ESTIMATED USE OF WATER IN THE UNITED STATES IN 1◇9◇9◇0

U.S. Geological Survey Circular 1081

Water-resources regions of the United States as established by the U.S. Water Resources Council in 1970. This map shows the relation of the regions to the States.
See glossary in this report for definitions of water-resources region.

ESTIMATED USE OF WATER IN THE UNITED STATES IN 1990

By Wayne B. Solley, Robert R. Pierce, and Howard A. Perlman

U.S. GEOLOGICAL SURVEY CIRCULAR 1081

U. S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

UNITED STATES GOVERNMENT PRINTING OFFICE: 1993

Free on application to the Books and Open-File Reports Sales,
U.S. Geological Survey, Federal Center, Box 25286, Denver, CO 80225

CONTENTS

FIGURES

TABLES

GLOSSARY

Water-use terminology is continuing to expand in this series of water-use circulars prepared at 5-year intervals. The term "water use" as initially used in 1950 in the U.S. Geological Survey's water-use circulars meant withdrawals of water; in the report for 1960, the term was redefined to include consumptive use of water as well as withdrawals. With the beginning of the Survey's National Water-Use Information Program in 1978 the term was again redefined to include return flow and offstream and instream uses. In the report for 1985, the term was redefined to include withdrawals plus deliveries.

TERMS USED IN THIS REPORT

acre-foot (acre-ft)—the volume of water required to cover 1 acre of land (43,560 square feet) to a depth of 1 foot.

animal specialties—water use associated with the production of fish in captivity except fish hatcheries, fur-bearing animals in captivity, horses, rabbits, and pets. *See also* livestock water use.

aquaculture—farming of organisms that live in water, such as fish, shellfish, and algae.

aquifer—a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

commercial water use—water for motels, hotels, restaurants, office buildings, other commercial facilities, and institutions. The water may be obtained from a public supply or may be self supplied. *See also* public supply and self- supplied water.

consumptive use—that part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment. Also referred to as water consumed.

conveyance loss—water that is lost in transit from a pipe, canal, conduit, or ditch by leakage or evaporation. Generally, the water is not available for further use; however, leakage from an irrigation ditch, for example, may percolate to a ground-water source and be available for further use.

cooling water—water used for cooling purposes, such as of condensers and nuclear reactors.

delivery/release—the amount of water delivered to the point of use and the amount released after use; the difference between these amounts is usually the same as the consumptive use. *See also* consumptive use.

domestic water use—water for household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens. Also called residential water use. The water may be obtained from a public supply or may be self supplied. *See also* public supply and self-supplied water.

evaporation—process by which water is changed from a liquid into a vapor. *See also* evapotranspiration and transpiration.

evapotranspiration—a collective term that includes water discharged to the atmosphere as a result of evaporation from the soil and surface-water bodies and as a result of plant transpiration. *See* also evaporation and transpiration.

freshwater—water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids; generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses.

ground water—generally all subsurface water as distinct from surface water; specifically, that part of the subsurface water in the saturated zone (a zone in which all voids are filled with water) where the water is under pressure greater than atmospheric.

hydroelectric power water use—the use of water in the generation of electricity at plants where the turbine generators are driven by falling water. Hydroelectric water use is classified as an instream use in this report.

in-channel use—*see* instream use.

industrial water use—water used for industrial purposes such as fabrication, processing, washing, and cooling, and includes such industries as steel, chemical and allied products, paper and allied products, mining, and petroleum refining. The water may be obtained from a public supply or may be self supplied. *See also* public supply and self- supplied water.

instream use—water that is used, but not withdrawn, from a ground- or surface-water source for such purposes as hydroelectric power generation, navigation, water-quality improvement, fish propagation, and recreation. Sometimes called nonwithdrawal use or in-channel use.

irrigation district—a cooperative, self-governing public corporation set up as a subdivision of the State government, with definite geographic boundaries, organized and having taxing power to obtain and distribute water for irrigation of lands within the district; created under the authority of a State legislature with the consent of a designated fraction of the landowners or citizens.

irrigation water use—artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth in recreational lands such as parks and golf courses.

kilowatthour (kWh)—a unit of energy equivalent to one thousand watthours.

livestock water use—water for livestock watering, feed lots, dairy operations, fish farming, and other on-farm needs. Livestock as used here includes cattle, sheep, goats, hogs, and poultry. Also included are animal specialties. *See* also rural water use and animal specialties water use.

million gallons per day (Mgal/d)—a rate of flow of water.

mining water use—water use for the extraction of minerals occurring naturally including solids, such as coal and ores; liquids, such as crude petroleum; and gases, such as natural gas. Also includes uses associated with quarrying, well operations (dewatering), milling (crushing, screening, washing, floatation, and so forth), and other preparations customarily done at the mine site or as part of a mining activity. Does not include water used in processing, such as smelting, refining petroleum, or slurry pipeline operations. These uses are included in industrial water use.

offstream use—water withdrawn or diverted from a ground- or surface-water source for public-water supply, industry, irrigation, livestock, thermoelectric power generation, and other uses. Sometimes called off-channel use or withdrawal.

per capita use—the average amount of water used per person during a standard time period, generally per day.

public supply—water withdrawn by public and private water suppliers and delivered to users. Public suppliers provide water for a variety of uses, such as domestic, commercial, thermoelectric power, industrial, and public water use. *See also* commercial water use, domestic water use, thermoelectric power water use, industrial water use, and public water use.

public-supply deliveries—water provided to users through a public-supply distribution system.

public water use—water supplied from a public-water supply and used for such purposes as firefighting, street washing, and municipal parks and swimming pools. *See also* public supply.

reclaimed wastewater—wastewater treatment plant effluent that has been diverted for beneficial use before it reaches a natural waterway or aquifer.

recycled water—water that is used more than one time before it passes back into the natural hydrologic system.

residential water use—*see* domestic water use.

return flow—the water that reaches a ground- or surface-water source after release from the point of use and thus becomes available for further use.

reuse—*see* recycled water.

rural water use—term used in previous water-use circulars to describe water used in suburban or farm areas for domestic and livestock needs. The water generally is self supplied, and includes domestic use, drinking water for livestock, and other uses, such as dairy sanitation, evaporation from stock-watering ponds, and cleaning and waste disposal. *See also* domestic water use, livestock water use, and self-supplied water.

saline water—water that contains more than 1,000 milligrams per liter of dissolved solids.

self-supplied water—water withdrawn from a surface- or ground-water source by a user rather than being obtained from a public supply.

standard industrial classification (SIC) codes—four- digit codes established by the Office of Management and Budget and used in the classification of establishments by type of activity in which they are engaged.

surface water—an open body of water, such as a stream or a lake.

thermoelectric power water use—water used in the process of the generation of thermoelectric power. The water may be obtained from a public supply or may be self supplied. *See* also public supply and self-supplied water.

transpiration—process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface. *See also* evaporation and evapotranspiration.

wastewater—water that carries wastes from homes, businesses, and industries.

wastewater treatment—the processing of wastewater for the removal or reduction of contained solids or other undesirable constituents.

wastewater-treatment return flow—water returned to the hydrologic system by wastewater-treatment facilities.

water-resources region—designated natural drainage basin or hydrologic area that contains either the drainage area of a major river or the combined drainage areas of two or more rivers; of 21 regions, 18 are in the conterminous United States, and one each are in Alaska, Hawaii, and the Caribbean. (*See* map on inside of front cover.)

water-resources subregion—the 21 designated water-resources regions of the United States are subdivided into 222 subregions. Each subregion includes that area drained by a river system, a reach of a river and its tributaries in that reach, a closed basin(s), or a group of streams forming a coastal drainage system.

water transfer—artificial conveyance of water from one area to another.

water use—1) in a restrictive sense, the term refers to water that is actually used for a specific purpose, such as for domestic use, irrigation, or industrial processing. In this report, the quantity of water use for a specific category is the combination of self-supplied withdrawals and public-supply deliveries. 2) More broadly, water use pertains to human's interaction with and influence on the hydrologic cycle, and includes elements such as water withdrawal, delivery, consumptive use, wastewater release, reclaimed wastewater, return flow, and instream use. *See also* offstream use and instream use.

watthour (Wh)—an electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electrical circuit steadily for one hour.

withdrawal—water removed from the ground or diverted from a surface-water source for use. *See also* offstream use and self-supplied water.

CONVERSION FACTORS

Multiply	By	To Obtain
	Area	
acre	43,560	square foot (ft^2)
	4,047	square meter (m^2)
	0.001562	square mile (mi^2)
	Flow	
gallon per day (gal/d)	3.785	liter per day
million gallons per day (Mgal/d)	1.121	thousand acre-feet per year
	0.001547	thousand cubic feet per second
	0.6944	thousand gallons per minute
	0.003785	million cubic meters per day
	1.3815	million cubic meters per year
thousand acre-feet per year	0.8921	million gallons per day
	0.001380	thousand cubic feet per second
	0.6195	thousand gallons per minute
	0.003377	million cubic meters per day

Some water relations in inch-pounds units are listed below:

		(Approximations)
1 gallon	=	8.34 pounds
1 million gallons	=	3.07 acre-feet
1 cubic foot	=	62.4 pounds
	=	7.48 gallons
1 acre-foot (acre-ft)	=	325,851 gallons
	=	43,560 cubic feet
1 inch of rain	=	17.4 million gallons per square mile
	=	27,200 gallons per acre
	=	100 tons per acre

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ABSTRACT

Water withdrawals in the United States during 1990 were estimated to average 408,000 million gallons per day (Mgal/d) of freshwater and saline water for offstream uses—2 percent more than the 1985 estimate. Total freshwater withdrawals were an estimated 339,000 Mgal/d during 1990, about the same as during 1985. Average per-capita use for all offstream uses was 1,620 gallons per day (gal/d) of freshwater and saline water combined and 1,340 gal/d of freshwater.

Offstream water-use categories are classified in this report as public supply, domestic, commercial, irrigation, livestock, industrial, mining, and thermoelectric power. During 1990, public-supply withdrawals were an estimated 38,500 Mgal/d, and self-supplied withdrawals were estimated as follows: domestic, 3,390 Mgal/d; commercial, 2,390 Mgal/d; irrigation, 137,000 Mgal/d; livestock, 4,500 Mgal/d; industrial, 22,600 Mgal/d, of which 3,270 Mgal/d was saline water; mining, 4,960 Mgal/d, of which 1,650 Mgal/d was saline; and thermoelectric power, 195,000 Mgal/d, of which 64,500 Mgal/d was saline.

Water use for hydroelectric power generation, the only instream use compiled in this report, was estimated to be 3,290,000 Mgal/d during 1990, or 8 percent more than during 1985 and about the same as estimated for 1975 and 1980.

Estimates of withdrawals by source indicate that during 1990, total surface-water withdrawals were 327,000 Mgal/d, or 1 percent more than during 1985, and total ground-water withdrawals were 80,600 Mgal/d, or 9 percent more than during 1985. Total saline-water withdrawals during 1990 were 69,400 Mgal/d, or 15 percent more than during 1985, most of which was saline surface water. Reclaimed wastewater averaged about 750 Mgal/d during 1990, or 30 percent more than during 1985.

Total freshwater consumptive use was an estimated 94,000 Mgal/d during 1990, or 2 percent more than during 1985. Consumptive use by irrigation accounted for the largest part of total consumptive use, and was an estimated 76,200 Mgal/d. Freshwater consumptive use in the East (water-resources regions east of and including the Mississippi regions) was about 12 percent of freshwater withdrawn in the East and accounted for only 21 percent of the Nation's total consumptive use. By comparison, freshwater consumptive use in the West was about 44 percent of the freshwater withdrawn in the West.

The 1990 estimates of total freshwater withdrawals and consumptive use were just slightly more than the 1985 estimates but substantially less than the 1980 estimates; this is consistent with the general trend indicated by a slackening in the rate of increase of total withdrawals from 1970 to 1975 and again from 1975 to 1980, and a decrease in total withdrawals from 1980 to 1985. Public-supply withdrawals during 1990 were 5 percent more than during 1985, and self-supplied withdrawals during 1990 compared to 1985 were as follows: domestic, 2 percent more; commercial, 95 percent more; irrigation, 0.3 percent less; livestock, 0.8 percent more; industrial, 13 percent less; mining, 44 percent more; and thermoelectric power, 4 percent more.

A comparison of total withdrawals (fresh, saline) by State indicates that 20 States and the District of Columbia had less water withdrawn for offstream uses during 1990 than during 1985. California accounted for the most water withdrawn for offstream use, 46,800 Mgal/d, more than the total of water withdrawn in both Texas or Idaho, the next largest users. A similar comparison by water-resources regions indicates that the coastal regions (New England, Mid Atlantic, South Atlantic-Gulf, Pacific Northwest, California) accounted for nearly one-half of the total water withdrawn in the United States. Total withdrawals in the East accounted for 54 percent of the Nation's total withdrawals, the same as during 1985.

INTRODUCTION

Water management in the United States has traditionally focused on manipulating the country's abundant supplies of freshwater to meet the needs of users. This "supply management" approach has resulted in the building of large dams and conveyance systems, especially in the West. Increasing development costs, capital shortages, government fiscal restraint, diminishing sources of water supply, polluted water, and a growing concern for the environment have forced water managers and planners to begin to rethink traditional approaches to management and to experiment with new ones. Experts on the subject of water (supply and demand) in the western United States agree that the area is in transition from the era of water-supply development to an era of water-demand management and conservation, (Wilkinson, 1985). Quantitative assessments derived from the type of national compilation contained in this report can be used to evaluate the effectiveness of alternative water-management policies and conservation activities.

PURPOSE AND SCOPE

The purpose of this report is to present consistent and current water-use estimates by State and water-resources region for the United States, Puerto Rico, the U.S. Virgin Islands, and the District of Columbia. Estimates of water withdrawn from surface- and ground-water sources, estimates of consumptive use, and estimates of instream use and wastewater releases during 1990 are presented in this report. The U.S. Geological Survey has compiled similar national estimates every 5 years since 1950 (MacKichan, 1951, 1957; MacKichan and Kammerer, 1961; Murray, 1968; Murray and Reeves, 1972, 1977; and Solley and others, 1983,1988). This series of reports can be used to develop and evaluate trends in water use and to plan for more effective uses of the Nation's water resources in the future.

This report discusses eight categories of offstream water use—public supply, domestic, commercial, irrigation, livestock, industrial, mining, and thermoelectric power—and one category of instream use: hydroelectric power. Detailed information for other instream uses, such as navigation, recreation, pollution abatement, and fish habitat, is beyond the scope of this report. Information on wastewater-treatment facilities is given in the "Wastewater Release" section.

Information on many of the water-use categories in this report is more detailed than the information presented in previous water-use circulars in this series. For each category of offstream water use, 1990 withdrawal and consumptive-use estimates are discussed and those estimates are compared

with corresponding 1985 estimates. The text is supplemented with illustrations and tables showing data for each State, Puerto Rico, the U.S. Virgin Islands, and the District of Columbia and for each of the 21 water-resources regions. (Water-resources regions are shown on a map on the inside of the front cover.) Totals are highlighted in the tables for ease of reference. At the beginning of this report is a section on total water use by category and source of water, and at the end is a section on trends in water use for the period 1950-90.

TERMINOLOGY

The terms and units used in this report are similar to those used in previous water-use circulars in this series. In this report, the term "offstream use" represents all water diverted or withdrawn from a surface- or ground-water source and conveyed to a place of use. "Instream use" refers to all uses taking place within the river channel itself. Hydroelectric power generation is discussed as an "instream use," although some hydroelectric power water uses could be considered as offstream use. The terms "freshwater," "saline water," and "reclaimed wastewater," as types of water, are defined in the glossary. Saline water is reported only for the industrial, mining, and thermoelectric power categories. Some public supplies treat saline water before it is distributed, but all public-supply withdrawals are considered as freshwater in this report. Surface water and ground water, as sources of water, and the categories of water use also are defined in the glossary. In this report, withdrawals refer to self-supplied withdrawals, and deliveries refer to public-supply deliveries. "Consumptive use" refers to that part of the water withdrawn that is evaporated, transpired, incorporated into products and crops, consumed by humans or livestock, or otherwise removed from the immediate water supply.

SOURCES OF DATA AND METHODS OF ANALYSIS

In cooperation with State and local agencies, the water-use estimates for 1990 were compiled by the U.S. Geological Survey's District Offices for each county in the United States, Puerto Rico, and the U.S. Virgin Islands, and for 2,149 water-resources cataloging units. [For an explanation of cataloging units, see Seaber and others (1987)]. These estimates were entered into a State water-use data base in each District Office and submitted to the Survey's headquarters in Reston, Va. The information was aggregated by State (including Puerto Rico, the U.S. Virgin Islands, and the District of Columbia) and by the 21 water-resources regions for each

category of water use. All the water-use information compiled for this report is stored in the U.S. Geological Survey's Aggregate Water-Use Data System (AWUDS). Sources of information and accuracy of data vary and are discussed for each category in subsequent parts of this report.

More comprehensive analyses of field data and more detailed evaluations of existing water-use data were performed in the compilation of data for this report and for the 1985 water-use circular than for previous water-use circulars in this series. The increase in analyses and evaluations result from the U.S. Geological Survey's National Water-Use Information Program designed in 1978 to provide more uniform, current, and reliable information on water use. Documentation is available from each District Office that identifies the sources of water-use information for that State and describes how the water-use estimates were determined for this report. As the State water-use information programs are developed and refined, the timeliness and accuracy of water-use data at the State and national levels will continue to improve.

Two regional meetings were held during 1990 with U.S. Geological Survey and State water-use personnel to familiarize them with available sources of water-use information and preferred methodologies for data collection. Guidelines developed by the U.S. Geological Survey for preparation of State water-use estimates were distributed at those meetings. The following national data files were made available to each District for reference: U.S. Environmental Protection Agency Industrial Facilities Discharge files and Public Drinking Water Supply files, U.S. Bureau of Census population files, and the U.S. Department of Energy, Energy Information Administration reports. Each District was responsible for determining the most reliable source of information available for that State.

Water-use numerical data are the average daily quantities used. Irrigation water is applied during only a part of each year, and at variable rates; therefore, the actual rate of application is much greater than the average daily rate given in tables in this report. In this report, the numerical data generally are rounded to three significant figures for values greater than 100 and two significant figures for values less than 100. Most tables show these data in million gallons per day. Selected tables also show per-capita-use data in gallons per day, rounded to three significant figures, and irrigation and hydroelectric power data in thousand-acre feet per year. A conversion table is given after the glossary to assist those readers who may wish to convert the data to other units of measurement. All numbers were rounded independently; thus, the sums of individual rounded numbers may not equal the totals. The percentage changes discussed in the text, were calculated from the unrounded data.

Population data, which are from the U.S. Bureau of the Census population estimates and projections (U.S. Bureau of the Census, 1991), are shown

to the nearest thousand. Data on population served by public supply were compiled in cooperation with State and local agencies; these data are rounded to three significant figures.

ACKNOWLEDGMENTS

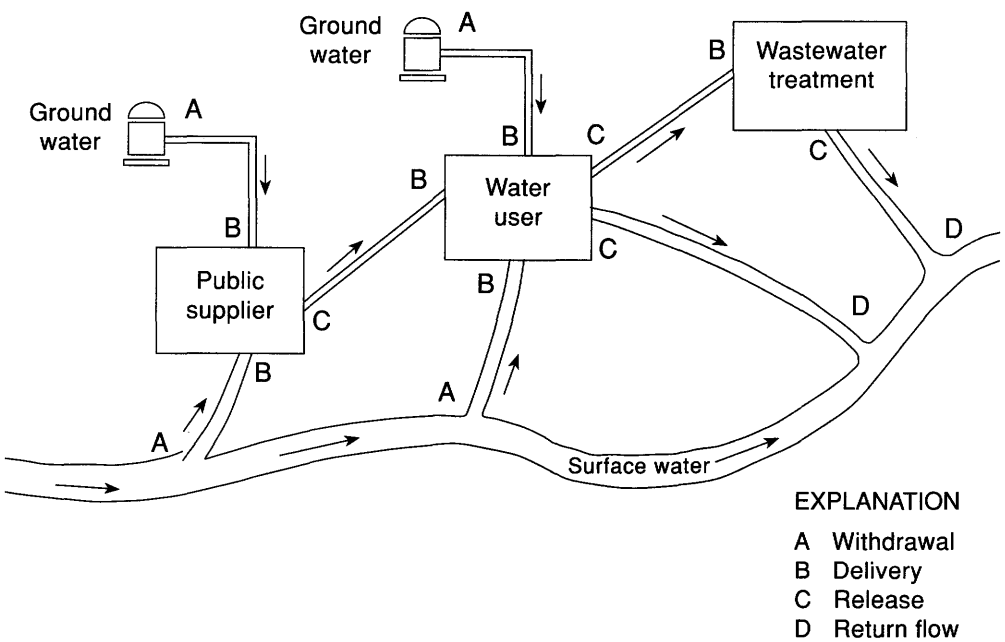
The authors acknowledge the assistance provided by the many State and local agencies that cooperated with the U.S. Geological Survey, and the many U.S. Geological Survey water-use project chiefs that participated in the collection and compilation of data for this report. Many of the States publish reports on water use as part of their participation in the National Water-Use Information Program, and a selected list of these publications is given at the end of this report.

WATER USE

Water use in this report is subdivided into offstream use, instream use, and wastewater release. The difference among these types of use is explained below.

Offstream use is a water use that depends on water being diverted or withdrawn from a surface- or ground-water source and conveyed to the place of use. To determine the total quantity of water used (self-supplied withdrawals and public-supply deliveries), five subtypes of use are evaluated, as explained below and shown in the following sketch.

1. Withdrawal—The quantity of water diverted or withdrawn from surface- or ground-water (A in sketch).
2. Delivery/release—The quantity of water delivered at the point of use (B) and the quantity released after use (C).
3. Conveyance loss—The quantity of water that is lost in transit, for example, from point of withdrawal to point of delivery (A-B), or from point of release to point of return (C-D).
4. Consumptive use—That part of water withdrawn that is evaporated, transpired, or incorporated into products or crops. In some instances, consumptive use will be the difference between the volume of water delivered and the volume released (B-C).
5. Return flow—The quantity of water that is discharged to a surface- or ground-water source (D) after release from the point of use and thus becomes available for further use.



In this report, self-supplied withdrawals, deliveries from public suppliers (where applicable), and consumptive use estimates are given for seven categories of offstream use: domestic, commercial, irrigation, livestock, industrial, mining, and thermoelectric power. For the public-supply category, in addition to withdrawals, the report also gives water delivered to domestic, commercial, industrial, and thermoelectric power users.

Each category of use typically has different effects on the reuse potential of return flows. Reuse potential reflects the quality and the quantity of water available for subsequent use; for example, irrigation return flow may be contaminated by pesticides and fertilizers, and, because of the high consumptive use of water during irrigation, the mineral content of the return flow often is substantially greater than that of the water applied. Consequently, irrigation return flow frequently has little reuse potential. This is a significant contrast to the reuse potential of most water discharged from thermoelectric plants, where the principal change in the water is an increase in temperature.

Instream use is a water use that takes place without the water being diverted or withdrawn from surface- or ground-water sources. Examples of instream uses are hydroelectric power generation, navigation, freshwater dilution of saline estuaries, maintenance of minimum streamflow to support fish habitat, and the assimilation of wastewater.

Quantitative estimates for most instream uses are difficult to compile on a national scale. However, because such uses compete with offstream uses and affect the quality and quantity of water resources for all uses, effective water-resources management requires that methods and procedures be devised to enable instream uses to be assessed quantitatively.

The only instream-use estimates compiled for this report are for hydroelectric power generation. Unlike other instream uses, the water used for hydroelectric power generation is a measurable quantity because the amount of water passed through the plant can be documented. Consumptive use in actual hydroelectric power generation (as opposed to evaporation from impoundments created by hydroelectric dams) generally is negligible.

In this report, wastewater release refers to water released from private and public wastewater-treatment facilities. Information is provided on the number of publicly- and privately-owned wastewater-treatment facilities and on releases from only the public wastewater-treatment facilities. The releases can be either returned to the natural environment or reclaimed for beneficial uses, such as irrigation of golf courses and parks.

