdrawals greater than 10,000 gpd (gallons per day) and review all surface-water withdrawals greater than 100,000 gpd.

In administering the Water Rights Act of June 24, 1939, the DEP reviews applications for surface-water withdrawals by public suppliers to ensure that new or expanded withdrawals:

- Will not conflict with water rights held by any other public supplier,
- Is reasonably necessary for the present purposes or future needs of the public supplier making the application,
- Will not interfere with navigation,
- Will not jeopardize public safety, and
- Will not cause substantial injury to the Commonwealth.

Instream uses downstream of public water-supply intakes are protected by permit conditions requiring either conservation releases from large reservoirs or minimum passby flows below small reservoirs, intake dams, or other intake structures. Conservation releases must be maintained at all times, regardless of inflow to the reservoir, and are therefore provided from the storage in the reservoir. Passby flows are minimum flow quantities that must be allowed to pass the intake structure. When inflows are inadequate to provide for the passby and the withdrawal, the withdrawal must be either reduced or discontinued to allow the passby quantity or natural inflow to pass the intake.

Pennsylvania is a member of both the DRBC and SRBC. The commissions were established under federal-state compacts to manage the water resources of the Delaware and Susquehanna River Basins and to resolve interstate conflicts related to water resources. The federal-state compacts vested these com-

missions with regulatory powers over the waters of the basins. DEP enforces and implements regulations of the DRBC and SRBC in eastern Pennsylvania. Because Pennsylvania lacks regulations for the allocation of ground water, DRBC and SRBC have basin-wide comprehensive plans and have the lead role in setting policies for water allocations within Pennsylvania for their respective basins.

The DRBC and SRBC have review and approval authority for ground-water and surface-water withdrawals and consumptive uses. Withdrawal or consumptive-use capacity that was in place and operative when each commission was formed (DRBC, October 1961; SRBC, December 1970) remains unregulated. Increases in or new *withdrawals* that exceed 100,000 gpd require approvals. Increases in or new *consumptive uses* that exceed 10,000 gpd also require approvals. SRBC imposes fees for consumptive uses. Those fees are used to pay for storage that provides for releases to make up for consumptive-use losses in the basin during low-flow events. In a five-county area in southeastern Pennsylvania where ground-water withdrawals threaten to exceed recharge rates, the DRBC imposes fees for withdrawals and ten-fold fees for depletive withdrawals from basin surface waters. Those fees are used to pay for storage releases to meet a flow objective of 3,000 ft<sup>3</sup>/s (cubic feet per second) in the Delaware River at Trenton, N.J.

## WATER-USE PROGRAM

Every 5 years since 1950, the U.S. Geological Survey (USGS) has issued reports summarizing water use in the United States. In 1977, the Congress of the United States recognized the need for nationally uniform data on water use and directed the USGS to establish a National Water-Use Information Program. The USGS cooperates with state and local agencies to collect, store, aggregate, and disseminate water-use information. Through this ongoing effort, the National Water-Use Information Program produced a circular "Estimated Use of Water in the United States in 1995." The USGS Pennsylvania District's Water-Use Program, in cooperation with DEP, compiles water-use data by county and watershed for the circulars. The water-use data are based on the information reported by public suppliers and collected through water-use surveys by DEP.

Data on water use are collected by DEP to support and implement water-management decisions in the Commonwealth, such as ensuring water is available to every community, imposing drought controls when necessary, and responding to hazardous-material spill emergencies. Public suppliers and electric power generation facilities (and registered industrial and commercial facilities in the Delaware River Basin) submit annual reports of

water use to DEP. DEP also distributes water-use surveys to industrial, commercial, and mining facilities throughout Pennsylvania on a cyclical schedule. The respondents are asked to identify sources of withdrawal, withdrawal amounts, use, consumptive use, discharges, and recycling. Estimates of water use in Pennsylvania for 1995 are based on data collected and available at the time of compilation.

—Russell A. Ludlow and William A. Gast

*Water-use data also are published as an integral part of USGS ground-water, surface-water and water-quality project reports and in specialized water-use project reports. Data on water use are provided on request to a diverse audience of public agencies, organizations, researchers, students, and the general public. The USGS cooperates with other government agencies, commissions, and non-profit organizations in water-use projects.*

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- Solley, W.B., Pierce, R.R., and Perlman, H.A., 1998, Estimated use of water in the United States in 1995: U.S. Geological Survey, Circular 1200, 71 p.
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- U.S. Geological Survey, 1999, National handbook of recommended methods for water data acquisition—Chapter 11—Water use [online]: January 1999 [cited April 5, 1999], available from World Wide Web <http://water.usgs.gov/public/pubs/chapter11>
- U.S. Geological Survey, WRD, Pennsylvania District, Aggregated Water-Use Data System (AWUDS), part of the USGS National Water Information System (NWIS) [digital data on disk].

## Internet Resources

- Delaware River Basin Commission  
<http://www.state.nj.us/drbc/>
- Pennsylvania Department of Environmental Protection, Office of Water Management Page:  
<http://www.dep.state.pa.us/dep/deputate/watermgt/watermgt.htm>
- Susquehanna River Basin Commission  
<http://www.srbc.net>
- US Department of Commerce, Bureau of the Census:  
<http://venus.census.gov/cdrom/lookup>
- USGS National Water-Use Information Home Page  
<http://water.usgs.gov/watuse>
- USGS Pennsylvania District Home Page:  
<http://pa.water.usgs.gov>
- USGS Water Resources Home Page:  
<http://water.usgs.gov>