OFFSTREAM USE

Total Water Use

Total fresh and saline withdrawals during 1990 were an estimated 408,000 million gallons per day (Mgal/d) for all offstream water-use categories (public supply, domestic, commercial, irrigation, livestock, industrial, mining, thermoelectric power), or 2 percent more than the withdrawals estimated for 1985. Average per-capita use was 1,620 gallons per day (gal/d) of freshwater and saline water and 1,340 gal/d of freshwater. Total surface-water withdrawals were an estimated 327,000 Mgal/d during 1990, or 1 percent more than during 1985. About 68,200 Mgal/d of surface water withdrawn (21 percent) was saline water. Total ground-water withdrawals were an estimated 80,600 Mgal/d, or 9 percent more than during 1985. About 99 percent of groundwater withdrawn was freshwater. The use of reclaimed wastewater averaged about 750 Mgal/d, or 30 percent more than during 1985.

A comparison by water-resources region (figure 1; table 1) indicates that the coastal regions (New England, Mid Atlantic, South Atlantic-Gulf, Pacific Northwest, California) accounted for nearly one-half of the total water withdrawn in the United States. About 54 percent of the Nation's total withdrawals were in the East (water-resources regions east of and including the Mississippi regions). These regions account for about one-third of the Nation's land area.

A similar comparison of total withdrawals by State (figure 2; table 2) indicates that California accounted for the largest withdrawals, 46,800 Mgal/d, more than the total withdrawn in Texas and Idaho, the next largest users. Some 20 States and the District of Columbia had less water withdrawn for offstream uses during 1990 than during 1985.

Irrigation is the largest category of freshwater use and thermoelectric power is the largest category of freshwater and saline water use. The California and Missouri Basin water-resources regions accounted for 21 percent of total freshwater withdrawals during 1990. In these water-resources regions, 73 percent of the withdrawals were for irrigation (table 3). The State of California accounted for the most freshwater withdrawn for public supply, domestic, and irrigation, and the most saline water withdrawn for thermoelectric power (table 4). Largest surface-water withdrawals occurred in the Mid Atlantic region which is fifteenth out of twenty-one regions in land area. Of the 45,000 Mgal/d withdrawn in the Mid Atlantic region, 56 percent was saline water used for thermoelectric power plants (table 5). The State of California led the Nation in both freshwater and saline surface-water withdrawals (table 6). Five water-resources regions, the Lower Mississippi, Missouri Basin, Arkansas-White-Red, Pacific Northwest, and California, accounted for 75 percent of the nation's irrigation ground-water withdrawals (table 7). The State of California accounted for 18 percent of total ground-water withdrawals. Irrigation was the predominant use of ground water in 22 states, most located in the West (table 8).

Freshwater consumptive use in the East was about 12 percent of the freshwater withdrawn in the East and accounted for 21 percent of Nation's freshwater consumptive use (figure 3). By comparison, freshwater consumptive use in the West was about 44 percent of freshwater withdrawals. The higher consumptive use in the West is attributed to the fact that 90 percent of the total water withdrawn for irrigation occurred in the West and irrigation accounts for the largest part of consumptive use. California accounted for the largest consumptive use (figure 4).

The distribution of per-capita freshwater withdrawals by State is shown in figure 5 and table 2. High per-capita values are characteristic of thinly populated states having large acreages of irrigated land such as Idaho, Montana, and Wyoming. In contrast, figure 6 shows the intensity of freshwater withdrawals by State in million gallons per day per square mile. The smaller states in the northeast show the most intense withdrawals by area.

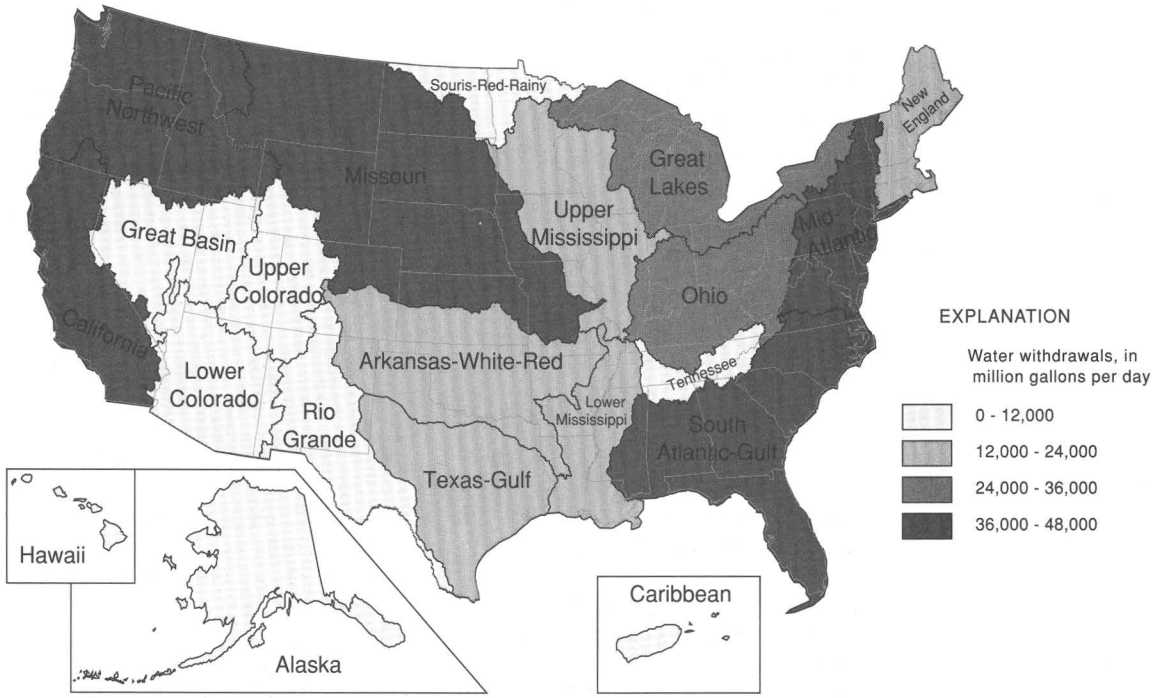


Figure 1. Total water withdrawals by water-resources region, 1990.

Table 1. Total offstream water use by water-resources region, 1990

[Figures may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day]

REGION	POPULATION, in thousands	PER CAPITA USE, freshwater, in gal/d	WITHDRAWALS, in Mgal/d (includes irrigation conveyance losses)									RECLAIMED WASTEWATER, in Mgal/d	CONVEYANCE LOSSES, in Mgal/d	CONSUMPTIVE USE, freshwater, in Mgal/d
			By source and type						Total					
			Ground water			Surface water								
			Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total			
New England	12,797	370	694	0.0	694	4,040	9,160	13,200	4,730	9,160	13,900	0.0	0.0	409
Mid Atlantic	41,541	508	2,640	1.2	2,640	18,500	26,500	45,000	21,100	26,500	47,600	63	2.5	1,260
South Atlantic-Gulf	34,732	962	7,110	9.1	7,120	26,300	10,800	37,100	33,400	10,800	44,200	236	68	5,140
Great Lakes	21,405	1,510	1,210	4.9	1,220	31,200	6.5	31,200	32,400	11	32,400	0	0	1,640
Ohio	21,882	1,390	2,650	22	2,670	27,800	.6	27,800	30,400	22	30,500	.3	.5	2,110
Tennessee	3,911	2,350	305	0	305	8,900	0	8,900	9,200	0	9,200	.4	0	321
Upper Mississippi	21,270	977	2,620	4.2	2,630	18,200	0	18,200	20,800	4.2	20,800	0	.1	1,960
Lower Mississippi	7,167	2,510	8,340	.6	8,340	9,630	1,120	10,800	18,000	1,120	19,100	.7	600	6,970
Souris-Red-Rainy	672	439	130	0	130	166	0	166	295	0	295	0	1.1	144
Missouri Basin	10,048	3,730	8,490	37	8,530	29,000	0	29,000	37,500	37	37,500	30	9,010	12,100
Arkansas-White-Red	8,250	1,870	7,420	291	7,710	7,990	0	7,990	15,400	291	15,700	11	794	7,870
Texas-Gulf	15,239	886	5,480	400	5,880	8,020	4,610	12,600	13,500	5,010	18,500	50	342	5,910
Rio Grande	2,229	2,690	2,140	39	2,180	3,850	0	3,850	6,000	39	6,030	1.1	1,070	3,460
Upper Colorado	625	11,300	127	28	155	6,950	0	6,950	7,080	28	7,110	.4	1,600	2,480
Lower Colorado	4,747	1,630	3,080	.6	3,080	4,670	.6	4,670	7,750	1.2	7,750	185	1,080	5,000
Great Basin	2,182	3,300	1,970	19	1,990	5,230	93	5,320	7,200	112	7,310	51	1,360	3,440
Pacific Northwest	8,912	4,070	9,780	0	9,780	26,500	36	26,500	36,300	36	36,300	12	9,670	12,100
California	29,442	1,200	14,400	310	14,700	21,000	11,400	32,400	35,400	11,700	47,200	128	1,750	20,800
Alaska	550	517	64	48	112	221	308	529	284	357	641	0	.1	26
Hawaii	1,108	1,070	589	.6	590	600	1,550	2,150	1,190	1,550	2,740	6.2	127	627
Caribbean	3,624	161	159	1.2	160	426	2,620	3,040	585	2,620	3,200	0	17	200
Total	252,336	1,340	79,400	1,220	80,600	259,000	68,200	327,000	339,000	69,400	408,000	750	27,500	94,000

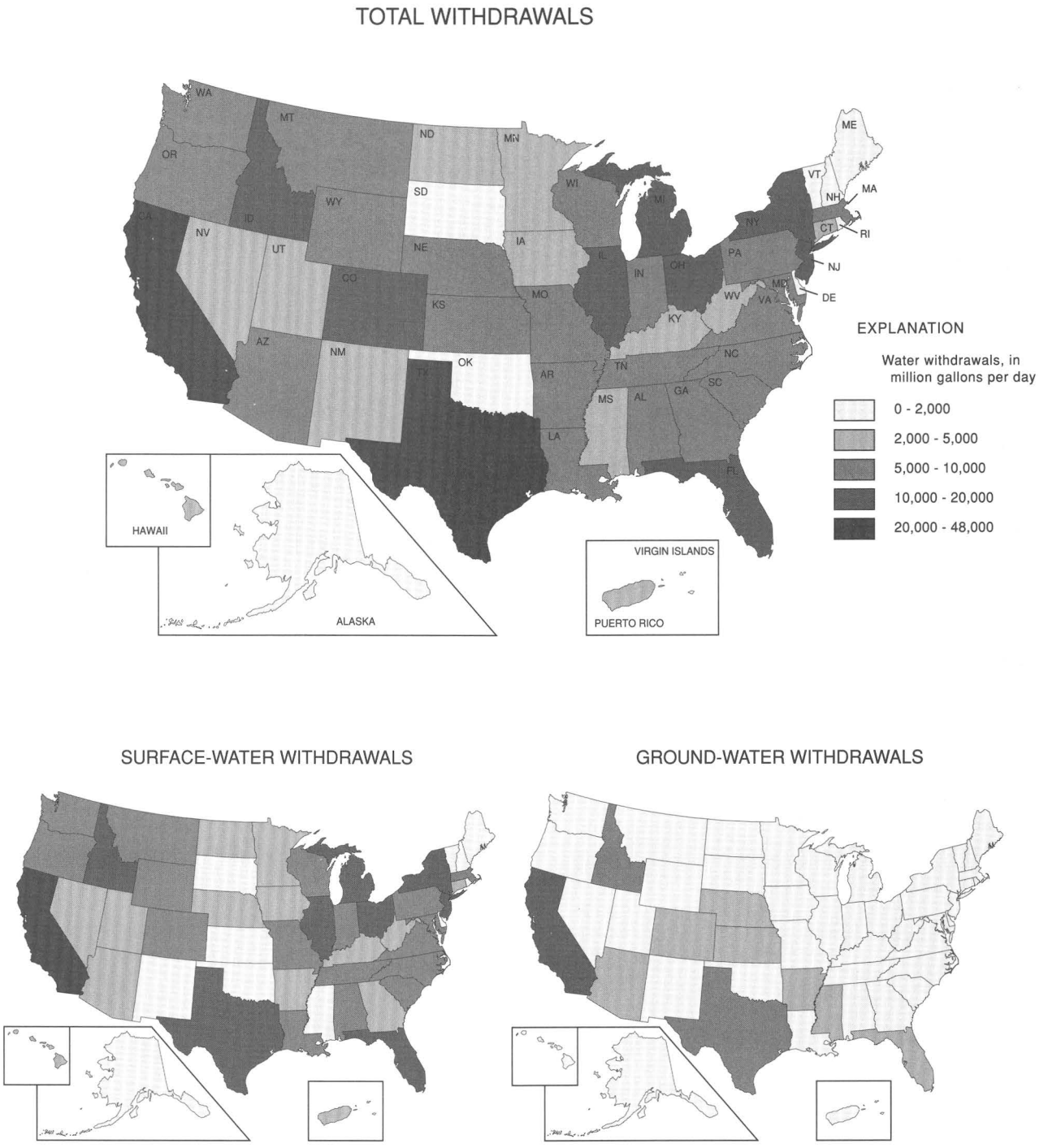


Figure 2. Total water withdrawals by source and State, 1990.

Table 2. Total offstream water use by State, 1990

[Figures may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day]

STATE	POPULATION, in thousands	PER CAPITA USE, freshwater, in gal/d	WITHDRAWALS, in Mgal/d (includes irrigation conveyance losses)									RECLAIMED WASTEWATER, in Mgal/d	CONVEYANCE LOSSES, in Mgal/d	CONSUMPTIVE USE, freshwater, in Mgal/d
			By source and type						Total					
			Ground water			Surface water								
			Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total			
Alabama	4,041	2,000	394	9.1	403	7,680	0.0	7,680	8,080	9.1	8,090	0.0	0.0	454
Alaska	550	517	64	48	112	221	308	529	284	357	641	0	.1	26
Arizona	3,665	1,790	2,740	.5	2,740	3,830	.6	3,830	6,570	1.2	6,570	183	1,010	4,350
Arkansas	2,353	3,330	4,710	0	4,710	3,130	0	3,130	7,840	0	7,840	0	368	4,140
California	29,760	1,180	14,600	310	14,900	20,500	11,400	31,900	35,100	11,700	46,800	133	1,560	20,900
Colorado	3,294	3,850	2,770	30	2,800	9,910	0	9,910	12,700	30	12,700	3.7	2,990	5,250
Connecticut	3,287	325	165	0	165	902	3,780	4,680	1,070	3,780	4,840	0	0	103
Delaware	666	1,540	89	0	89	939	339	1,280	1,030	339	1,370	0	0	59
D.C.	607	256	10	0	10	80	0	80	90	0	90	0	0	16
Florida	12,938	582	4,660	0	4,660	2,870	10,400	13,200	7,530	10,400	17,900	170	64	3,130
Georgia	6,478	816	996	0	996	4,290	65	4,360	5,290	65	5,350	36	0	822
Hawaii	1,108	1,070	589	.6	590	600	1,550	2,150	1,190	1,550	2,740	6.2	127	627
Idaho	1,007	19,600	7,590	0	7,590	12,100	0	12,100	19,700	0	19,700	0	7,160	6,090
Illinois	11,431	1,570	920	25	945	17,100	0	17,100	18,000	25	18,000	0	0	750
Indiana	5,544	1,700	621	0	621	8,810	0	8,810	9,430	0	9,430	0	0	451
Iowa	2,777	1,030	495	0	495	2,370	0	2,370	2,860	0	2,860	0	0	271
Kansas	2,478	2,460	4,360	0	4,360	1,720	0	1,720	6,080	0	6,080	60	146	4,410
Kentucky	3,685	1,170	247	0	247	4,070	0	4,070	4,320	0	4,320	0	.5	309
Louisiana	4,220	2,200	1,340	.6	1,340	7,950	67	8,010	9,290	67	9,350	0	90	1,590
Maine	1,228	433	85	0	85	446	609	1,060	532	609	1,140	0	0	51
Maryland	4,781	307	239	0	239	1,230	4,950	6,180	1,470	4,950	6,420	63	0	126
Massachusetts	6,016	338	338	0	338	1,690	3,490	5,180	2,030	3,490	5,520	0	0	195
Michigan	9,295	1,250	703	4.6	707	10,900	0	10,900	11,600	4.6	11,600	0	0	738
Minnesota	4,375	748	797	0	797	2,480	0	2,480	3,270	0	3,270	0	0	872
Mississippi	2,573	1,290	2,670	0	2,670	648	316	963	3,320	316	3,640	10	188	1,800
Missouri	5,117	1,150	727	.1	728	5,150	1,060	6,200	5,870	1,060	6,930	0	0	529
Montana	799	11,600	205	13	218	9,100	0	9,100	9,300	13	9,320	0	4,620	2,090
Nebraska	1,578	5,660	4,790	4.7	4,800	4,150	0	4,150	8,940	4.7	8,940	0	2,160	4,230
Nevada	1,202	2,780	1,060	12	1,070	2,280	0	2,280	3,340	12	3,350	11	615	1,690
New Hampshire	1,109	378	64	0	64	356	894	1,250	420	894	1,310	0	0	26
New Jersey	7,730	287	566	.2	566	1,650	10,600	12,200	2,220	10,600	12,800	0	0	211
New Mexico	1,515	2,300	1,760	0	1,760	1,720	0	1,720	3,480	0	3,480	0	590	2,060
New York	17,990	583	839	1.5	840	9,650	8,490	18,100	10,500	8,490	19,000	0	0	562
North Carolina	6,629	1,350	435	0	435	8,500	5.5	8,510	8,940	5.5	8,940	17	0	390
North Dakota	639	4,190	141	0	141	2,540	0	2,540	2,680	0	2,680	0	5.9	228
Ohio	10,847	1,080	904	0	904	10,800	0	10,800	11,700	0	11,700	0	.1	901
Oklahoma	3,146	452	662	243	905	760	0	760	1,420	243	1,670	0	5.4	659
Oregon	2,842	2,970	767	0	767	7,660	0	7,660	8,430	0	8,430	12	1,270	3,160
Pennsylvania	11,882	827	1,020	0	1,020	8,810	0	8,810	9,830	0	9,830	0	0	581
Rhode Island	1,003	132	25	0	25	108	393	501	133	393	526	0	0	18
South Carolina	3,487	1,720	282	0	282	5,720	0	5,720	6,000	0	6,000	14	0	293
South Dakota	696	851	251	0	251	341	0	341	592	0	592	0	62	345
Tennessee	4,877	1,880	503	0	503	8,690	0	8,690	9,190	0	9,190	.7	0	252
Texas	16,986	1,180	7,380	492	7,880	12,700	4,610	17,300	20,100	5,100	25,200	56	660	9,020
Utah	1,723	2,540	964	7.2	971	3,410	93	3,510	4,380	100	4,480	39	624	2,230
Vermont	563	1,120	45	0	45	587	0	587	632	0	632	0	0	29
Virginia	6,187	762	443	0	443	4,270	2,150	6,420	4,710	2,150	6,860	0	3.6	224
Washington	4,867	1,630	1,450	0	1,450	6,460	36	6,490	7,910	36	7,940	0	997	2,830
West Virginia	1,793	2,560	728	0	728	3,860	0	3,860	4,580	0	4,580	0	0	509
Wisconsin	4,892	1,330	681	0	681	5,830	0	5,830	6,510	0	6,510	0	0	461
Wyoming	454	16,700	384	19	403	7,200	0	7,200	7,580	19	7,600	0	2,150	2,730
Puerto Rico	3,522	163	157	0	157	419	2,470	2,880	576	2,470	3,040	0	17	199
Virgin Islands	102	91	1.9	1.2	3.1	7.4	153	160	9.3	154	164	0	0	1.5
Total	252,336	1,340	79,400	1,220	80,600	259,000	68,200	327,000	339,000	69,400	408,000	750	27,500	94,000

Table 3. Total water withdrawals by water-use category and water-resources region, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

REGION	PUBLIC SUPPLY	DOMESTIC	COMMER-CIAL	IRRIGATION	LIVESTOCK	INDUSTRIAL		MINING		THERMOELECTRIC		TOTAL	
	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Saline	Fresh	Saline	Fresh	Saline	Fresh	Saline
New England	1,400	169	133	120	8.1	479	68	20	0.0	2,400	9,090	4,730	9,160
Mid Atlantic	5,980	396	133	197	107	1,730	1,470	387	30	12,200	25,000	21,100	26,500
South Atlantic-Gulf	4,850	659	134	4,450	350	2,810	94	437	9.1	19,700	10,700	33,400	10,800
Great Lakes	4,340	283	108	290	92	4,190	3.7	249	7.7	22,800	0	32,400	11
Ohio	2,530	360	89	68	132	2,370	0	1,000	22	23,900	0	30,400	22
Tennessee	511	56	56	27	201	1,190	0	92	0	7,070	0	9,200	0
Upper Mississippi	1,890	371	260	392	269	967	0	154	4.2	16,500	0	20,800	4.2
Lower Mississippi	1,040	90	92	7,380	1,070	2,620	67	40	0	5,640	1,060	18,000	1,120
Souris-Red-Rainy	72	22	.3	98	21	49	0	8.2	0	26	0	295	0
Missouri Basin	1,620	139	40	24,800	415	171	0	279	37	10,000	0	37,500	37
Arkansas-White-Red	1,400	118	165	8,390	359	368	0	74	291	4,530	0	15,400	291
Texas-Gulf	2,520	79	57	5,100	156	741	1,460	130	399	4,710	3,150	13,500	5,010
Rio Grande	533	23	20	5,290	33	12	0	66	39	18	0	6,000	39
Upper Colorado	118	10	6.3	6,590	117	5.4	0	51	28	177	0	7,080	28
Lower Colorado	1,070	39	29	6,060	98	174	0	170	.7	109	.4	7,750	1.2
Great Basin	610	15	16	6,300	37	106	2.3	83	110	31	0	7,200	112
Pacific Northwest	1,580	220	718	31,800	620	1,030	36	15	0	355	0	36,300	36
California	5,750	313	271	28,300	405	130	25	22	310	246	11,400	35,400	11,700
Alaska	92	6.9	18	.6	.6	111	0	25	357	31	0	284	357
Hawaii	238	9.9	40	755	7.2	43	.6	1.4	0	95	1,550	1,190	1,550
Caribbean	411	8.2	.8	140	8.9	11	51	2.6	0	2.6	2,570	585	2,620
Total	38,500	3,390	2,390	137,000	4,500	19,300	3,270	3,310	1,650	131,000	64,500	339,000	69,400

Table 4. Total water withdrawals by water-use category and State, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	PUBLIC SUPPLY	DOMESTIC	COMMER-CIAL	IRRIGATION	LIVESTOCK	INDUSTRIAL		MINING		THERMOELECTRIC		TOTAL	
	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Saline	Fresh	Saline	Fresh	Saline	Fresh	Saline
Alabama	707	28	3.5	94	141	784	0.0	11	9.1	6,310	0.0	8,080	9.1
Alaska	92	6.9	18	.6	.6	111	0	25	357	31	0	284	357
Arizona	707	32	18	5,300	89	163	0	156	.7	103	.4	6,570	1.2
Arkansas	309	51	222	5,250	189	177	0	2.5	0	1,640	0	7,840	0
California	5,830	318	234	27,900	411	129	25	20	310	246	11,400	35,100	11,700
Colorado	650	19	8.6	11,600	162	118	0	54	30	114	0	12,700	30
Connecticut	374	46	18	15	1.5	80	68	2.2	0	530	3,710	1,070	3,780
Delaware	85	11	1.8	32	2.4	65	60	0	0	831	333	1,030	339
D.C.	0	0	0	0	0	.5	0	.5	0	80	0	90	0
Florida	1,930	299	52	3,730	78	403	56	315	0	732	10,300	7,530	10,400
Georgia	963	100	42	441	46	657	33	12	0	3,030	33	5,290	65
Hawaii	238	9.9	40	755	7.2	43	.6	1.4	0	95	1,550	1,190	1,550
Idaho	201	48	16	18,700	560	196	0	8.4	0	6.1	0	19,700	0
Illinois	1,860	115	173	78	63	464	0	69	25	15,200	0	18,000	25
Indiana	604	118	63	51	46	2,480	0	97	0	5,960	0	9,430	0
Iowa	322	45	27	23	121	219	0	34	0	2,070	0	2,860	0
Kansas	373	25	6.2	4,190	114	53	0	26	0	1,300	0	6,080	0
Kentucky	427	56	13	12	33	313	0	18	0	3,440	0	4,320	0
Louisiana	619	50	13	708	551	2,360	67	37	0	4,950	0	9,290	67
Maine	106	49	34	1.8	1.7	254	0	3.7	0	82	609	532	609
Maryland	798	70	26	29	27	70	379	28	21	421	4,550	1,470	4,950
Massachusetts	714	37	74	100	1.7	87	0	50	0	1,010	3,490	2,030	3,490
Michigan	1,400	123	35	240	29	1,680	3.7	55	.9	8,060	0	11,600	4.6
Minnesota	515	168	71	195	67	154	0	220	0	1,880	0	3,270	0
Mississippi	320	33	16	1,880	411	269	0	3.4	0	386	316	3,320	316
Missouri	677	62	22	371	55	85	0	25	.1	4,580	1,060	5,870	1,060
Montana	135	16	0	9,000	52	57	0	6.2	13	33	0	9,300	13
Nebraska	301	47	.2	6,100	139	41	0	131	4.7	2,180	0	8,940	4.7
Nevada	385	9.8	23	2,820	5.6	10	0	49	12	34	0	3,340	12
New Hampshire	95	27	.6	.9	10	37	0	2.8	0	255	894	420	894
New Jersey	1,040	68	17	58	2.1	326	1,020	110	0	599	9,550	2,220	10,600
New Mexico	273	24	17	3,010	22	6.3	0	80	0	50	0	3,480	0
New York	2,910	120	61	54	26	274	0	45	16	6,990	8,470	10,500	8,490
North Carolina	805	103	17	114	201	390	5.5	96	0	7,210	0	8,940	5.5
North Dakota	76	12	.1	164	24	8.8	0	3.7	0	2,390	0	2,680	0
Ohio	1,300	134	36	15	34	354	0	243	0	9,550	0	11,700	0
Oklahoma	515	41	6.3	601	131	35	0	2.8	243	89	0	1,420	243
Oregon	470	64	711	6,860	21	284	0	1.5	0	15	0	8,430	0
Pennsylvania	1,730	141	24	14	53	1,870	0	252	0	5,750	0	9,830	0
Rhode Island	102	4.9	5.6	2.1	.3	12	0	6.8	0	0	393	133	393
South Carolina	352	103	2.1	55	25	632	0	12	0	4,820	0	6,000	0
South Dakota	76	8.8	17	392	43	15	0	38	0	3.2	0	592	0
Tennessee	695	59	55	38	49	882	0	90	0	7,320	0	9,190	0
Texas	3,090	93	62	8,490	228	884	1,460	139	491	7,130	3,150	20,100	5,100
Utah	508	6.1	4.2	3,590	34	106	2.3	41	98	87	0	4,380	100
Vermont	39	17	3.8	.5	6.1	44	0	3.7	0	519	0	632	0
Virginia	709	113	35	36	29	495	66	91	0	3,210	2,080	4,710	2,150
Washington	875	104	27	6,030	30	501	36	30	0	334	0	7,910	36
West Virginia	160	49	3.1	0	4.8	132	0	527	0	3,710	0	4,580	0
Wisconsin	595	90	11	151	99	468	0	.2	0	5,100	0	6,510	0
Wyoming	88	8.5	1.6	7,160	27	16	0	101	19	184	0	7,580	19
Puerto Rico	404	6.7	.1	140	8.3	11	0	2.6	0	2.6	2,470	576	2,470
Virgin Islands	6.4	1.6	.7	0	.5	.1	51	0	0	0	103	9.3	154
Total	38,500	3,390	2,390	137,000	4,500	19,300	3,270	3,310	1,650	131,000	64,500	339,000	69,400

Table 5. Surface-water withdrawals by water-use category and water-resources region, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	PUBLIC SUPPLY	DOMESTIC	COMMERCIAL	IRRIGATION	LIVESTOCK	INDUSTRIAL		MINING		THERMOELECTRIC		TOTAL	
	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Saline	Fresh	Saline	Fresh	Saline	Fresh	Saline
New England	1,070	0.0	51	111	2.8	382	68	19	0.0	2,400	9,090	4,040	9,160
Mid Atlantic	4,580	.1	39	95	36	1,370	1,470	176	29	12,200	25,000	18,500	26,500
South Atlantic-Gulf	2,340	0	14	2,160	152	1,920	94	53	0	19,700	10,700	26,300	10,800
Great Lakes	3,880	10	81	158	41	3,950	0	227	6.5	22,800	0	31,200	6.5
Ohio	1,750	8.1	31	40	79	1,840	0	218	.6	23,800	0	27,800	.6
Tennessee	402	0	.2	23	169	1,170	0	67	0	7,070	0	8,900	0
Upper Mississippi	724	0	126	38	52	618	0	143	0	16,500	0	18,200	0
Lower Mississippi	334	0	72	1,150	358	2,120	67	32	0	5,570	1,060	9,630	1,120
Souris-Red-Rainy	37	0	.2	42	4.9	47	0	80	0	26	0	166	0
Missouri Basin	1,010	10	6.4	17,600	172	57	0	182	0	9,980	0	29,000	0
Arkansas-White-Red	1,040	0	138	1,790	200	301	0	25	0	4,500	0	7,990	0
Texas-Gulf	1,470	0	11	1,130	102	600	1,460	47	0	4,660	3,150	8,020	4,610
Rio Grande	163	0	1.2	3,670	13	10	0	1.5	0	1.8	0	3,850	0
Upper Colorado	86	.3	.7	6,560	112	2.5	0	12	0	177	0	6,950	0
Lower Colorado	552	2.1	6.3	3,820	68	124	0	30	.2	62	.4	4,670	.6
Great Basin	256	2.6	9.3	4,890	9.9	29	0	5.7	93	24	0	5,230	93
Pacific Northwest	850	7.7	669	23,900	29	691	36	10	0	345	0	26,500	36
California	2,530	103	213	17,700	204	4.8	25	70	.4	241	11,400	21,000	11,400
Alaska	58	.7	90	.5	.5	106	0	20	308	26	0	221	308
Hawaii	17	1.4	.6	555	3.8	23	0	0	0	0	1,550	600	1,550
Caribbean	330	4.6	.3	87	3.7	0	50	.7	0	0	2,570	426	2,620
Total	23,500	132	1,480	85,500	1,810	15,400	3,260	1,280	438	130,000	64,500	259,000	68,200

Table 6. Surface-water withdrawals by water-use category and State, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	PUBLIC SUPPLY	DOMESTIC	COMMERCIAL	IRRIGATION	LIVESTOCK	INDUSTRIAL		MINING		THERMOELECTRIC		TOTAL	
	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Saline	Fresh	Saline	Fresh	Saline	Fresh	Saline
Alabama	483	0.0	0.3	62	69	753	0.0	70	0.0	6,310	0.0	7,680	0.0
Alaska	58	.7	90	.5	.5	106	0	20	308	26	0	221	308
Arizona	305	.3	0	3,250	64	124	0	29	.2	61	.4	3,830	.6
Arkansas	190	0	207	949	64	78	0	.7	0	1,640	0	3,130	0
California	2,560	106	177	17,200	206	3.4	25	70	.4	241	11,400	20,500	11,400
Colorado	567	0	.9	9,000	140	85	0	26	0	94	0	9,910	0
Connecticut	301	0	.6	6.5	.4	61	68	1.8	0	530	3,710	902	3,780
Delaware	52	0	0	9.5	.3	47	60	0	0	830	333	939	339
D.C.	0	0	0	0	0	0	0	0	0	80	0	80	0
Florida	226	0	1.5	1,780	9.6	121	56	17	0	709	10,300	2,870	10,400
Georgia	730	0	12	178	36	311	33	2.9	0	3,020	33	4,290	65
Hawaii	17	1.4	.6	555	3.8	23	0	0	0	0	1,550	600	1,550
Idaho	28	0	0	12,100	0	26	0	7.8	0	0	0	12,100	0
Illinois	1,420	0	119	3.7	2.2	309	0	61	0	15,200	0	17,100	0
Indiana	330	0	31	31	20	2,350	0	88	0	5,950	0	8,810	0
Iowa	88	0	80	1.4	30	148	0	33	0	2,060	0	2,370	0
Kansas	197	0	0	199	31	3.8	0	.9	0	1,290	0	1,720	0
Kentucky	372	5.5	9.2	11	31	220	0	13	0	3,410	0	4,070	0
Louisiana	344	0	.9	256	329	2,070	67	36	0	4,910	0	7,950	67
Maine	86	0	30	1.6	1.1	244	0	2.9	0	81	609	446	609
Maryland	722	0	6.4	10	14	50	379	7.5	21	419	4,550	1,230	4,950
Massachusetts	535	0	18	100	.4	22	0	50	0	1,010	3,490	1,690	3,490
Michigan	1,140	.1	27	135	10	1,510	0	46	0	8,050	0	10,900	0
Minnesota	225	0	16	38	10	89	0	217	0	1,880	0	2,480	0
Mississippi	38	0	0	130	12	126	0	.5	0	342	316	648	316
Missouri	493	0	0	36	41	32	0	.1	0	4,540	1,060	5,150	1,060
Montana	83	.8	0	8,910	36	27	0	3.6	0	33	0	9,100	0
Nebraska	66	0	0	1,740	31	2.4	0	130	0	2,180	0	4,150	0
Nevada	281	.2	16	1,950	4.6	.8	0	3.5	0	22	0	2,280	0
New Hampshire	61	0	.2	.8	.3	37	0	2.7	0	254	894	356	894
New Jersey	643	0	1.4	36	0	273	1,020	103	0	597	9,550	1,650	10,600
New Mexico	32	0	1.2	1,640	3.6	1.7	0	2.4	0	40	0	1,720	0
New York	2,360	0	32	26	10	189	0	34	15	6,990	8,470	9,650	8,490
North Carolina	668	0	0	102	165	328	5.5	28	0	7,210	0	8,500	5.5
North Dakota	45	0	0	86	11	6.6	0	.7	0	2,390	0	2,540	0
Ohio	904	2.7	11	11	26	230	0	40	0	9,540	0	10,800	0
Oklahoma	435	0	1.5	108	96	32	0	.5	0	88	0	760	0
Oregon	365	7.6	704	6,300	18	254	0	.6	0	15	0	7,660	0
Pennsylvania	1,300	0	10	11	6.9	1,690	0	41	0	5,750	0	8,810	0
Rhode Island	88	0	1.3	1.8	.2	9.1	0	6.8	0	0	393	108	393
South Carolina	273	0	0	25	12	585	0	3.6	0	4,820	0	5,720	0
South Dakota	24	0	4.6	251	26	10	0	23	0	2.8	0	341	0
Tennessee	426	0	0	23	21	813	0	82	0	7,320	0	8,690	0
Texas	1,830	0	11	2,900	135	741	1,460	46	0	7,070	3,150	12,700	4,610
Utah	203	1.4	0	3,080	70	29	0	3.6	93	87	0	3,410	93
Vermont	19	0	10	.5	1.5	43	0	3.4	0	518	0	587	0
Virginia	640	0	8.3	28	21	300	66	68	0	3,210	2,080	4,270	2,150
Washington	441	0	.4	5,280	8.4	397	36	.6	0	330	0	6,460	36
West Virginia	118	10	.6	0	3.6	26	0	0	0	3,710	0	3,860	0
Wisconsin	301	0	0	1.8	25	409	0	0	0	5,090	0	5,830	0
Wyoming	47	.4	.7	6,920	13	9.9	0	26	0	183	0	7,200	0
Puerto Rico	325	3.2	0	87	3.5	0	0	.7	0	0	2,470	419	2,470
Virgin Islands	5.4	1.4	.3	0	.2	0	50	0	0	0	103	7.4	153
Total	23,500	132	1,480	85,500	1,810	15,400	3,260	1,280	438	130,000	64,500	259,000	68,200

Table 7. Ground-water withdrawals by water-use category and water-resources region, 1990
[Figures may not add to totals because of independent rounding. All values in million gallons per day]

REGION	PUBLIC SUPPLY	DOMESTIC	COMMER-CIAL	IRRIGATION	LIVESTOCK	INDUSTRIAL		MINING		THERMOELECTRIC	TOTAL	
	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Saline	Fresh	Saline	Fresh	Fresh	Saline
New England	328	169	82	8.8	5.4	96	0.0	1.3	0.0	2.9	694	0.0
Mid Atlantic	1,400	396	94	102	71	360	.2	210	10	4.6	2,640	1.2
South Atlantic-Gulf	2,510	659	120	2,300	198	896	0	384	9.1	41	7,110	9.1
Great Lakes	460	282	27	132	51	235	3.7	22	1.2	3.2	1,210	4.9
Ohio	774	352	58	28	54	532	0	784	22	65	2,650	22
Tennessee	109	56	56	3.8	32	23	0	25	0	0	305	0
Upper Mississippi	1,160	371	134	354	217	349	0	11	4.2	21	2,620	4.2
Lower Mississippi	701	90	20	6,230	710	501	.6	7.9	0	75	8,340	.6
Souris-Red-Rainy	34	22	.1	56	16	1.3	0	.2	0	0	130	0
Missouri Basin	612	138	33	7,200	242	114	0	96	37	50	8,490	37
Arkansas-White-Red.	364	118	27	6,600	158	67	0	49	291	31	7,420	291
Texas-Gulf	1,050	79	47	3,970	54	141	1.1	84	399	46	5,480	400
Rio Grande	370	23	19	1,620	20	11	0	65	39	16	2,140	39
Upper Colorado	32	9.9	5.6	32	5.3	2.9	0	39	28	0	127	28
Lower Colorado	513	37	23	2,240	30	49	0	139	.6	47	3,080	.6
Great Basin	354	13	70	1,410	27	77	2.3	77	17	7.2	1,970	19
Pacific Northwest	727	212	49	7,850	591	336	0	50	0	10	9,780	0
California	3,210	210	58	10,600	201	126	0	15	310	4.6	14,400	310
Alaska	34	6.2	8.7	.1	.1	5.2	0	4.3	48	4.7	64	48
Hawaii	221	8.5	39	200	3.4	20	.6	1.4	0	95	589	.6
Caribbean	81	3.7	.4	54	5.2	11	1.2	1.9	0	2.6	159	1.2
Total	15,100	3,260	908	51,000	2,690	3,950	9.7	2,020	1,210	525	79,400	1,220

Table 8. Ground-water withdrawals by water-use category and State, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	PUBLIC SUPPLY	DOMESTIC	COMMER-CIAL	IRRIGATION	LIVESTOCK	INDUSTRIAL		MINING		THERMO-ELECTRIC	TOTAL	
	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Saline	Fresh	Saline	Fresh	Fresh	Saline
Alabama	224	28	3.1	33	72	31	0.0	40	9.1	0.0	394	9.1
Alaska	34	6.2	8.7	.1	.1	5.2	0	4.3	48	4.7	64	48
Arizona	401	32	18	2,060	26	39	0	127	.5	42	2,740	.5
Arkansas	119	51	14	4,300	125	99	0	1.8	0	2.4	4,710	0
California	3,260	212	57	10,700	205	125	0	13	310	4.6	14,600	310
Colorado	83	19	7.7	2,560	22	33	0	28	30	21	2,770	30
Connecticut	73	46	18	8.2	1.1	19	0	.4	0	.2	165	0
Delaware	33	11	1.8	23	2.1	18	0	0	0	.5	89	0
D.C.	0	0	0	0	0	.5	0	.5	0	0	10	0
Florida	1,700	299	50	1,940	69	282	0	299	0	23	4,660	0
Georgia	234	100	30	263	9.9	346	0	8.7	0	5.2	996	0
Hawaii	221	8.5	39	200	3.4	20	.6	1.4	0	95	589	.6
Idaho	173	48	16	6,620	560	170	0	.6	0	6.1	7,590	0
Illinois	444	115	54	75	61	155	0	7.6	25	90	920	25
Indiana	274	118	33	20	26	129	0	9.5	0	12	621	0
Iowa	234	45	19	21	91	71	0	.7	0	12	495	0
Kansas	176	25	6.2	3,990	83	50	0	25	0	13	4,360	0
Kentucky	55	50	4.2	.5	1.6	93	0	5.2	0	38	247	0
Louisiana	275	50	12	451	222	289	.6	.4	0	40	1,340	.6
Maine	21	49	3.6	.2	.6	9.8	0	.7	0	1.4	85	0
Maryland	76	70	19	19	12	20	0	21	0	1.8	239	0
Massachusetts	179	37	55	0	1.4	65	0	0	0	.5	338	0
Michigan	261	123	8.1	105	19	175	3.7	8.8	.9	2.8	703	4.6
Minnesota	290	168	56	157	57	65	0	2.4	0	2.4	797	0
Mississippi	282	33	16	1,750	399	144	0	2.9	0	43	2,670	0
Missouri	185	62	22	335	14	53	0	25	.1	32	727	.1
Montana	51	15	0	90	16	30	0	2.6	13	0	205	13
Nebraska	235	47	.2	4,360	108	39	0	1.2	4.7	60	4,790	4.7
Nevada	104	9.6	7.1	871	10	9.4	0	45	12	12	1,060	12
New Hampshire	34	27	.4	.1	.8	.3	0	.1	0	.8	64	0
New Jersey	396	68	15	22	2.1	53	.2	7.8	0	1.6	566	.2
New Mexico	241	24	16	1,370	18	4.6	0	77	0	9.9	1,760	0
New York	550	120	29	28	15	85	0	11	1.5	0	839	1.5
North Carolina	137	103	17	12	36	63	0	68	0	0	435	0
North Dakota	32	12	.1	78	13	2.1	0	30	0	.1	141	0
Ohio	396	131	25	4.7	7.8	123	0	203	0	13	904	0
Oklahoma	80	41	4.8	493	35	3.3	0	2.2	243	1.8	662	243
Oregon	105	57	7.3	563	3.2	31	0	10	0	0	767	0
Pennsylvania	427	141	14	3.5	46	180	0	211	0	0	1,020	0
Rhode Island	13	4.9	4.2	.3	.1	2.5	0	0	0	0	25	0
South Carolina	79	103	2.1	30	12	47	0	80	0	1.4	282	0
South Dakota	52	8.8	12	141	17	50	0	15	0	.4	251	0
Tennessee	269	59	55	15	29	69	0	8.2	0	0	503	0
Texas	1,270	93	51	5,590	93	143	1.1	93	491	54	7,380	492
Utah	305	4.6	4.2	508	27	77	2.3	37	50	0	964	7.2
Vermont	19	17	2.8	0	4.6	10	0	.3	0	.4	45	0
Virginia	69	113	27	7.9	8.5	195	0	23	0	.4	443	0
Washington	434	104	27	754	22	104	0	2.4	0	40	1,450	0
West Virginia	43	48	2.5	0	1.3	106	0	527	0	.4	728	0
Wisconsin	294	90	11	150	74	58	0	.2	0	2.4	681	0
Wyoming	41	8.1	.9	237	14	60	0	75	19	10	384	19
Puerto Rico	80	3.5	.1	54	4.8	11	0	1.9	0	2.6	157	0
Virgin Islands	10	.2	.4	0	.3	.1	1.2	0	0	0	1.9	1.2
Total	15,100	3,260	908	51,000	2,690	3,950	9.7	2,020	1,210	525	79,400	1,220

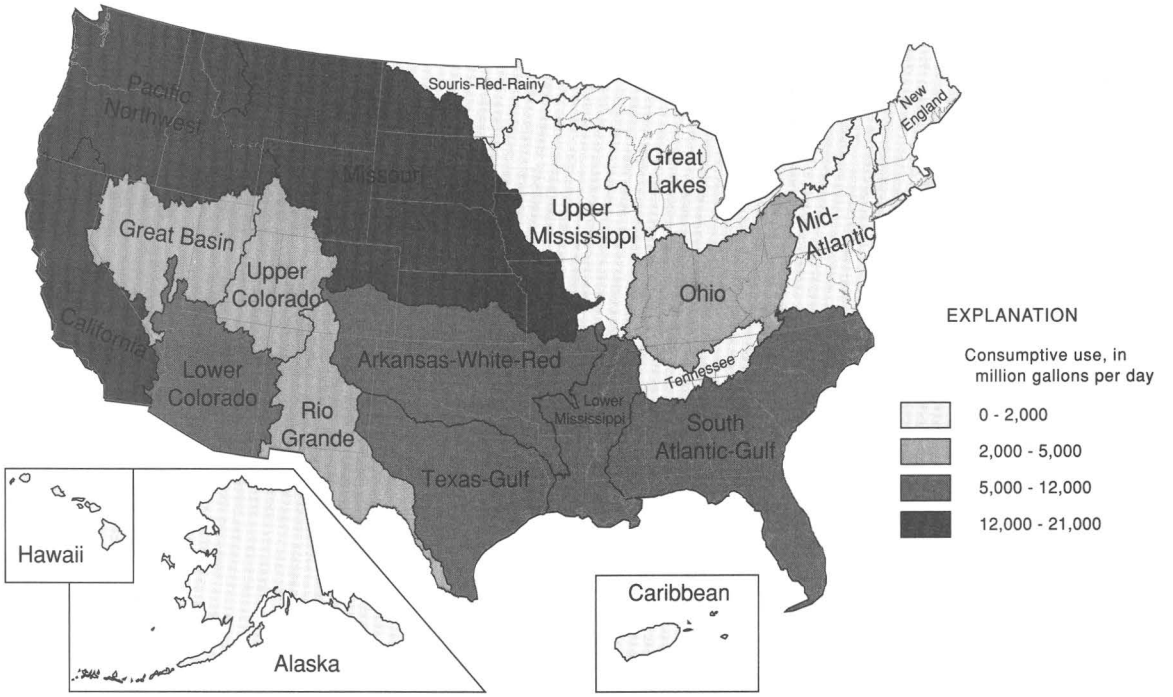


Figure 3. Freshwater consumptive use by water-resources region, 1990.

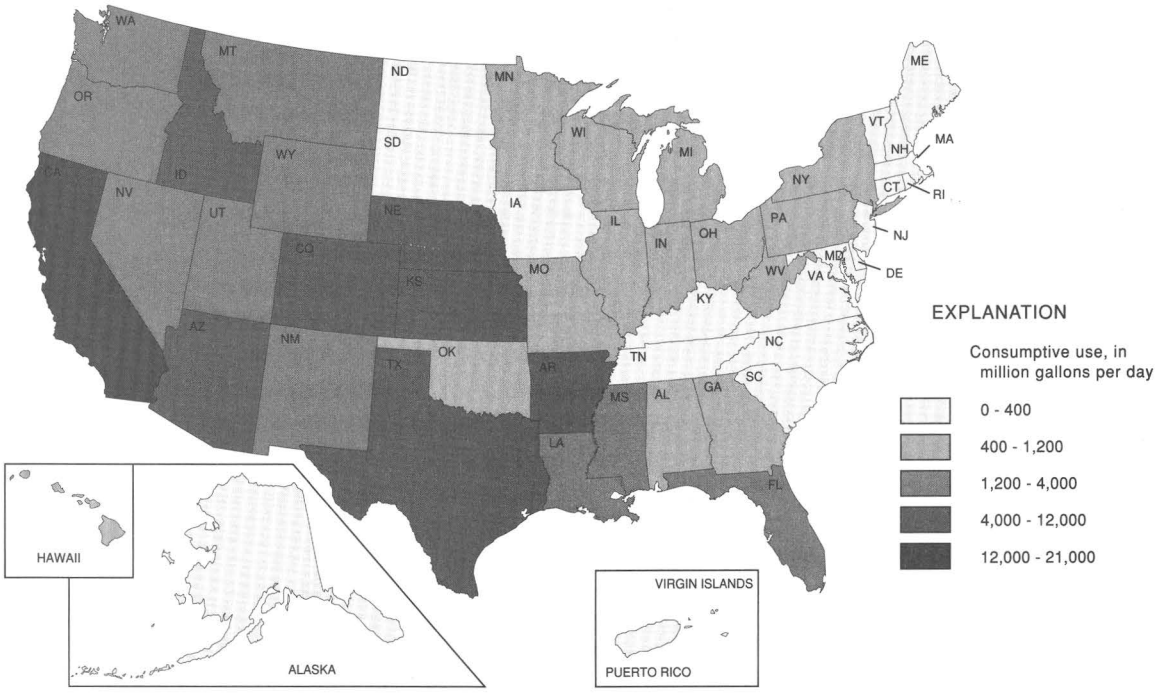


Figure 4. Freshwater consumptive use by State, 1990.

Figure 5. Intensity of freshwater withdrawals per capita by State, 1990.

Figure 6. Intensity of freshwater withdrawals per area by State, 1990.

For an overview of how the 339,000 Mgal/d of freshwater withdrawn during 1990 was used, the eight offstream categories mentioned above have been combined into five major categories: public supply, domestic and commercial, irrigation and livestock, industrial and mining, and thermoelectric power. The source (withdrawals), use (withdrawals, deliveries), and disposition of freshwater for each category of use are summarized in figure 7. The source column shows the proportion of withdrawals by source and the distribution of withdrawals by water-use category. Source data indicate, for example, that surface water was the source of 259,000 Mgal/d of freshwater, or 76.5 percent of total freshwater withdrawals in the United States. Of the 259,000 Mgal/d of surface water, 50.2 percent was withdrawn directly for thermoelectric power. Public supply is considered a source of water and figure 7 shows the total quantity of water withdrawn by public supply, the percentage of surface and ground water withdrawn, and the percentage of water delivered to the other water-use categories. The use column shows total freshwater use for each category and the percentage each category represents of total offstream water use. In addition, the use column shows the proportion of the source (surface water, ground water, public supply) and disposition (consumptive use, return flow) for each category. The use data indicate, for example, that domestic and commercial use totaled 39,100 Mgal/d, (including losses in the public-supply distribution system), or 11.5 percent of the Nation's total freshwater withdrawals. Of this 39,100 Mgal/d, 85.2 percent was supplied by public-supply systems, and 82.7 percent was returned to a surface- or ground-water source after use. The disposition column shows the quantity of consumptive use and return flow after use. The disposition data indicate that of the total freshwater withdrawn, consumptive use was 94,000 Mgal/d, or 27.8 percent, and return flow was 245,000 Mgal/d, or 72.2 percent (including 27,500 Mgal/d of irrigation conveyance losses). Irrigation accounted for 84.3 percent of consumptive use and thermoelectric power accounted for 52.0 percent of return flow.

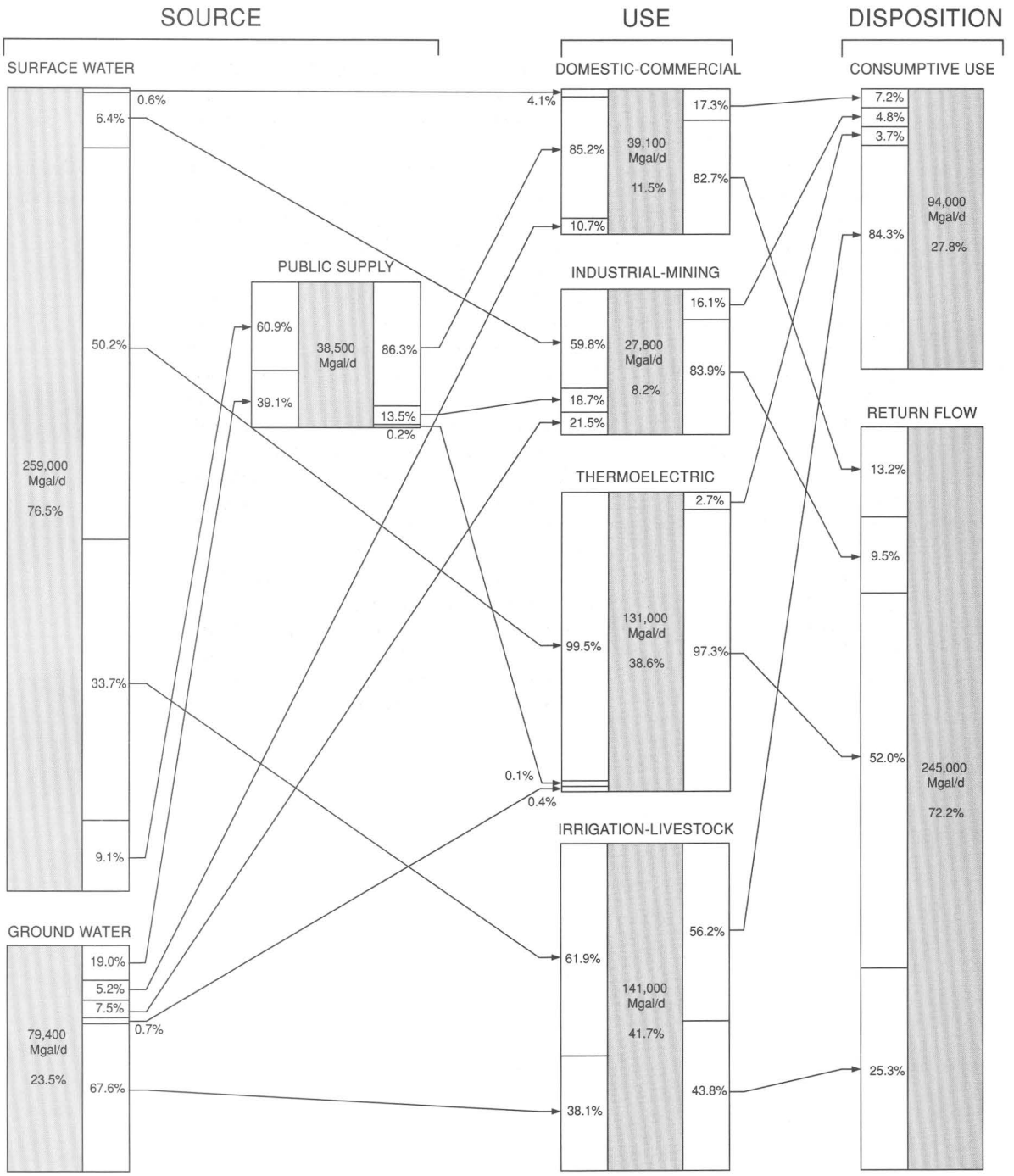


Figure 7. Source, use, and disposition of freshwater in the United States, 1990. For each water-use category, this diagram shows the relative proportion of water source and disposition and the general distribution of water from source to disposition. The lines and arrows indicate the distribution of water from source to disposition for each category; for example, surface water was 76.5 percent of total freshwater withdrawn, and going from "Source" to "Use" columns, the line from the surface-water block to the domestic and commercial block indicates that 0.6 percent of all surface water withdrawn was the source for 4.1 percent of total water (self-supplied withdrawals, public-supply deliveries) for domestic and commercial purposes. In addition, going from the "Use" to "Disposition" columns, the line from the domestic and commercial block to the consumptive use block indicates that 17.3 percent of the water for domestic and commercial purposes was consumptive use; this represents 7.2 percent of total consumptive use by all water-use categories.

Public Supply

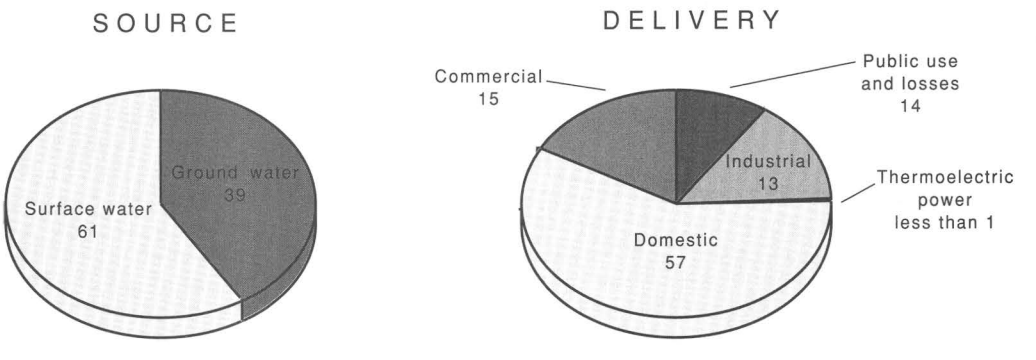
Public supply refers to water withdrawn by public and private water suppliers and delivered to multiple users for domestic, commercial, industrial, and thermoelectric power uses. In this report, public supply includes public and private water systems that furnish water to at least 25 people, or that have a minimum of 15 hookups. The difference in the quantity of water withdrawn by public suppliers in a water-resources region or State and the quantity of water delivered to all users represents losses in the collection and distribution systems, public use (water for firefighting, street washing, municipal parks, and swimming pools) and, in a few areas, water transferred between adjacent States or water-resources regions. These differences are shown in the chart below and in tables 9 and 10, as "Public use and losses".

Information on public supply generally was available from State health agencies and through State permitting offices. The U.S. Environmental Protection Agency's Public Drinking Water Supply file also was used as a reference. Data on population served and withdrawals usually are accurate because local and State agencies maintain relatively complete information. Deliveries from public suppliers to various users are more difficult to obtain and the information generally is less accurate.

The quantity of water withdrawn for public supply during 1990 was an estimated 38,500 Mgal/d (tables 9, 10), or 5 percent more than during 1985. Total public-supply withdrawals averaged 183 gal/d for each person served. Public-supply withdrawals represent 11 percent of total freshwater withdrawals for all offstream categories. Public suppliers served about 210 million people during 1990, (a 5-percent increase from 1985), or about 83 percent of the total population.

The source and delivery of water for public supply are shown in the chart below. Surface water was the source for about 61 percent of public-supply withdrawals. Ground water was the source for 39 percent of withdrawals, about the same as in 1985. Public-supply withdrawals were distributed to users as follows: domestic, 57 percent; commercial, 15 percent; industrial, 13 percent; and thermoelectric power, 0.2 percent. The remaining 14 percent of withdrawals represented public use and losses in the distribution system. Large positive values listed under "Public use and losses" in tables 9 and 10 may indicate, in addition to public use and losses, large exports of public-supply water to adjacent areas; negative values indicate imports of public-supply water from adjacent areas to the extent that public-supply deliveries in a region or in a State exceed public-supply withdrawals. This was the case in Washington, D.C., which imports public-supply water from Maryland.

Public-supply withdrawals in the Mid Atlantic, South Atlantic-Gulf, and California water-resources regions, three of the most populated regions, accounted for about 43 percent of total public-supply withdrawals (figure 8; table 9). Surface water was the source for 81 percent of public-supply withdrawals in the New England, Mid Atlantic, and Great Lakes regions. Ground water was the primary source in the South Atlantic-Gulf, Lower and Upper Mississippi, Rio Grande, and California regions. Ground water was the source for 93 percent of public-supply withdrawals in Hawaii. Public-supply withdrawals in California, New York, and Texas, the three most populous States (26 percent of the Nation's population), accounted for 31 percent of nationwide public-supply withdrawals (figure 9; table 10).



38,500 MILLION GALLONS PER DAY

PUBLIC–SUPPLY SOURCE AND DELIVERY, 1990, IN PERCENT

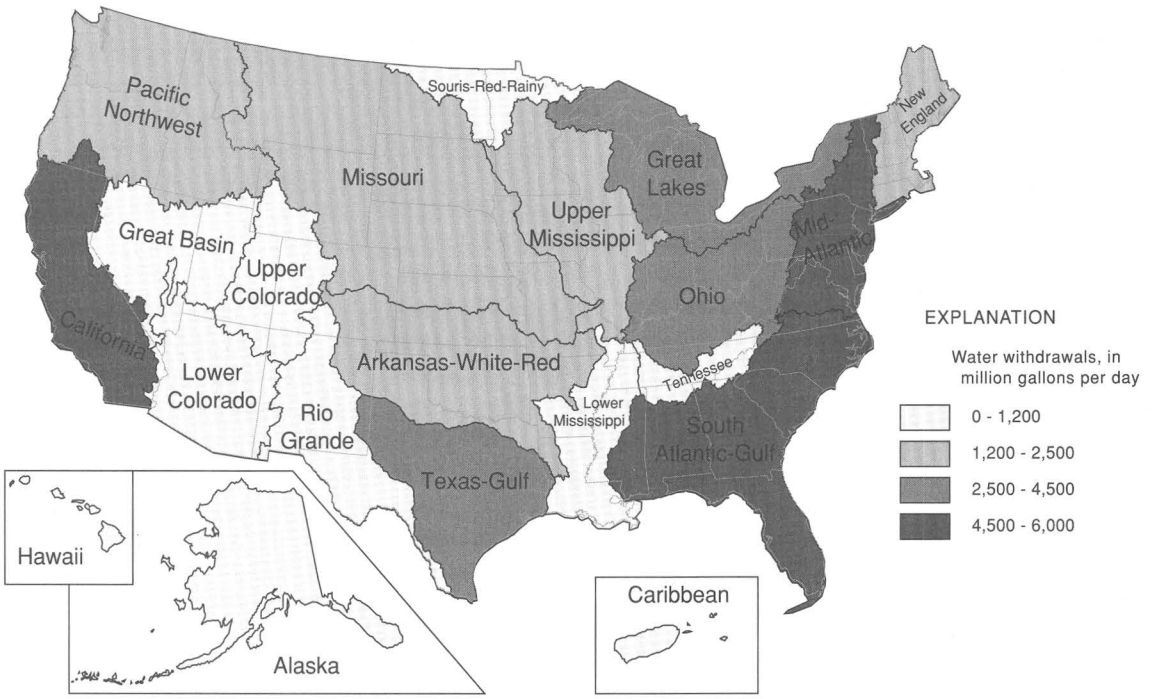


Figure 8. Public-supply freshwater withdrawals by water-resources region, 1990.

Table 9. Public-supply freshwater use by water-resources region, 1990

[Figures may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day]

REGION	POPULATION SERVED, in thousands			WATER WITHDRAWALS, in Mgal/d			PER CAPITA USE, in gal/d	WATER DELIVERIES, BY TYPE OF USE, in Mgal/d				PUBLIC USE AND LOSSES[1]
	Source			Source								
	Ground water	Surface water	Total	Ground water	Surface water	Total		Domestic	Commercial	Industrial	Thermoelectric power	
New England	3,170	7,400	10,600	328	1,070	1,400	133	713	172	219	6.6	291
Mid Atlantic	10,700	24,400	35,100	1,400	4,580	5,980	171	3,270	937	672	1.1	1,100
South Atlantic-Gulf	15,600	12,100	27,700	2,510	2,340	4,850	175	2,790	746	855	6.1	458
Great Lakes	3,110	14,500	17,600	460	3,880	4,340	247	1,400	637	852	.1	1,450
Ohio	5,960	10,500	16,500	774	1,750	2,530	153	1,050	411	615	.9	450
Tennessee	757	2,270	3,030	109	402	511	169	252	111	94	0	55
Upper Mississippi	8,060	8,870	16,900	1,160	724	1,890	112	1,530	607	467	5.8	-716
Lower Mississippi	4,300	1,640	5,940	701	334	1,040	174	698	150	70	.7	117
Souris-Red-Rainy	239	222	461	34	37	72	156	45	11	3.4	0	12
Missouri Basin	3,430	4,920	8,350	612	1,010	1,620	194	925	270	112	7.0	307
Arkansas-White-Red	2,430	4,430	6,870	364	1,040	1,400	204	705	241	257	26	174
Texas-Gulf	6,310	8,230	14,500	1,050	1,470	2,520	173	2,060	113	143	7.1	197
Rio Grande	1,560	361	1,920	370	163	533	278	282	64	19	0	169
Upper Colorado	128	361	488	32	86	118	242	83	19	4.4	0	13
Lower Colorado	2,500	1,880	4,380	513	552	1,070	243	722	191	80	.8	72
Great Basin	1,120	918	2,040	354	256	610	300	432	89	21	0	68
Pacific Northwest	3,220	3,860	7,080	727	850	1,580	223	960	202	175	0	239
California	13,500	11,800	25,200	3,210	2,530	5,750	228	3,690	780	495	13	773
Alaska	126	250	376	34	58	92	245	30	33	18	1.0	11
Hawaii	1,030	23	1,060	221	17	238	225	126	62	7.5	.4	42
Caribbean	807	2,610	3,420	81	330	411	120	163	57	12	3.3	176
Total	88,000	122,000	210,000	15,100	23,500	38,500	184	21,900	5,900	5,190	80	5,460

[1] Includes transfers from adjacent areas.

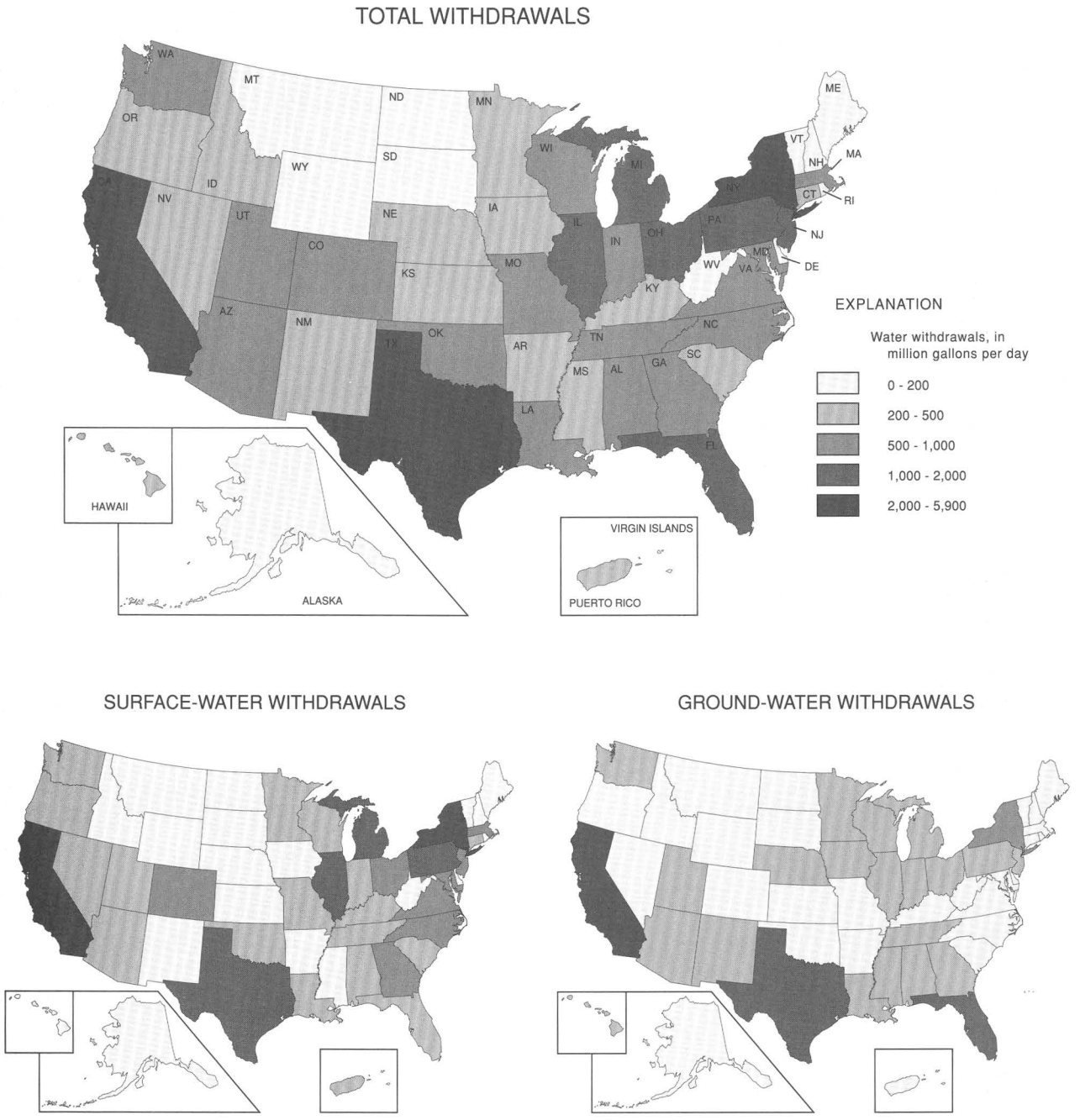


Figure 9. Public-supply freshwater withdrawals by source and State, 1990.

Table 10. Public-supply freshwater use by State, 1990

[Figures may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day]

STATE	POPULATION SERVED, in thousands			WATER WITHDRAWALS, in Mgal/d			PER CAPITA USE, in gal/d	WATER DELIVERIES, BY TYPE OF USE, in Mgal/d				PUBLIC USE AND LOSSES[1]
	Source			Source								
	Ground water	Surface water	Total	Ground water	Surface water	Total		Domestic	Commercial	Industrial	Thermoelectric power	
Alabama	1,450	2,220	3,670	224	483	707	193	368	58	185	0.0	95
Alaska	126	250	376	34	58	92	245	30	33	18	1.0	11
Arizona	2,190	1,210	3,390	401	305	707	208	509	117	78	0	2.1
Arkansas	878	902	1,780	119	190	309	173	188	106	.7	0	13
California	13,600	11,900	25,500	3,260	2,560	5,830	229	3,740	791	492	13	792
Colorado	422	2,620	3,050	83	567	650	213	441	108	21	13	68
Connecticut	514	2,160	2,670	73	301	374	140	188	51	64	2.6	69
Delaware	297	231	528	33	52	85	160	41	18	15	.9	10
D.C.	0	607	607	0	0	0	256	109	47	0	0	-155
Florida	10,000	1,210	11,200	1,700	226	1,930	171	1,250	282	183	5.5	207
Georgia	1,560	3,590	5,150	234	730	963	187	594	151	157	0	62
Hawaii	1,030	23	1,060	221	17	238	225	126	62	7.5	.4	42
Idaho	626	143	768	173	28	201	262	143	6.1	3.8	0	48
Illinois	3,280	6,780	10,100	444	1,420	1,860	185	904	498	263	1.3	193
Indiana	1,960	2,030	3,990	274	330	604	151	303	102	105	0	94
Iowa	1,460	632	2,090	234	88	322	154	138	59	34	4.7	87
Kansas	1,040	1,190	2,230	176	197	373	167	192	77	35	.8	69
Kentucky	332	2,240	2,570	55	372	427	166	179	23	199	0	26
Louisiana	1,840	1,770	3,610	275	344	619	171	448	54	32	0	84
Maine	162	527	689	21	86	106	154	40	24	17	1.2	24
Maryland	645	3,290	3,940	76	722	798	203	414	87	52	0	245
Massachusetts	2,010	3,500	5,500	179	535	714	130	365	58	108	2.8	181
Michigan	1,610	6,000	7,610	261	1,140	1,400	184	585	340	411	0	67
Minnesota	2,020	908	2,930	290	225	515	176	432	22	44	.5	16
Mississippi	1,730	188	1,920	282	38	320	167	236	33	19	.3	32
Missouri	1,500	2,590	4,090	185	493	677	166	348	59	133	.2	137
Montana	221	374	595	51	83	135	226	77	25	1.0	0	32
Nebraska	975	226	1,200	235	66	301	251	138	50	33	1.9	78
Nevada	318	802	1,120	104	281	385	344	238	89	2.6	.8	54
New Hampshire	300	394	694	34	61	95	137	49	17	15	0	14
New Jersey	2,710	4,110	6,820	396	643	1,040	152	511	140	241	.2	146
New Mexico	1,050	156	1,210	241	32	273	226	163	68	15	.1	26
New York	4,340	11,600	15,900	550	2,360	2,910	183	1,890	391	314	0	318
North Carolina	962	3,790	4,760	137	668	805	169	319	138	245	.4	102
North Dakota	233	250	483	32	45	76	158	42	15	2.6	0	17
Ohio	3,160	5,900	9,060	396	904	1,300	143	455	325	325	0	194
Oklahoma	734	1,930	2,670	80	435	515	193	227	100	113	1.5	75
Oregon	513	1,710	2,220	105	365	470	212	246	67	81	0	76
Pennsylvania	3,230	5,920	9,160	427	1,300	1,730	189	570	205	248	0	705
Rhode Island	120	814	934	13	88	102	109	63	22	12	0	4.5
South Carolina	685	1,430	2,120	79	273	352	166	160	119	46	0	27
South Dakota	404	151	555	52	24	76	137	45	16	8.0	0	6.7
Tennessee	1,590	2,380	3,970	269	426	695	175	338	181	106	.5	69
Texas	7,190	8,940	16,100	1,270	1,830	3,090	192	2,310	119	255	22	388
Utah	948	705	1,650	305	203	508	308	360	62	21	0	65
Vermont	173	160	333	19	19	39	116	27	3.1	3.1	.1	5.8
Virginia	632	4,050	4,680	69	640	709	151	351	173	152	0	34
Washington	2,040	1,920	3,960	434	441	875	221	546	119	93	0	117
West Virginia	323	858	1,180	43	118	160	136	87	20	13	.9	39
Wisconsin	1,900	1,510	3,410	294	301	595	175	179	99	151	0	167
Wyoming	160	180	340	41	47	88	260	55	16	5.5	0	11
Puerto Rico	799	2,570	3,370	80	325	404	120	162	55	12	2.8	173
Virgin Islands	7.5	37	44	1.0	5.4	6.4	144	1.0	2.1	0	.5	2.8
Total	88,000	122,000	210,000	15,100	23,500	38,500	184	21,900	5,900	5,190	80	5,460

[1] Includes transfers from adjacent areas.

Domestic

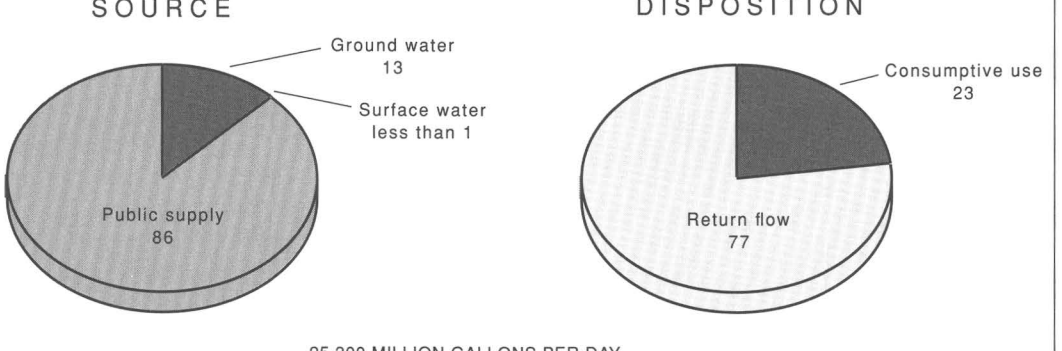
Domestic water use includes water for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens. State agencies generally obtain reliable information from public suppliers about withdrawals and population served. Information on deliveries to various users was more difficult to obtain and generally was estimated from the population served.

The number of people served by their own water systems (self supplied) was determined by subtracting the number of people served by public suppliers from the total population as reported by the U.S. Bureau of the Census. The difference between these totals indicated that 42.8 million people, or 17 percent of the Nation's total population, were served by their own water-supply systems in 1990, compared with 42.5 million people in 1985. Self-supplied domestic systems rarely are metered and few data exist. Self-supplied domestic withdrawals were estimated using per-capita use coefficients that generally ranged from 50 to 120 gallons per person per day. Consumptive use estimates were based on coefficients, generally ranging from 10 to 50 percent of withdrawals and deliveries.

Domestic water use (withdrawals, deliveries) during 1990 was an estimated 25,300 Mgal/d (tables 11, 12), or 4 percent more than during 1985. Domestic use represents 7 percent of total freshwater use for all offstream categories. Domestic withdrawals were an estimated 3,390 Mgal/d. Ground water was the source for about 96 percent of domestic withdrawals; surface water was the source for the remaining 4 percent. More than 50 percent of the Nation's population is dependent on ground water for domestic use. Withdrawals for the population served by their own water systems averaged about 79 gal/d for each person, compared to 78 gal/d during 1985. Public suppliers delivered about 21,900 Mgal/d of water to domestic users; this accounted for 57 percent of total public-supply withdrawals. Public-supply domestic deliveries averaged 105 gal/d for each person served, the same as during 1985. The per-capita use has remained about the same for the last decade as the result of active conservation programs in many states that include the installation of additional meters and water-conserving plumbing fixtures.

The source and disposition of water for domestic purposes are shown in the chart below. The consumptive use of water for domestic purposes during 1990 was 5,880 Mgal/d, or about 23 percent of withdrawals and deliveries.

In 1990, the South Atlantic-Gulf water-resources region had the largest self-supplied withdrawals for domestic purposes (figure 10), whereas the California region accounted for the largest total of domestic withdrawals and deliveries (table 11). Self-supplied domestic withdrawals were fairly evenly distributed among the States (figure 11). California, Texas, New York, Florida, and Illinois accounted for 44 percent of domestic water use because of large public-supply deliveries. (See figure 12; table 12.)



DOMESTIC SOURCE AND DISPOSITION, 1990, IN PERCENT

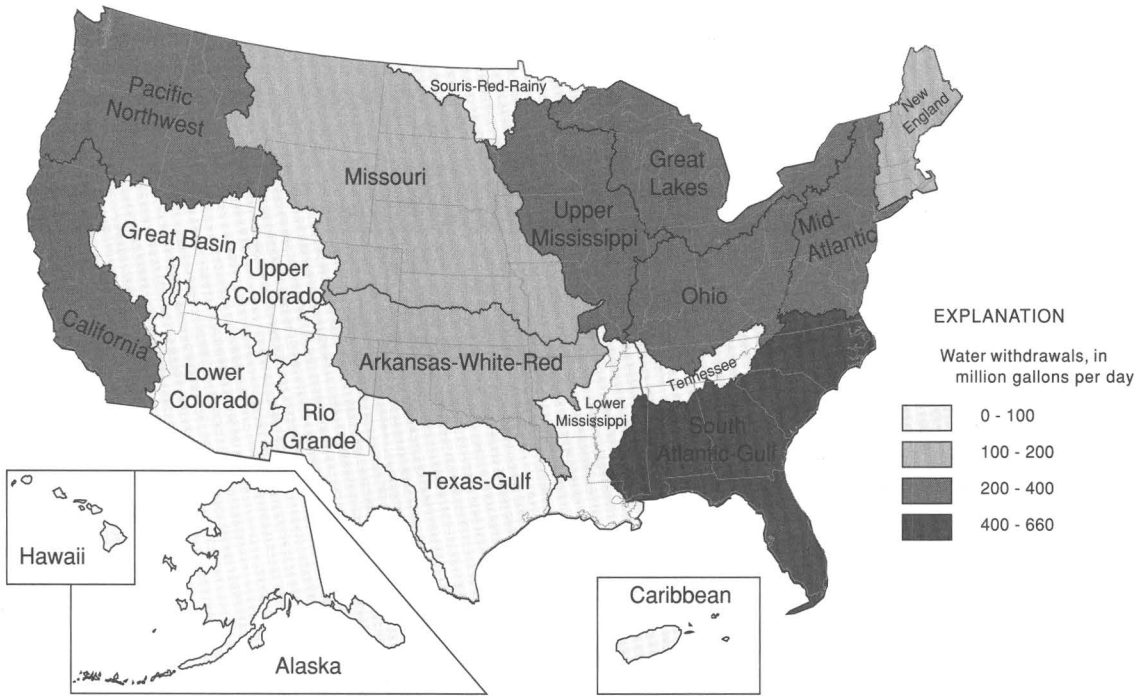


Figure 10. Domestic freshwater withdrawals by water-resources region, 1990.

Table 11. Domestic freshwater use by water-resources region, 1990

[Figures may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day]

REGION	SELF SUPPLIED					PUBLIC SUPPLY			TOTAL USE	
	Population, in thousands	Water withdrawals, in Mgal/d			Per capita use, in gal/d	Population served, in thousands	Water deliveries, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
		Source		Total						
		Ground water	Surface water							
New England	2,220	169	0.0	169	76	10,600	713	67	882	124
Mid Atlantic	6,470	396	.1	396	61	35,100	3,270	93	3,660	415
South Atlantic-Gulf	6,990	659	0	659	94	27,700	2,790	100	3,450	815
Great Lakes	3,820	282	1.0	283	74	17,600	1,400	80	1,690	235
Ohio	5,390	352	8.1	360	67	16,500	1,050	64	1,410	191
Tennessee	883	56	0	56	63	3,030	252	83	308	43
Upper Mississippi	4,340	371	0	371	85	16,900	1,530	90	1,900	401
Lower Mississippi	1,230	90	0	90	74	5,940	698	117	788	151
Souris-Red-Rainy	211	22	0	22	105	461	45	99	68	25
Missouri Basin	1,700	138	1.0	139	82	8,350	925	111	1,060	400
Arkansas-White-Red	1,380	118	0	118	85	6,870	705	103	823	267
Texas-Gulf	700	79	0	79	113	14,500	2,060	142	2,140	760
Rio Grande	311	23	0	23	75	1,920	282	147	305	142
Upper Colorado	137	9.9	.3	10	74	488	83	169	93	34
Lower Colorado	363	37	2.1	39	108	4,380	722	165	761	363
Great Basin	145	13	2.6	15	106	2,040	432	212	448	165
Pacific Northwest	1,830	212	7.7	220	120	7,080	960	136	1,180	186
California	4,200	210	103	313	74	25,200	3,690	146	4,000	1,020
Alaska	174	6.2	.7	6.9	40	376	30	79	36	3.7
Hawaii	53	8.5	1.4	9.9	189	1,060	126	119	136	68
Caribbean	208	3.7	4.6	8.2	40	3,420	163	48	171	74
Total	42,800	3,260	132	3,390	79	210,000	21,900	105	25,300	5,880

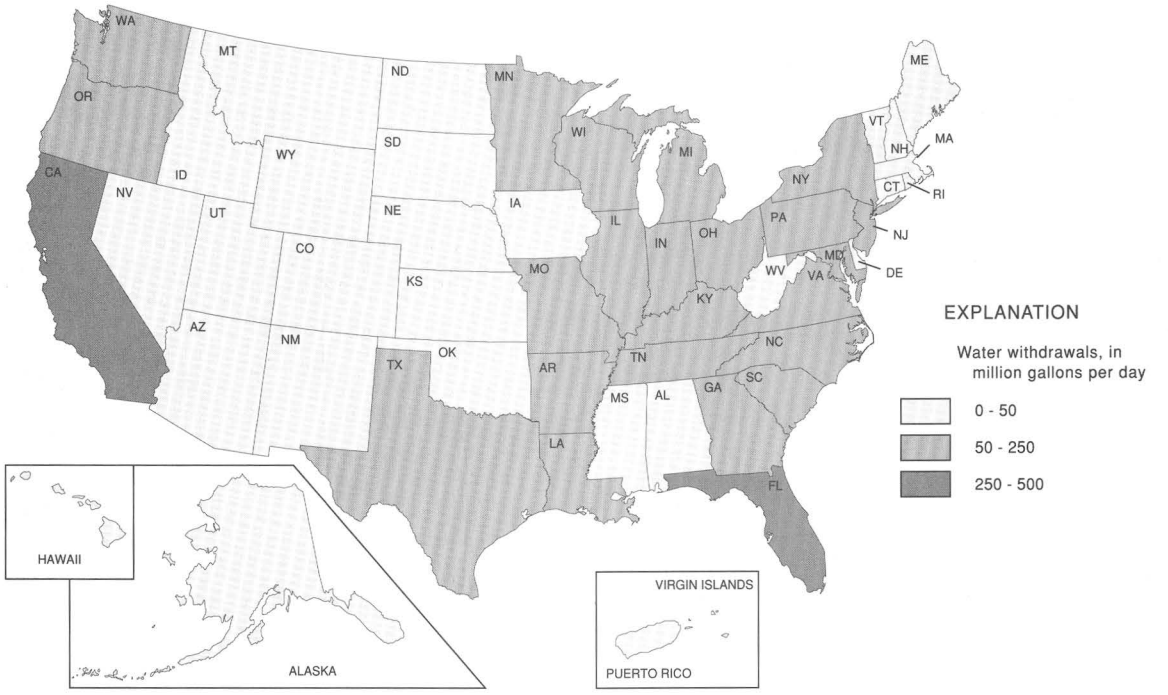


Figure 11. Domestic freshwater withdrawals by State, 1990.

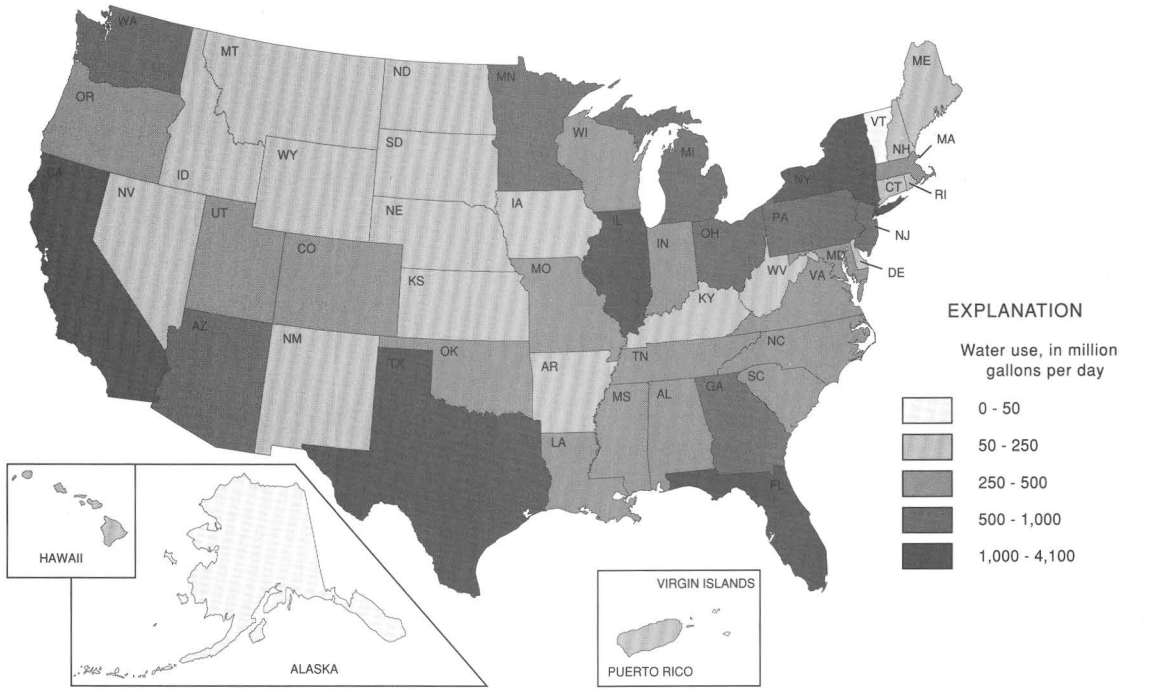


Figure 12. Domestic freshwater use (withdrawals, deliveries) by State, 1990.

Table 12. Domestic freshwater use by State, 1990

[Figures may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day]

STATE	SELF SUPPLIED					PUBLIC SUPPLY			TOTAL USE	
	Population, in thousands	Water withdrawals, in Mgal/d			Per capita use, in gal/d	Population served, in thousands	Water deliveries, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
		Source		Total						
		Ground water	Surface water							
Alabama	369	28	0.0	28	75	3,670	368	100	396	53
Alaska	174	6.2	.7	6.9	40	376	30	79	36	3.7
Arizona	270	32	.3	32	118	3,390	509	150	541	268
Arkansas	573	51	0	51	88	1,780	188	106	239	51
California	4,280	212	106	318	74	25,500	3,740	147	4,060	1,030
Colorado	248	19	0	19	76	3,050	441	145	460	139
Connecticut	616	46	0	46	75	2,670	188	70	234	47
Delaware	138	11	0	11	79	528	41	78	52	5.2
D.C.	0	0	0	0	0	607	109	179	109	11
Florida	1,710	299	0	299	175	11,200	1,250	111	1,550	434
Georgia	1,320	100	0	100	75	5,150	594	115	693	125
Hawaii	53	8.5	1.4	9.9	189	1,060	126	119	136	68
Idaho	238	48	0	48	200	768	143	186	191	3.7
Illinois	1,370	115	0	115	84	10,100	904	90	1,020	102
Indiana	1,550	118	0	118	76	3,990	303	76	421	63
Iowa	682	45	0	45	67	2,090	138	66	183	73
Kansas	250	25	0	25	100	2,230	192	86	217	115
Kentucky	1,120	50	5.5	56	50	2,570	179	70	235	41
Louisiana	607	50	0	50	83	3,610	448	124	498	100
Maine	539	49	0	49	90	689	40	58	88	13
Maryland	843	70	0	70	83	3,940	414	105	484	48
Massachusetts	512	37	0	37	72	5,500	365	66	402	40
Michigan	1,690	123	.1	123	73	7,610	585	77	707	103
Minnesota	1,440	168	0	168	117	2,930	432	148	601	204
Mississippi	658	33	0	33	50	1,920	236	123	269	54
Missouri	1,030	62	0	62	60	4,090	348	85	410	114
Montana	204	15	.8	16	78	595	77	129	93	44
Nebraska	378	47	0	47	125	1,200	138	115	185	103
Nevada	82	9.6	.2	9.8	120	1,120	238	213	248	124
New Hampshire	415	27	0	27	65	694	49	71	76	11
New Jersey	911	68	0	68	75	6,820	511	75	580	106
New Mexico	308	24	0	24	78	1,210	163	135	187	109
New York	2,060	120	0	120	58	15,900	1,890	119	2,010	201
North Carolina	1,870	103	0	103	55	4,760	319	67	422	135
North Dakota	156	12	0	12	78	483	42	86	54	17
Ohio	1,790	131	2.7	134	75	9,060	455	50	589	88
Oklahoma	480	41	0	41	86	2,670	227	85	268	79
Oregon	622	57	7.6	64	104	2,220	246	111	311	81
Pennsylvania	2,720	141	0	141	52	9,160	570	62	711	71
Rhode Island	69	4.9	0	4.9	70	934	63	67	67	10
South Carolina	1,370	103	0	103	75	2,120	160	76	263	53
South Dakota	141	8.8	0	8.8	63	555	45	81	54	14
Tennessee	908	59	0	59	65	3,970	338	85	397	40
Texas	857	93	0	93	108	16,100	2,310	143	2,400	854
Utah	70	4.6	1.4	6.1	86	1,650	360	218	366	126
Vermont	230	17	0	17	72	333	27	80	43	6.5
Virginia	1,500	113	0	113	75	4,680	351	75	464	47
Washington	902	104	0	104	116	3,960	546	138	650	85
West Virginia	612	48	1.0	49	80	1,180	87	74	136	14
Wisconsin	1,490	90	0	90	61	3,410	179	52	269	54
Wyoming	114	8.1	.4	8.5	75	340	55	163	64	25
Puerto Rico	150	3.5	3.2	6.7	44	3,370	162	48	168	74
Virgin Islands	57	.2	1.4	1.6	28	44	1.0	23	2.6	.6
Total	42,800	3,260	132	3,390	79	210,000	21,900	105	25,300	5,880

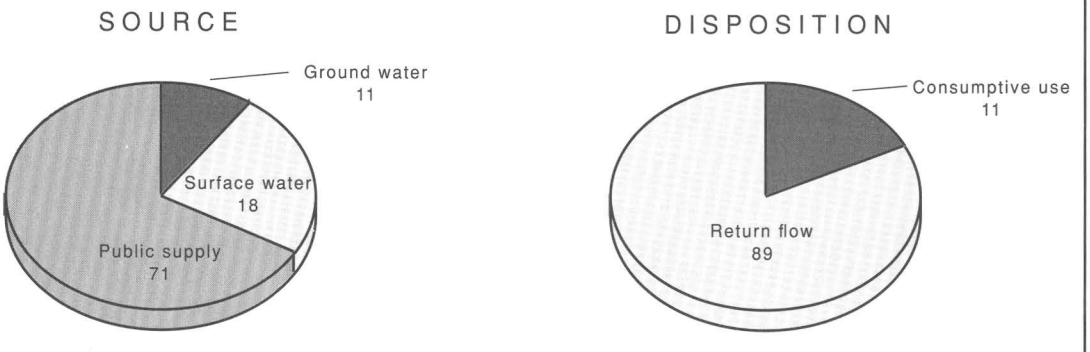
Commercial

Commercial water use includes water for motels, hotels, restaurants, office buildings, other commercial facilities, and civilian and military institutions. A few States, such as Arkansas, Oregon, and California, have some offstream fish hatcheries that are included in the commercial category in this report. Most fish hatcheries are located instream and are not included in this compilation. Information on commercial withdrawals sometimes is available through State agencies that permit withdrawals or require permits to operate potable water supplies. In many cases, withdrawal estimates were based on the population of the commercial facilities; that is, the number of students attending a university, inmates in a penal institution, workers in an office building, or the average occupancy rate of a hotel. Information on deliveries from public suppliers to commercial users were estimated from a variety of methods if not available directly from public suppliers. Consumptive use estimates were based on coefficients generally ranging from 5 to 30 percent of withdrawals and deliveries.

Commercial water use (withdrawals, deliveries) during 1990 was an estimated 8,290 Mgal/d, or 19 percent more than during 1985. Over one-half of the increase occurred in Oregon, the result of including offstream fish hatcheries in this category. Commercial use represents about 2 percent of total freshwater use for all offstream categories. Commercial withdrawals were an estimated 2,390 Mgal/d. Surface water was the source for about 62 percent of commercial withdrawals. Public suppliers delivered about 5,900 Mgal/d of freshwater to commercial users during 1990; this accounted for about 15 percent of total public-supply withdrawals.

The source and disposition of water for commercial purposes are shown in the chart below. The consumptive use of water for commercial purposes during 1990 was about 885 Mgal/d, or 11 percent of withdrawals and deliveries.

The Pacific Northwest, California, and Upper Mississippi water-resources regions withdrew the most water for commercial purposes as shown in figure 13. These regions accounted for over 50 percent of withdrawals for commercial use (table 13). Oregon reported the largest self-supplied commercial withdrawals as shown in figure 14 and table 14. The large increase in Oregon was because offstream fish hatcheries were included in the commercial category for the first time. California, Oregon, and Illinois reported the most commercial water use (figure 15).



COMMERCIAL SOURCE AND DISPOSITION, 1990, IN PERCENT

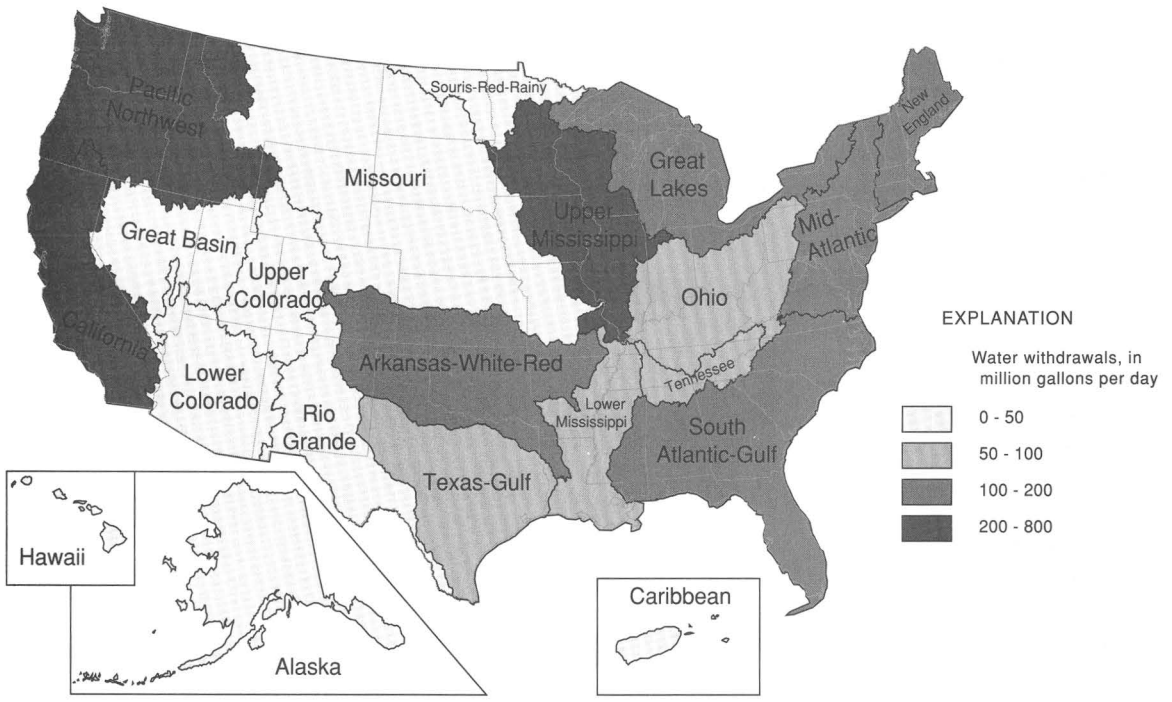


Figure 13. Commercial freshwater withdrawals by water-resources region, 1990.

Table 13. Commercial freshwater use by water-resources region, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

REGION	SELF-SUPPLIED WITHDRAWALS			PUBLIC-SUPPLY DELIVERIES	TOTAL USE	
	Source		Total		Withdrawals and deliveries	Consumptive use
	Ground water	Surface water				
New England	82	51	133	172	305	36
Mid Atlantic	94	39	133	937	1,070	101
South Atlantic-Gulf	120	14	134	746	880	121
Great Lakes	27	81	108	637	746	69
Ohio	58	31	89	411	500	52
Tennessee	56	.2	56	111	167	16
Upper Mississippi	134	126	260	607	867	83
Lower Mississippi	20	72	92	150	242	29
Souris-Red-Rainy	.1	.2	.3	11	11	1.0
Missouri Basin	33	6.4	40	270	309	63
Arkansas-White-Red	27	138	165	241	406	53
Texas-Gulf	47	11	57	113	170	14
Rio Grande	19	1.2	20	64	84	44
Upper Colorado	5.6	.7	6.3	19	25	5.3
Lower Colorado	23	6.3	29	191	220	76
Great Basin	7.0	9.3	16	89	105	14
Pacific Northwest	49	669	718	202	920	52
California	58	213	271	780	1,050	7.8
Alaska	8.7	9.0	18	33	51	5.0
Hawaii	39	.6	40	62	102	26
Caribbean	.4	.3	.8	57	58	18
Total	908	1,480	2,390	5,900	8,290	885

Figure 14. Commercial freshwater withdrawals by State, 1990.

Figure 15. Commercial freshwater use (withdrawals, deliveries) by State, 1990.

Table 14. Commercial freshwater use by State, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	SELF-SUPPLIED WITHDRAWALS			PUBLIC-SUPPLY DELIVERIES	TOTAL USE	
	Source		Total		Withdrawals and deliveries	Consumptive use
	Ground water	Surface water				
Alabama	3.1	0.3	3.5	58	61	13
Alaska	8.7	9.0	18	33	51	5.0
Arizona	18	0	18	117	135	61
Arkansas	14	207	222	106	328	38
California	57	177	234	791	1,020	7.1
Colorado	7.7	.9	8.6	108	116	17
Connecticut	18	.6	18	51	69	13
Delaware	1.8	0	1.8	18	20	2.0
D.C.	0	0	0	47	47	4.7
Florida	50	1.5	52	282	334	35
Georgia	30	12	42	151	192	35
Hawaii	39	.6	40	62	102	26
Idaho	16	0	16	6.1	22	1.1
Illinois	54	119	173	498	672	54
Indiana	33	31	63	102	165	25
Iowa	19	8.0	27	59	86	11
Kansas	6.2	0	6.2	77	83	33
Kentucky	4.2	9.2	13	23	37	1.3
Louisiana	12	.9	13	54	67	10
Maine	3.6	30	34	24	58	5.5
Maryland	19	6.4	26	87	113	11
Massachusetts	55	18	74	58	132	13
Michigan	8.1	27	35	340	375	30
Minnesota	56	16	71	22	93	12
Mississippi	16	0	16	33	48	8.2
Missouri	22	0	22	59	81	5.5
Montana	0	0	0	25	25	9.1
Nebraska	.2	0	.2	50	50	16
Nevada	7.1	16	23	89	112	20
New Hampshire	.4	.2	.6	17	17	1.9
New Jersey	15	1.4	17	140	157	6.3
New Mexico	16	1.2	17	68	86	51
New York	29	32	61	391	452	45
North Carolina	17	0	17	138	155	17
North Dakota	.1	0	.1	15	16	2.5
Ohio	25	11	36	325	361	30
Oklahoma	4.8	1.5	6.3	100	106	7.7
Oregon	7.3	704	711	67	778	18
Pennsylvania	14	10	24	205	229	23
Rhode Island	4.2	1.3	5.6	22	28	2.7
South Carolina	2.1	0	2.1	119	121	18
South Dakota	12	4.6	17	16	33	3.2
Tennessee	55	0	55	181	236	21
Texas	51	11	62	119	181	8.9
Utah	4.2	0	4.2	62	66	8.7
Vermont	2.8	1.0	3.8	3.1	6.9	.9
Virginia	27	8.3	35	173	208	25
Washington	27	.4	27	119	146	29
West Virginia	2.5	.6	3.1	20	23	2.3
Wisconsin	11	0	11	99	110	22
Wyoming	.9	.7	1.6	16	18	2.7
Puerto Rico	.1	0	.1	55	56	18
Virgin Islands	.4	.3	.7	2.1	2.8	.4
Total	908	1,480	2,390	5,900	8,290	885

Irrigation

Irrigation water use includes all water artificially applied to farm and horticultural crops as well as water used to irrigate public and private golf courses. Irrigation water can be self supplied or supplied by irrigation companies or districts. However, all irrigation withdrawals in this report are identified as self-supplied withdrawals.

Irrigation of crops developed concurrently with the settlement of the arid West, where natural precipitation was insufficient to raise many crops. In the humid eastern States, irrigation has been used to supplement natural precipitation to increase the number of plantings per year or the yields of crops, and to reduce the risk of crop failures during droughts.

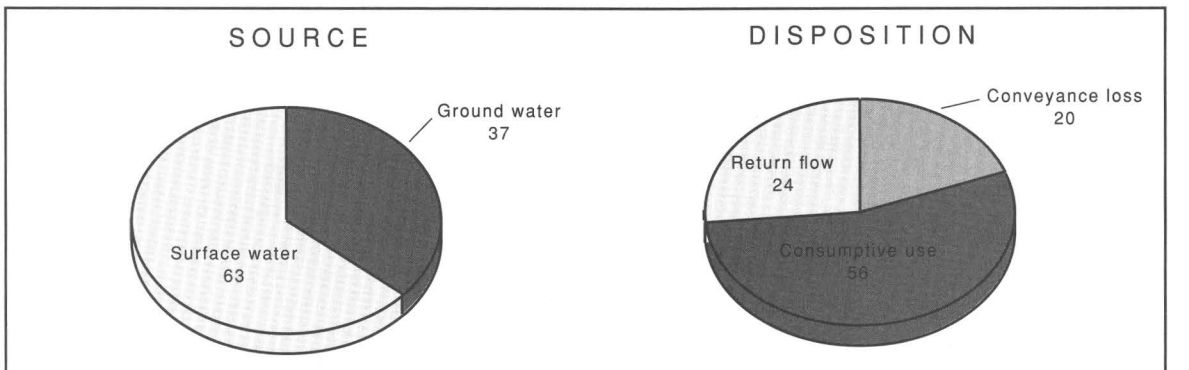
Information about the number of acres irrigated and the quantity of water withdrawn was obtained from a variety of sources such as State agencies responsible for permitting or allocating the withdrawal of water, the U.S. Soil Conservation Service, U.S. Bureau of Reclamation, county Cooperative Extension Service, individual farmers, agricultural research stations, and the U.S. Bureau of the Census, Agricultural Census, and Farm and Ranch Survey. Total acres irrigated are reported in two classes—spray irrigation (includes center pivot, travelling gun, trickle, and drip) and flood irrigation (includes flooding, furrow, and ditch).

Methods of estimating withdrawals for irrigation varied greatly. In some instances, they were based on theoretical estimates of water required to raise a given crop in an area. In other instances, accurate records of water application rates were available. Fairly accurate estimates of water withdrawn for irrigation can be made if the acreage irrigated, water application rates, and conveyance losses are known. It usually is difficult to obtain reliable estimates for consumptive use and for conveyance loss. Thus, some of the estimates of consumptive use and conveyance loss may be only rough approximations of actual conditions. In most States, consumptive use was based on coefficients ranging from 40 to 100 percent of withdrawals, or on theoretical crop requirements. In a few States, consumptive use was calculated as the difference between reported withdrawals and reported return flows.

The quantity of water withdrawn for irrigation during 1990 was an estimated 137,000 Mgal/d or 153 million acre-feet. (See tables 15, 16.) Irrigation withdrawals as well as acres irrigated during 1990 were about the same as during 1985. Irrigation use represents 40 percent of total freshwater use for all offstream categories.

The source and disposition of water for irrigation are shown in the chart below. Surface water was the source for about 63 percent of irrigation withdrawals, and, except for a small fraction of 1 percent that was reclaimed wastewater, ground water furnished the remainder. Surface-water withdrawals for irrigation during 1990 were about 6 percent less than during 1985, and ground-water withdrawals for irrigation during 1990 were about 12 percent more than during 1985. Of the 137,000 Mgal/d withdrawn for irrigation, 20 percent was lost in conveyance, 56 percent was consumptive use, and 24 percent was returned to surface- or groundwater supplies.

Irrigation is by far the largest water use in the West. The nine western water-resources regions (excluding Alaska and Hawaii), led by the Pacific Northwest region, accounted for 90 percent of the total water withdrawn for irrigation during 1990 (figure 16; table 15). In the eastern regions, most of the water withdrawn for irrigation was in the Lower Mississippi and South Atlantic-Gulf regions, which together had about 2,400 Mgal/d more water withdrawn during 1990 than during 1985. By State, California and Idaho were by far the largest users of irrigation water (figure 17) and, together, accounted for 34 percent of the national total (table 16). Florida withdrew the most water for irrigation in the East although it ranked thirteenth nationwide.



IRRIGATION SOURCE AND DISPOSITION, 1990, IN PERCENT

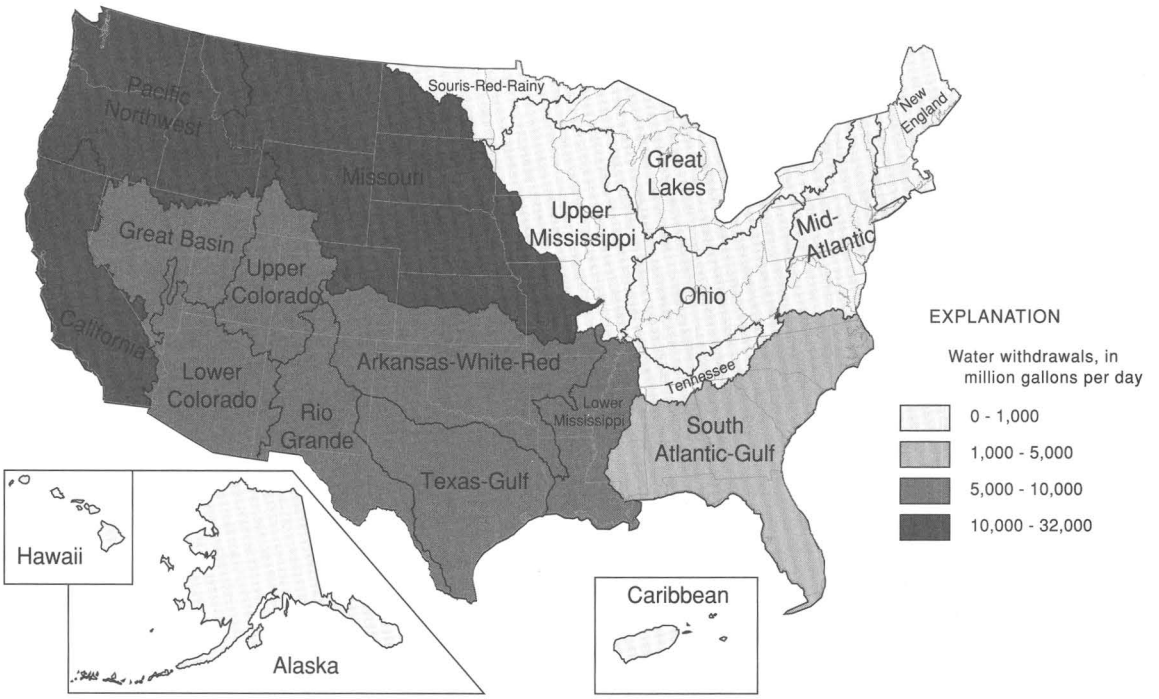


Figure 16. Irrigation freshwater withdrawals by water-resources region, 1990.

Table 15. Irrigation water use by water-resources region, 1990

[Figures may not add to totals because of independent rounding]

REGION	IRRIGATED LAND BY TYPE, in thousand acres		THOUSAND ACRE-FEET PER YEAR						MILLION GALLONS PER DAY				
			Withdrawals, by source			Reclaimed waste-water	Conveyance losses	Consumptive use, fresh-water	Withdrawals, by source			Conveyance losses	Consumptive use, fresh water
			Freshwater		Total				Freshwater		Total		
	Spray	Flood	Ground	Surface					Ground	Surface			
New England	49	12	9.9	124	134	0.0	0.0	134	8.8	111	120	0.0	120
Mid Atlantic	347	3.6	114	106	221	0	2.8	188	102	95	197	2.5	168
South Atlantic-Gulf	2,660	1,140	2,580	2,420	4,990	264	76	3,570	2,300	2,160	4,450	68	3,180
Great Lakes	537	.9	148	177	325	0	0	308	132	158	290	0	274
Ohio	166	.5	31	45	76	.3	.6	67	28	40	68	.5	59
Tennessee	31	.1	4.2	26	30	.4	0	21	3.8	23	27	0	19
Upper Mississippi	838	11	397	42	440	.1	.1	408	354	38	392	.1	364
Lower Mississippi	977	3,800	6,990	1,290	8,280	.8	672	6,160	6,230	1,150	7,380	600	5,490
Souris-Red-Rainy	98	22	63	47	110	0	1.2	98	56	42	98	1.1	87
Missouri Basin	4,880	7,950	8,070	19,700	27,800	3.4	10,100	12,300	7,200	17,600	24,800	9,010	10,900
Arkansas-White-Red	2,270	3,520	7,400	2,010	9,410	10	891	7,750	6,600	1,790	8,390	794	6,910
Texas-Gulf	1,710	2,680	4,450	1,270	5,720	34	383	4,820	3,970	1,130	5,100	342	4,300
Rio Grande	354	1,030	1,810	4,120	5,930	.7	1,200	3,570	1,620	3,670	5,290	1,070	3,180
Upper Colorado	233	1,330	36	7,350	7,390	.5	1,790	2,510	32	6,560	6,590	1,600	2,240
Lower Colorado	427	1,100	2,510	4,280	6,800	205	1,210	4,560	2,240	3,820	6,060	1,080	4,070
Great Basin	570	1,370	1,580	5,480	7,060	58	1,530	3,490	1,410	4,890	6,300	1,360	3,110
Pacific Northwest	4,210	3,280	8,800	26,800	35,600	12	10,800	13,100	7,850	23,900	31,800	9,670	11,700
California	2,310	7,300	11,900	19,800	31,700	143	1,960	21,700	10,600	17,700	28,300	1,750	19,400
Alaska	1.4	0	.1	.5	.6	0	.1	.3	.1	.5	.6	.1	.3
Hawaii	115	12	224	622	846	6.9	143	586	200	555	755	127	523
Caribbean	21	14	60	97	157	0	19	102	54	87	140	17	91
Total	22,800	34,600	57,200	95,900	153,000	740	30,800	85,400	51,000	85,500	137,000	27,500	76,200

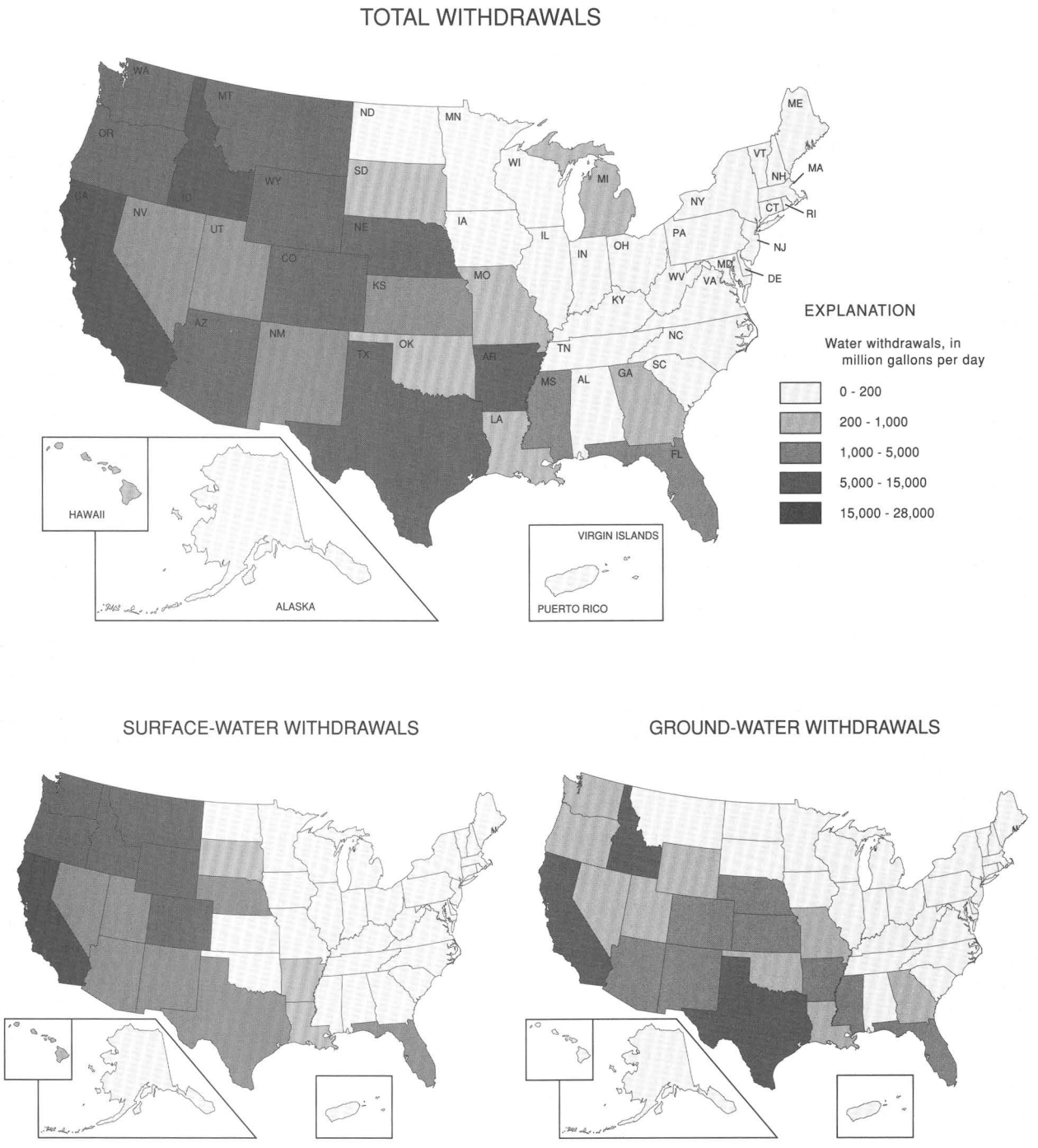


Figure 17. Irrigation freshwater withdrawals by source and State, 1990.

Table 16. Irrigation water use by State, 1990

[Figures may not add to totals because of independent rounding]

STATE	IRRIGATED LAND BY TYPE, in thousand acres		THOUSAND ACRE-FEET PER YEAR						MILLION GALLONS PER DAY				
			Withdrawals, by source			Reclaimed waste-water	Convey-ance losses	Consump-tive use, fresh-water	Withdrawals, by source			Convey-ance losses	Consump-tive use, fresh water
			Freshwater		Total				Freshwater		Total		
	Spray	Flood	Ground	Surface					Ground	Surface			
Alabama	147	0.0	37	69	106	0.0	0.0	79	33	62	94	0.0	71
Alaska	1.4	0	.1	.5	.6	0	.1	.3	.1	.5	.6	.1	.3
Arizona	409	940	2,300	3,640	5,940	202	1,130	3,990	2,060	3,250	5,300	1,010	3,560
Arkansas	297	2,680	4,820	1,060	5,880	0	412	4,360	4,300	949	5,250	368	3,890
California	2,230	7,250	12,000	19,300	31,200	148	1,750	21,800	10,700	17,200	27,900	1,560	19,500
Colorado	897	2,660	2,870	10,100	13,000	4.2	3,350	5,560	2,560	9,000	11,600	2,990	4,960
Connecticut	28	0	9.2	7.3	17	0	0	17	8.2	6.5	15	0	15
Delaware	64	0	26	11	36	0	0	36	23	9.5	32	0	32
D.C.	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	1,020	1,130	2,180	2,000	4,180	190	72	2,780	1,940	1,780	3,730	64	2,480
Georgia	1,180	0	294	199	494	39	0	494	263	178	441	0	441
Hawaii	115	12	224	622	846	6.9	143	586	200	555	755	127	523
Idaho	1,540	1,870	7,420	13,500	20,900	0	8,020	6,810	6,620	12,100	18,700	7,160	6,070
Illinois	287	0	84	4.2	88	.1	0	79	75	3.7	78	0	70
Indiana	169	0	22	35	57	0	0	51	20	31	51	0	46
Iowa	74	0	24	1.6	25	0	0	25	21	1.4	23	0	23
Kansas	1,450	1,660	4,470	224	4,690	6.2	163	4,530	3,990	199	4,190	146	4,040
Kentucky	32	.7	.5	12	13	0	.5	12	.5	11	12	.5	11
Louisiana	193	496	506	287	793	0	101	693	451	256	708	90	618
Maine	5.1	0	.2	1.8	2.0	0	0	2.0	.2	1.6	1.8	0	1.8
Maryland	64	0	22	11	33	0	0	33	19	10	29	0	29
Massachusetts	6.4	12	0	112	112	0	0	112	0	100	100	0	100
Michigan	367	0	118	151	269	0	0	255	105	135	240	0	227
Minnesota	349	17	176	43	219	0	0	196	157	38	195	0	175
Mississippi	449	728	1,970	146	2,110	1.1	211	1,490	1,750	130	1,880	188	1,330
Missouri	228	323	376	40	416	0	0	301	335	36	371	0	269
Montana	597	1,340	101	9,990	10,100	0	5,180	2,170	90	8,910	9,000	4,620	1,940
Nebraska	3,000	3,860	4,880	1,950	6,840	0	2,420	4,410	4,360	1,740	6,100	2,160	3,930
Nevada	155	574	976	2,190	3,160	12	690	1,640	871	1,950	2,820	615	1,460
New Hampshire	2.9	.3	.1	.9	1.0	0	0	.9	.1	.8	.9	0	.8
New Jersey	100	3.4	25	40	65	0	0	47	22	36	58	0	42
New Mexico	421	564	1,540	1,840	3,380	0	661	1,990	1,370	1,640	3,010	590	1,780
New York	68	.5	32	29	61	0	0	55	28	26	54	0	49
North Carolina	184	.2	13	114	127	19	0	127	12	102	114	0	114
North Dakota	109	59	88	96	184	0	6.6	165	78	86	164	5.9	148
Ohio	66	0	5.2	12	17	0	.1	16	4.7	11	15	.1	14
Oklahoma	317	186	553	121	673	0	6.0	426	493	108	601	5.4	380
Oregon	1,070	965	631	7,060	7,690	12	1,430	3,350	563	6,300	6,860	1,270	2,990
Pennsylvania	30	0	4.0	12	16	0	0	16	3.5	11	14	0	14
Rhode Island	6.8	0	.3	2.0	2.4	0	0	2.4	.3	1.8	2.1	0	2.1
South Carolina	69	0	34	28	61	16	0	61	30	25	55	0	55
South Dakota	287	109	158	281	439	0	69	305	141	251	392	62	272
Tennessee	45	.5	17	26	43	.8	0	26	15	23	38	0	23
Texas	2,160	4,060	6,270	3,250	9,520	38	740	7,990	5,590	2,900	8,490	660	7,130
Utah	457	837	569	3,460	4,020	44	699	2,160	508	3,080	3,590	624	1,930
Vermont	1.8	.2	0	.5	.6	0	0	.5	0	.5	.5	0	.5
Virginia	90	0	8.9	31	40	0	4.0	26	7.9	28	36	3.6	23
Washington	1,510	472	845	5,920	6,760	0	1,120	2,930	754	5,280	6,030	997	2,610
West Virginia	0	0	0	0	0	0	0	0	0	0	0	0	0
Wisconsin	227	0	168	2.0	170	0	0	170	150	1.8	151	0	151
Wyoming	211	1,730	266	7,760	8,020	0	2,410	2,910	237	6,920	7,160	2,150	2,590
Puerto Rico	21	14	60	97	157	0	19	102	54	87	140	17	91
Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	22,800	34,600	57,200	95,900	153,000	740	30,800	85,400	51,000	85,500	137,000	27,500	76,200

Livestock

Livestock water use includes water for livestock, feed lots, dairies, fish farms, and other on-farm needs. The "Livestock category" includes livestock water use, which is defined as water associated with the production of red meat, poultry, eggs, milk, and wool; and animal specialities water use, which is defined as water use associated with the production of fish in captivity (except fish hatcheries), fur-bearing animals in captivity, horses, rabbits, and pets (Office of Management and Budget, 1987, p. 27-29). A few States, such as Arkansas, Oregon, and California, have some offstream fish hatcheries that are included in the commercial category in this report. Water used instream for fish hatcheries is not included in this report.

Livestock use in this report is equivalent to the livestock category listed under "Livestock" or "Rural use" in previous water-use circulars in this series. In this report, animal specialties are separated from livestock activities because of the large increase in fish-farming water use. Fish farms are primarily engaged in the production of food fish under controlled feeding, sanitation, and harvesting procedures (Office of Management and Budget, 1987, p.29). Most water used for fish farms is required to maintain acceptable pond levels and water quality.

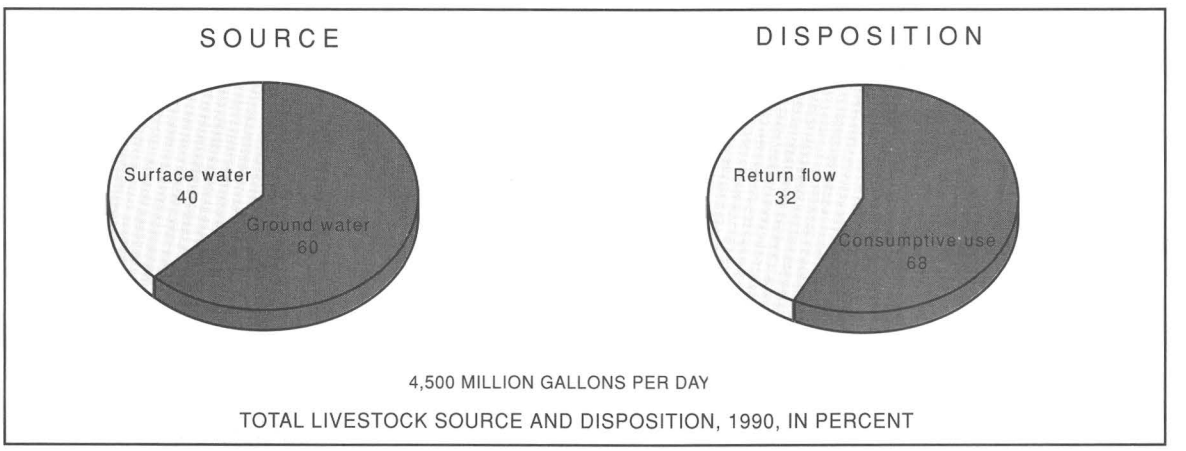
The quantity of surface water and ground water withdrawn for use by livestock was estimated from the numbers of animals in a county. The livestock and poultry numbers are available in most States from the U.S. Department of Agriculture Crop and Livestock Reporting Service or the Cooperative Extension Service. The number of each type of animal in each county was multiplied by an average water use per animal to obtain the water-use estimate. The Crop and Livestock Reporting Service or the Cooperative Extension Service generally have pond acreage for fish farms. Water use is estimated by multiplying pond acreage by an application rate. In some States, water use for fish farms is reported under a permit system.

The uncertainties in the livestock water-use estimates include difficulties in determining the sources of water and great variations in estimates of consumptive use. Consumptive use estimates generally were based on coefficients ranging from 10 to 100 percent of withdrawals.

The quantity of water withdrawn for total livestock purposes (livestock, animal specialties) during 1990 was an estimated 4,500 Mgal/d (tables 17, 18), or less than 1 percent more than withdrawn during 1985. Several States, including Louisiana and North Carolina, reported a significant increase in animal specialties water use, primarily fish farming. Idaho reported a significant decrease based on more reliable information. Total livestock use represents 1 percent of total freshwater use for all offstream categories.

The source and disposition of water for total livestock are shown in the chart below. Ground water was the source for about 60 percent of withdrawals for total livestock use, and surface water was the source for the remaining 40 percent. The consumptive use of water for total livestock during 1990 was about 3,040 Mgal/d, or 68 percent of withdrawals for total livestock use.

The Lower Mississippi and Pacific Northwest water-resources regions had the most water withdrawn for total livestock (figure 18) and accounted for nearly 38 percent of the Nation's total livestock use. The Missouri Basin and Arkansas-White-Red regions had the most water withdrawn for livestock, and the Lower Mississippi and Pacific Northwest regions had the most water withdrawn for animal specialties. By State, Idaho and Louisiana used the most water for total livestock (figure 19); Louisiana, Idaho, and Mississippi accounted for 64 percent of the Nation's animal specialties water use, largely because of fish farming.



TOTAL LIVESTOCK SOURCE AND DISPOSITION, 1990, IN PERCENT

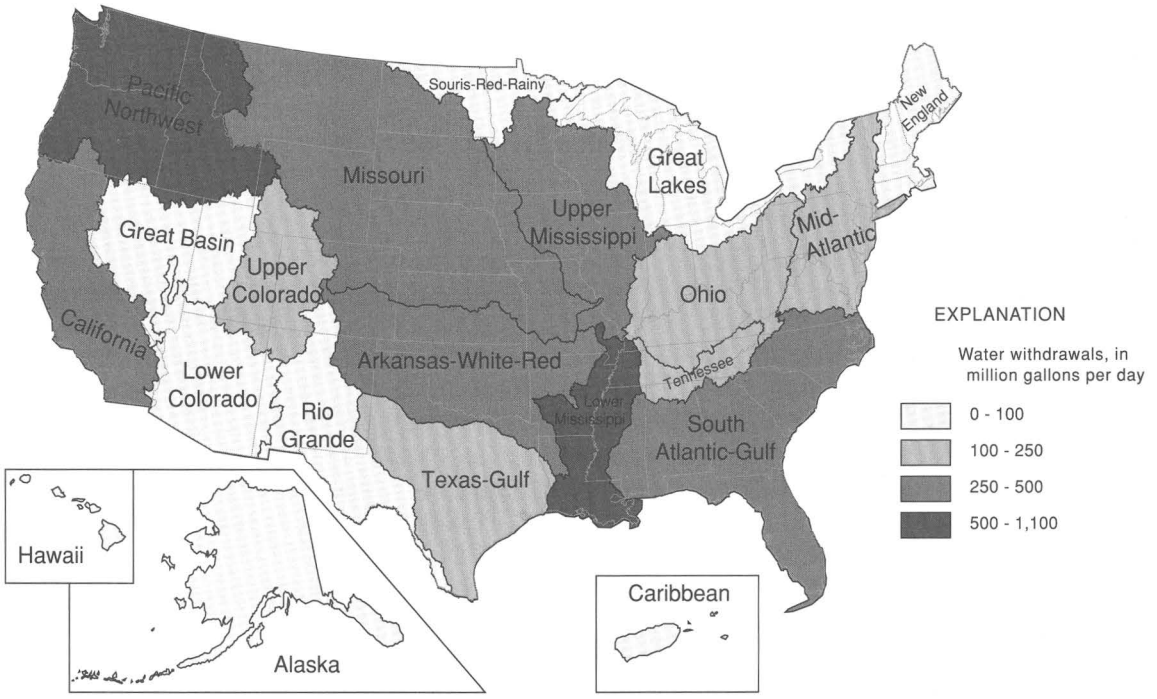


Figure 18. Total livestock freshwater withdrawals by water-resources region, 1990.

Table 17. Livestock freshwater use by water-resources region, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

REGION	LIVESTOCK				ANIMAL SPECIALTIES				TOTAL LIVESTOCK			
	Withdrawals				Withdrawals				Withdrawals			
	Ground water	Surface water	Total	Consumptive use	Ground water	Surface water	Total	Consumptive use	Ground water	Surface water	Total	Consumptive use
New England	4.9	2.5	7.5	6.8	0.4	0.2	0.6	0.6	5.4	2.8	8.1	7.4
Mid Atlantic	66	25	90	78	5.4	4.0	9.4	1.5	71	29	100	79
South Atlantic-Gulf	123	73	196	196	75	79	154	61	198	152	350	257
Great Lakes	49	23	72	62	2.1	18	20	2.4	51	41	92	64
Ohio	51	74	125	111	2.6	4.8	7.4	4.6	54	79	132	116
Tennessee	18	15	33	33	14	154	168	23	32	169	201	56
Upper Mississippi	193	43	236	217	23	9.0	32	17	217	52	269	233
Lower Mississippi	13	15	28	28	697	342	1,040	890	710	358	1,070	918
Souris-Red-Rainy	16	4.9	21	21	.1	0	.1	.1	16	4.9	21	21
Missouri Basin	229	155	384	380	13	18	31	5.9	242	172	415	386
Arkansas-White-Red	147	191	337	336	12	9.7	21	14	158	200	359	350
Texas-Gulf	54	102	156	155	0	0	0	0	54	102	156	155
Rio Grande	20	11	31	25	0	1.9	1.9	0	20	13	33	25
Upper Colorado	5.3	105	110	12	0	7.4	7.4	.1	5.3	112	117	12
Lower Colorado	28	11	38	31	2.8	57	60	.2	30	68	98	31
Great Basin	27	9.1	36	7.9	.2	.7	.9	.3	27	9.9	37	8.1
Pacific Northwest	73	28	101	59	518	.9	519	1.4	591	29	620	60
California	101	130	232	217	100	74	173	31	201	204	405	249
Alaska	.1	.5	.6	.6	0	0	0	0	.1	.5	.6	.6
Hawaii	2.1	3.4	5.4	5.4	1.4	.4	1.8	0	3.4	3.8	7.2	5.4
Caribbean	5.1	3.7	8.8	8.7	.1	0	.1	.1	5.2	3.7	8.9	8.9
Total	1,220	1,020	2,250	1,990	1,470	789	2,260	1,050	2,690	1,810	4,500	3,040

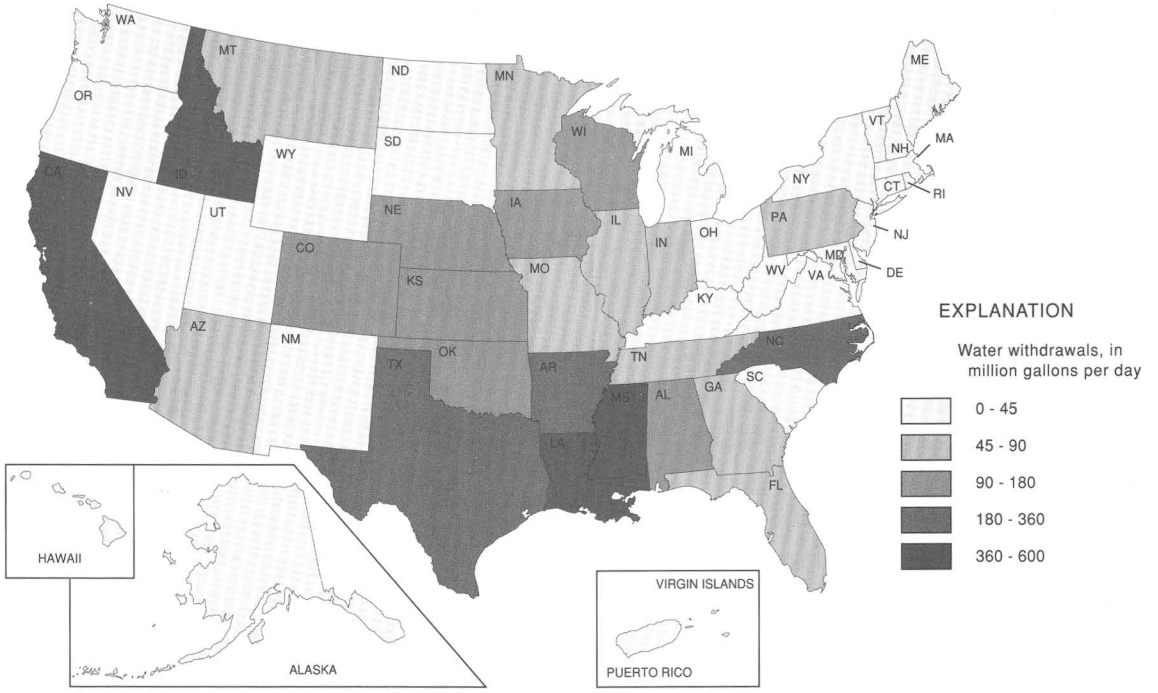


Figure 19. Total livestock freshwater withdrawals by State, 1990.

Table 18. Livestock freshwater use by State, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	LIVESTOCK				ANIMAL SPECIALTIES				TOTAL LIVESTOCK			
	Withdrawals			Consumptive use	Withdrawals			Consumptive use	Withdrawals			Consumptive use
	Ground water	Surface water	Total		Ground water	Surface water	Total		Ground water	Surface water	Total	
Alabama	41	23	64	64	31	46	77	16	72	69	141	79
Alaska	.1	.5	.6	.6	0	0	0	0	.1	.5	.6	.6
Arizona	23	6.6	29	22	2.8	57	60	.2	26	64	89	22
Arkansas	26	42	68	68	99	22	121	68	125	64	189	136
California	105	132	238	223	100	74	173	31	205	206	411	255
Colorado	22	126	147	43	0	14	14	0	22	140	162	43
Connecticut	.9	.3	1.2	1.0	.2	.1	.3	.3	1.1	.4	1.5	1.3
Delaware	2.1	.3	2.4	2.4	0	0	0	0	2.1	.3	2.4	2.4
D.C.	0	0	0	0	0	0	0	0	0	0	0	0
Florida	50	9.0	59	59	18	.6	19	19	69	9.6	78	78
Georgia	1.6	27	28	28	8.2	9.0	17	17	9.9	36	46	46
Hawaii	2.1	3.4	5.4	5.4	1.4	.4	1.8	0	3.4	3.8	7.2	5.4
Idaho	48	0	48	9.7	512	0	512	0	560	0	560	9.7
Illinois	52	0	52	41	9.0	2.2	11	11	61	2.2	63	52
Indiana	25	20	46	36	.5	0	.5	.5	26	20	46	37
Iowa	89	30	118	118	1.9	.5	2.4	2.4	91	30	121	121
Kansas	78	30	108	108	4.7	1.2	5.9	5.9	83	31	114	114
Kentucky	1.5	30	32	32	0	.9	.9	.9	1.6	31	33	33
Louisiana	3.5	5.0	8.5	8.4	219	324	543	542	222	329	551	550
Maine	.6	1.1	1.7	1.5	0	0	0	0	.6	1.1	1.7	1.5
Maryland	7.9	2.4	10	10	4.5	5	12	0	12	7	20	10
Massachusetts	1.2	.4	1.6	1.6	.1	0	.2	.2	1.4	.4	1.7	1.7
Michigan	18	4.8	23	19	.7	5.5	6.3	.8	19	10	29	20
Minnesota	55	9.7	65	65	1.6	.6	2.2	2.2	57	10	67	67
Mississippi	6.3	9.4	16	16	393	2.4	395	292	399	12	411	308
Missouri	13	39	52	52	.8	1.7	2.5	2.5	14	41	55	55
Montana	16	35	51	51	.3	.6	.9	.9	16	36	52	52
Nebraska	102	19	121	121	5.9	12	18	1.8	108	31	139	122
Nevada	1.0	4.1	5.1	2.1	0	.5	.5	0	1.0	4.6	5.6	2.1
New Hampshire	.7	.2	1.0	.8	0	0	0	0	.8	.3	1.0	.9
New Jersey	1.5	0	1.5	1.5	.6	0	.6	.6	2.1	0	2.1	2.1
New Mexico	18	3.6	22	21	0	0	0	0	18	3.6	22	21
New York	15	10	25	23	.4	.1	.5	.5	15	10	26	23
North Carolina	34	5.7	39	39	2.1	159	162	2.1	36	165	201	41
North Dakota	13	8.8	22	22	0	2.2	2.2	0	13	11	24	22
Ohio	7.3	26	33	32	.5	0	.5	0	7.8	26	34	32
Oklahoma	35	95	131	131	0	.2	.2	0	35	96	131	131
Oregon	3.2	18	21	21	0	.6	.6	.6	3.2	18	21	21
Pennsylvania	46	6.9	53	40	0	0	0	0	46	6.9	53	40
Rhode Island	.1	.1	.2	.1	0	.1	.2	.1	.1	.2	.3	.3
South Carolina	4.0	4.9	8.9	8.9	8.3	7.4	16	.8	12	12	25	9.7
South Dakota	17	26	43	43	0	0	0	0	17	26	43	43
Tennessee	12	9.6	21	21	17	11	28	28	29	21	49	49
Texas	93	135	228	227	0	0	0	0	93	135	228	227
Utah	27	6.6	34	6.3	.2	.3	.5	.3	27	7.0	34	6.6
Vermont	4.5	1.5	6.0	5.4	0	0	0	0	4.6	1.5	6.1	5.5
Virginia	8.5	20	28	28	.1	.8	.9	.9	8.5	21	29	29
Washington	21	8.2	29	25	.6	.2	.8	.7	22	8.4	30	26
West Virginia	1.3	3.4	4.7	4.0	0	.1	.1	.1	1.3	3.6	4.8	4.2
Wisconsin	61	6.8	68	55	13	18	31	3.1	74	25	99	58
Wyoming	3.3	13	16	16	10	0	10	0	14	13	27	16
Puerto Rico	4.8	3.4	8.2	8.2	.1	0	.1	.1	4.8	3.5	8.3	8.3
Virgin Islands	.3	.2	.5	.5	0	0	0	0	.3	.2	.5	.5
Total	1,220	1,020	2,250	1,990	1,470	789	2,260	1,050	2,690	1,810	4,500	3,040

Industrial

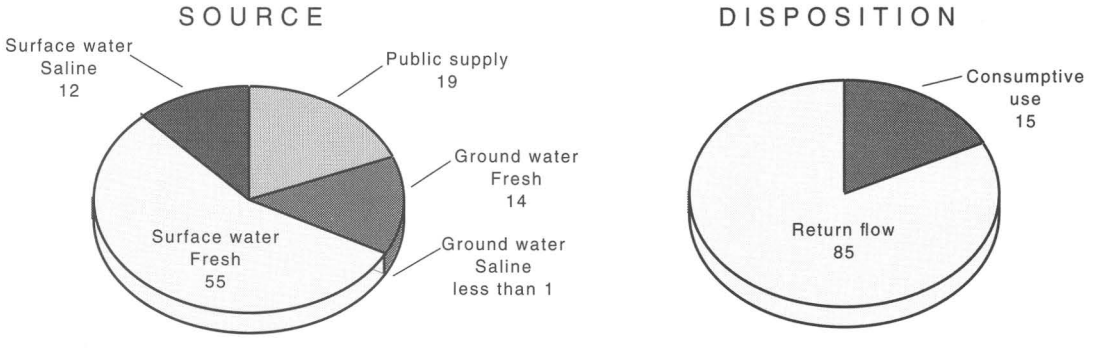
Industrial water use includes water for such purposes as processing, washing, and cooling in facilities that manufacture products. Major water-using industries include, but are not limited to, steel, chemical and allied products, paper and allied products, and petroleum refining.

Many States have developed permit programs that require reporting of industrial withdrawals and return flows. Estimates for 1990 are improved over those of previous years because of the availability of more comprehensive inventories of industrial facilities and more complete water-use records. Information on deliveries from public suppliers to industrial users were estimated from a variety of methods if not available directly from public suppliers. Consumptive-use estimates generally were based on coefficients ranging from 3 to 80 percent (depending on the type of industry) of withdrawals and deliveries.

Industrial water use (freshwater withdrawals, public-supply deliveries, saline water withdrawals) during 1990 was an estimated 19,300 Mgal/d of self-supplied freshwater, 5,190 Mgal/d of public-supplied freshwater, and an additional 3,270 Mgal/d of saline water. (See tables 19, 20.) Industrial freshwater use during 1990 was 13 percent less than during 1985 and represents 7 percent of total freshwater use for all offstream categories. Surface water was the source for about 82 percent of self-supplied industrial withdrawals; ground water, 18 percent; and reclaimed wastewater, only a fraction of 1 percent. Public-supplied deliveries to industries accounted for 13 percent of public-supply withdrawals.

The source and disposition of water for industrial purposes are shown in the chart below. The consumptive use of freshwater for industrial purposes during 1990 was 3,330 Mgal/d, or 14 percent of freshwater withdrawals and deliveries; saline consumptive use was 913 Mgal/d, or about 28 percent of saline water withdrawals.

In 1990, the Great Lakes and Mid Atlantic water-resources regions had the largest withdrawals for industrial purposes as shown in figure 20. Indiana, Louisiana, Texas, Pennsylvania, and Michigan reported the largest withdrawals for industries as shown in figure 21. Indiana, Louisiana, Pennsylvania, and Michigan reported the largest freshwater use (figure 22), and Maryland and Texas reported the largest quantities of reclaimed wastewater used by industries.



INDUSTRIAL SOURCE AND DISPOSITION, 1990, IN PERCENT

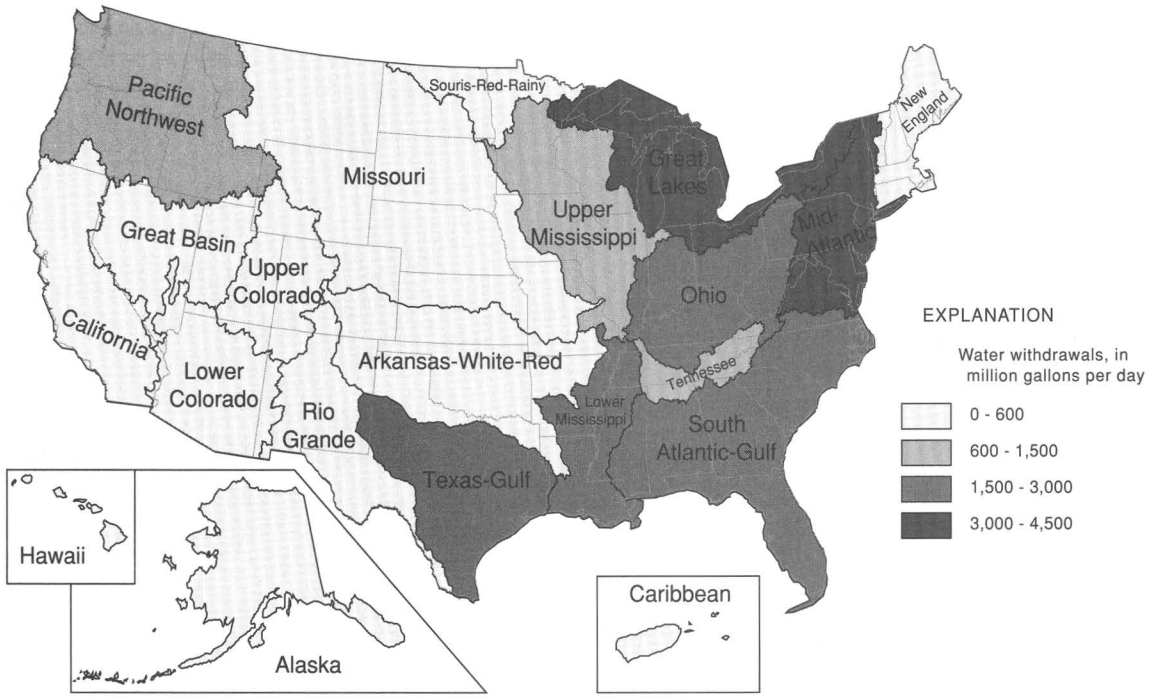


Figure 20. Industrial water withdrawals (fresh, saline) by water-resources region, 1990.

Table 19. Industrial water use by water-resources region, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

REGION	SELF-SUPPLIED WITHDRAWALS							RECLAIMED WASTE-WATER	PUBLIC-SUPPLY DELIV-ERIES	TOTAL USE		
	By source and type				Total					With-drawals and deliveries	Consumptive use	
	Ground water		Surface water									
	Fresh	Saline	Fresh	Saline	Fresh	Saline	Total		Fresh	Fresh	Fresh	Saline
New England	96	0.0	382	68	479	68	547	0.0	219	698	71	14
Mid Atlantic	360	.2	1,370	1,470	1,730	1,470	3,200	63	672	2,400	256	85
South Atlantic-Gulf	896	0	1,920	94	2,810	94	2,910	.5	855	3,670	470	2.9
Great Lakes	235	3.7	3,950	0	4,190	3.7	4,190	0	852	5,040	458	.4
Ohio	532	0	1,840	0	2,370	0	2,370	0	615	2,990	297	0
Tennessee	23	0	1,170	0	1,190	0	1,190	0	94	1,290	163	0
Upper Mississippi	349	0	618	0	967	0	967	0	467	1,430	214	0
Lower Mississippi	501	.6	2,120	67	2,620	67	2,690	0	70	2,690	286	.4
Souris-Red-Rainy	1.3	0	47	0	49	0	49	0	3.4	52	9.5	0
Missouri Basin	114	0	57	0	171	0	171	0	112	282	87	0
Arkansas-White-Red	67	0	301	0	368	0	368	1.9	257	625	113	0
Texas-Gulf	141	1.1	600	1,460	741	1,460	2,200	20	143	884	359	803
Rio Grande	11	0	1.0	0	12	0	12	.5	19	31	16	0
Upper Colorado	2.9	0	2.5	0	5.4	0	5.4	0	4.4	9.7	4.7	0
Lower Colorado	49	0	124	0	174	0	174	2.3	80	254	227	0
Great Basin	77	2.3	29	0	106	2.3	108	0	21	127	55	1.0
Pacific Northwest	336	0	691	36	1,030	36	1,060	1.6	175	1,200	125	4.8
California	126	0	4.8	25	130	25	156	.8	495	625	102	.3
Alaska	5.2	0	106	0	111	0	111	0	18	129	13	0
Hawaii	20	.6	23	0	43	.6	44	0	7.5	51	2.2	0
Caribbean	11	1.2	0	50	11	51	62	0	12	23	6.5	1.0
Total	3,950	9.7	15,400	3,260	19,300	3,270	22,600	90	5,190	24,500	3,330	913

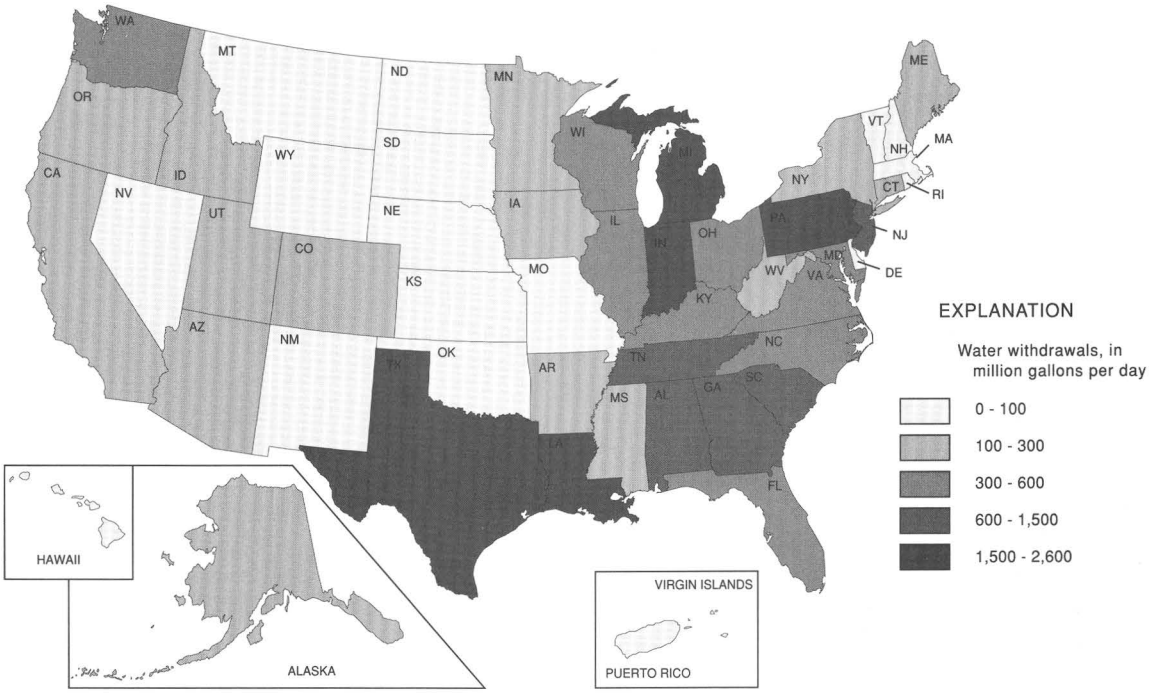


Figure 21. Industrial water withdrawals (fresh, saline) by State, 1990.

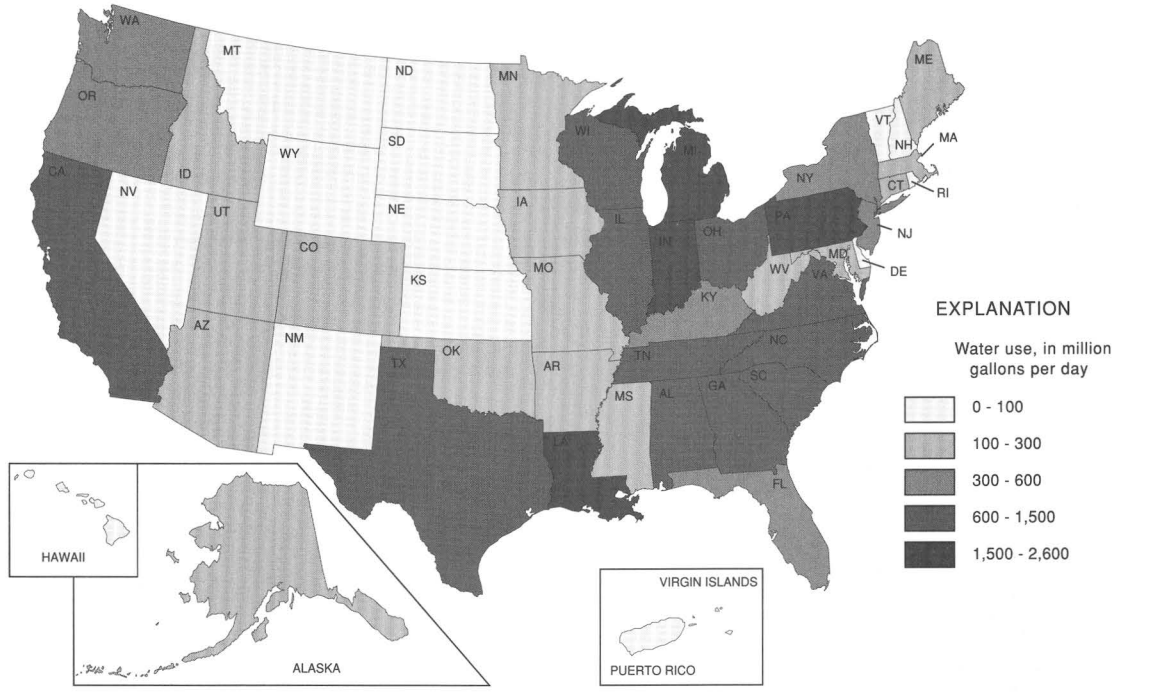


Figure 22. Industrial freshwater use (withdrawals, deliveries) by State, 1990.

Table 20. Industrial water use by State, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	SELF-SUPPLIED WITHDRAWALS							RECLAIMED WASTE-WATER	PUBLIC-SUPPLY DELIV-ERIES	TOTAL USE		
	By source and type				Total					With-drawals and deliveries	Consumptive use	
	Ground water		Surface water									
	Fresh	Saline	Fresh	Saline	Fresh	Saline	Total		Fresh	Fresh	Fresh	Saline
Alabama	31	0.0	753	0.0	784	0.0	784	0.0	185	969	194	0.0
Alaska	5.2	0	106	0	111	0	111	0	18	129	13	0
Arizona	39	0	124	0	163	0	163	2.3	78	242	223	0
Arkansas	99	0	78	0	177	0	177	0	.7	178	13	0
California	125	0	3.4	25	129	25	154	.8	492	621	101	.3
Colorado	33	0	85	0	118	0	118	0	21	139	41	0
Connecticut	19	0	61	68	80	68	148	0	64	144	16	14
Delaware	18	0	47	6.0	65	6.0	71	0	15	80	12	0
D.C.	.5	0	0	0	.5	0	.5	0	0	.5	0	0
Florida	282	0	121	56	403	56	459	0	183	586	67	0
Georgia	346	0	311	33	657	33	689	.5	157	814	77	2.3
Hawaii	20	.6	23	0	43	.6	44	0	7.5	51	2.2	0
Idaho	170	0	26	0	196	0	196	0	3.8	200	6.0	0
Illinois	155	0	309	0	464	0	464	0	263	728	80	0
Indiana	129	0	2,350	0	2,480	0	2,480	0	105	2,590	155	0
Iowa	71	0	148	0	219	0	219	0	34	253	33	0
Kansas	50	0	3.8	0	53	0	53	.5	35	88	30	0
Kentucky	93	0	220	0	313	0	313	0	199	512	19	0
Louisiana	289	.6	2,070	67	2,360	67	2,430	0	32	2,390	265	.4
Maine	9.8	0	244	0	254	0	254	0	17	270	27	0
Maryland	20	0	50	379	70	379	449	63	52	122	18	57
Massachusetts	65	0	22	0	87	0	87	0	108	195	20	0
Michigan	175	3.7	1,510	0	1,680	3.7	1,690	0	411	2,100	152	.4
Minnesota	65	0	89	0	154	0	154	0	44	198	35	0
Mississippi	144	0	126	0	269	0	269	0	19	288	46	0
Missouri	53	0	32	0	85	0	85	0	133	218	29	0
Montana	30	0	27	0	57	0	57	0	1.0	58	8.8	0
Nebraska	39	0	2.4	0	41	0	41	0	33	74	31	0
Nevada	9.4	0	.8	0	10	0	10	0	2.6	13	2.5	0
New Hampshire	.3	0	37	0	37	0	37	0	15	53	5.3	0
New Jersey	53	.2	273	1,020	326	1,020	1,340	0	241	567	45	20
New Mexico	4.6	0	1.7	0	6.3	0	6.3	0	15	21	14	0
New York	85	0	189	0	274	0	274	0	314	588	60	0
North Carolina	63	0	328	5.5	390	5.5	396	0	245	635	34	.6
North Dakota	2.1	0	6.6	0	8.8	0	8.8	0	2.6	11	9.2	0
Ohio	123	0	230	0	354	0	354	0	325	679	204	0
Oklahoma	3.3	0	32	0	35	0	35	0	113	148	10	0
Oregon	31	0	254	0	284	0	284	1.6	81	365	39	0
Pennsylvania	180	0	1,690	0	1,870	0	1,870	0	248	2,120	189	0
Rhode Island	2.5	0	9.1	0	12	0	12	0	12	24	1.7	0
South Carolina	47	0	585	0	632	0	632	0	46	678	102	0
South Dakota	5.0	0	10	0	15	0	15	0	8.0	23	3.4	0
Tennessee	69	0	813	0	882	0	882	0	106	988	109	0
Texas	143	1.1	741	1,460	884	1,460	2,340	22	255	1,140	418	803
Utah	77	2.3	29	0	106	2.3	108	0	21	128	56	1.0
Vermont	1.0	0	43	0	44	0	44	0	3.1	47	4.7	0
Virginia	195	0	300	66	495	66	561	0	152	647	78	7.9
Washington	104	0	397	36	501	36	536	0	93	594	73	4.8
West Virginia	106	0	26	0	132	0	132	0	13	145	22	0
Wisconsin	58	0	409	0	468	0	468	0	151	619	125	0
Wyoming	6.0	0	9.9	0	16	0	16	0	5.5	21	3.2	0
Puerto Rico	11	0	0	0	11	0	11	0	12	23	6.5	0
Virgin Islands	.1	1.2	0	50	.1	51	51	0	0	.1	0	1.0
Total	3,950	9.7	15,400	3,260	19,300	3,270	22,600	90	5,190	24,500	3,330	913

Mining

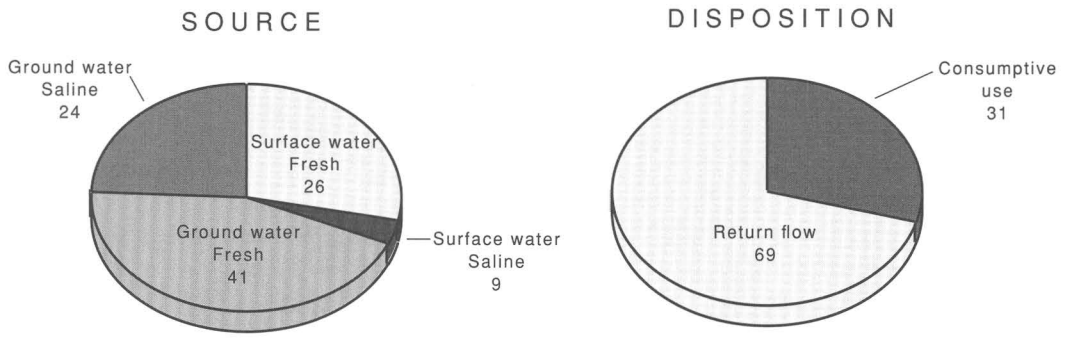
Mining water use includes water for the extraction of naturally occurring materials (including petroleum), dewatering, milling, and other preparations that are a part of mining activities. All water is self supplied and saline water is significant.

Water used in mining is difficult to quantify. Except for some washing and milling, water used at mining sites tends to be an impediment to or a byproduct of the extraction process. Unless water is needed for the mining operation, little attention is paid to quantities withdrawn. Estimates for mining withdrawals were obtained from State agencies that regulate discharges, or by estimating a coefficient for the relation between the quantity of water withdrawn and the quantity of material extracted. Consumptive-use estimates were based on coefficients, ranging from 10 to 100 percent of withdrawals, depending on the type of mining activity.

The quantity of water withdrawn for mining during 1990 was an estimated 3,310 Mgal/d of freshwater, and an additional 1,650 Mgal/d of saline water. (See tables 21, 22.) Mining freshwater use during 1990 was 24 percent more than during 1985, and represents 1 percent of total freshwater use for all offstream categories. Some of the increase can be attributed to a more complete inventory of mines in some States.

The source and disposition of water for mining purposes are shown in the chart below. Ground water was the source for about 65 percent of mining withdrawals, and surface water was the source for the remaining 35 percent. Saline water accounted for approximately one-third of total mining withdrawals. The consumptive use of freshwater and saline water for mining during 1990 was about 1,550 Mgal/d or 31 percent of total withdrawals.

The most water withdrawn for mining use during 1990 was in the Ohio water-resources region, followed by the Texas-Gulf, the South Atlantic-Gulf, and the Mid Atlantic regions, as shown in figure 23. By State, Texas and West Virginia had the most freshwater and saline water withdrawn for mining (figure 24), and accounted for about 23 percent of the Nation's total mining withdrawals. West Virginia and Florida had the most freshwater withdrawn for mining (figure 25).



MINING SOURCE AND DISPOSITION, 1990, IN PERCENT

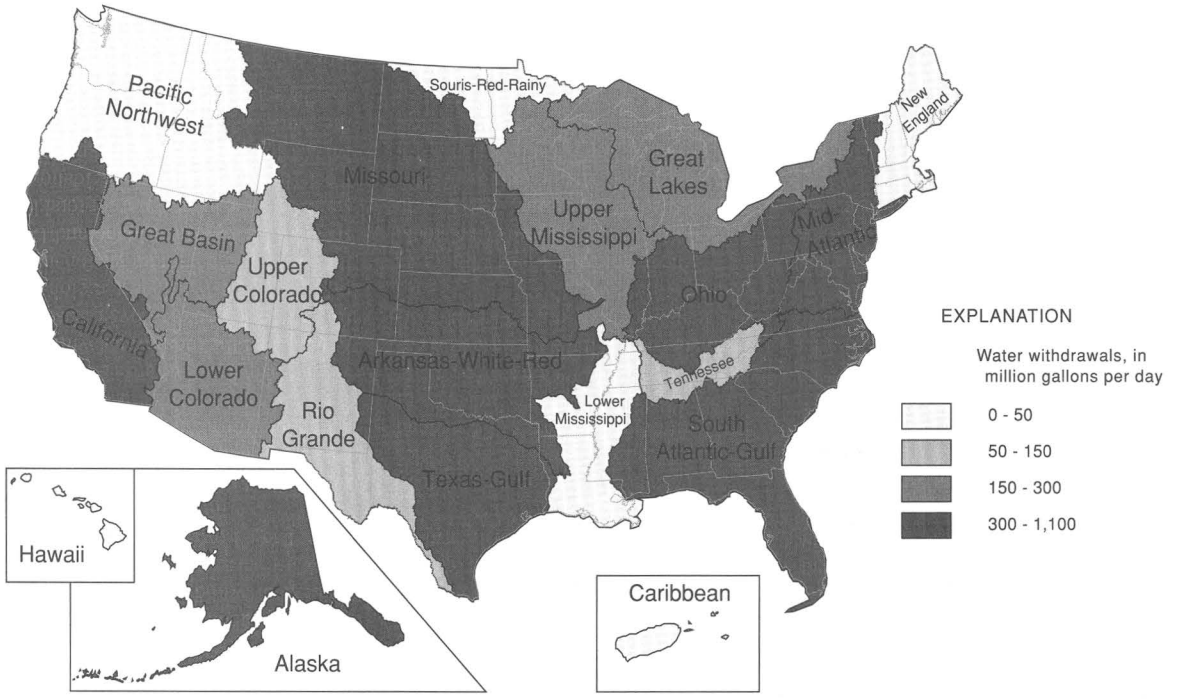


Figure 23. Mining water withdrawals (fresh, saline) by water-resources region, 1990.

Table 21. Mining water use by water-resources region, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

REGION	WITHDRAWALS									CONSUMPTIVE USE		
	By source and type						Total					
	Ground water			Surface water								
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
New England	1.3	0.0	1.3	19	0.0	19	20	0.0	20	2.2	0.0	2.2
Mid Atlantic	210	1.0	211	176	29	205	387	30	416	58	23	81
South Atlantic-Gulf	384	9.1	393	53	0	53	437	9.1	446	23	3.3	26
Great Lakes	22	1.2	23	227	6.5	233	249	7.7	257	64	2.0	66
Ohio	784	22	806	218	.6	219	1,000	22	1,020	509	22	530
Tennessee	25	0	25	67	0	67	92	0	92	9.6	0	9.6
Upper Mississippi	11	4.2	15	143	0	143	154	4.2	158	28	4.2	33
Lower Mississippi	7.9	0	7.9	32	0	32	40	0	40	6.1	0	6.1
Souris-Red-Rainy	.2	0	.2	8.0	0	8.0	8.2	0	8.2	.4	0	.4
Missouri Basin	96	37	134	182	0	182	279	37	316	44	2.7	47
Arkansas-White-Red	49	291	340	25	0	25	74	291	365	30	0	30
Texas-Gulf	84	399	482	47	0	47	130	399	529	121	0	121
Rio Grande	65	39	104	1.5	0	1.5	66	39	105	42	0	42
Upper Colorado	39	28	67	12	0	12	51	28	79	22	1.4	24
Lower Colorado	139	.6	140	30	.2	30	170	.7	170	130	.7	131
Great Basin	77	17	94	5.7	93	98	83	110	192	57	105	162
Pacific Northwest	5.0	0	5.0	10	0	10	15	0	15	2.5	0	2.5
California	15	310	324	7.0	.4	7.4	22	310	332	6.5	225	231
Alaska	4.3	48	52	20	308	329	25	357	381	.2	3.6	3.8
Hawaii	1.4	0	1.4	0	0	0	1.4	0	1.4	1.2	0	1.2
Caribbean	1.9	0	1.9	.7	0	.7	2.6	0	2.6	.8	0	.8
Total	2,020	1,210	3,240	1,280	438	1,720	3,310	1,650	4,960	1,160	393	1,550

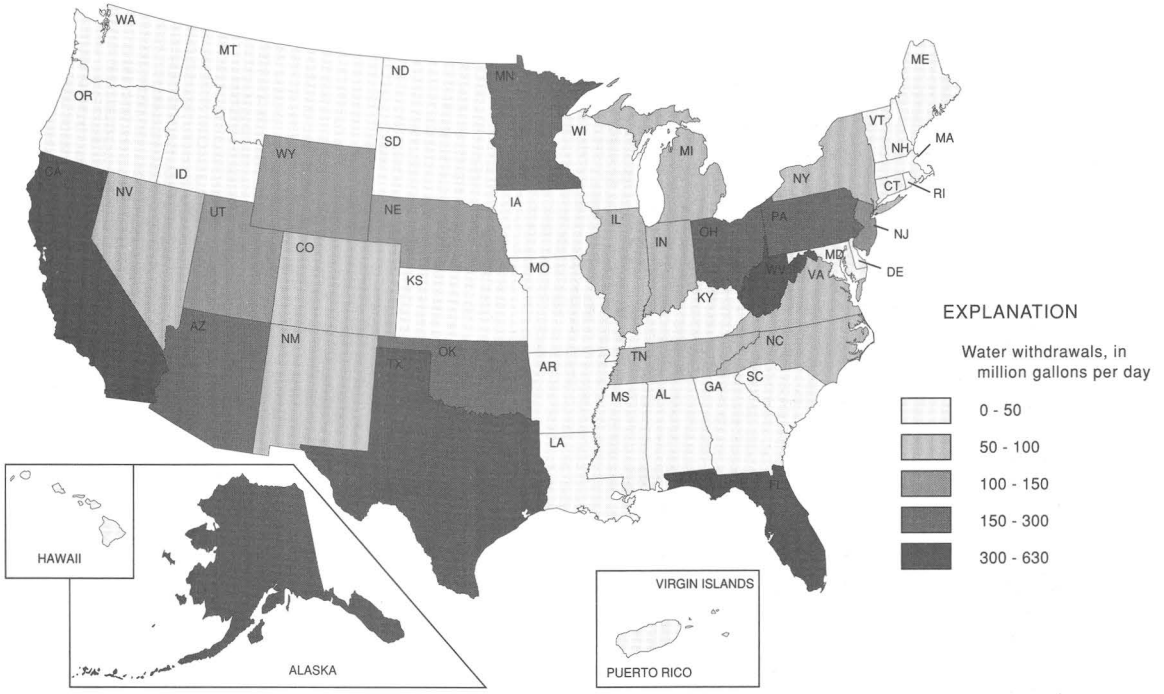


Figure 24. Mining withdrawals (fresh, saline) by State, 1990.

Figure 25. Mining freshwater withdrawals by State, 1990.

Table 22. Mining water use by State, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	WITHDRAWALS									CONSUMPTIVE USE		
	By source and type						Total					
	Ground water			Surface water								
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alabama	4.0	9.1	13	7.0	0.0	7.0	11	9.1	20	0.0	3.3	3.3
Alaska	4.3	48	52	20	308	329	25	357	381	.2	3.6	3.8
Arizona	127	.5	128	29	.2	29	156	.7	157	119	.7	119
Arkansas	1.8	0	1.8	.7	0	.7	2.5	0	2.5	2.5	0	2.5
California	13	310	323	7.0	.4	7.4	20	310	330	4.4	225	229
Colorado	28	30	57	26	0	26	54	30	84	14	4.1	18
Connecticut	.4	0	.4	1.8	0	1.8	2.2	0	2.2	.4	0	.4
DElaware	0	0	0	0	0	0	0	0	0	0	0	0
D.C.	.5	0	.5	0	0	0	.5	0	.5	0	0	0
Florida	299	0	299	17	0	17	315	0	315	15	0	15
Georgia	8.7	0	8.7	2.9	0	2.9	12	0	12	0	0	0
Hawaii	1.4	0	1.4	0	0	0	1.4	0	1.4	1.2	0	1.2
Idaho	.6	0	.6	7.8	0	7.8	8.4	0	8.4	.8	0	.8
Illinois	7.6	25	33	61	0	61	69	25	94	20	25	46
Indiana	9.5	0	9.5	88	0	88	97	0	97	5.8	0	5.8
Iowa	.7	0	.7	33	0	33	34	0	34	0	0	0
Kansas	25	0	25	.9	0	.9	26	0	26	10	0	10
Kentucky	5.2	0	5.2	13	0	13	18	0	18	.5	0	.5
Louisiana	.4	0	.4	36	0	36	37	0	37	3.8	0	3.8
Maine	.7	0	.7	2.9	0	2.9	3.7	0	3.7	.5	0	.5
Maryland	21	0	21	7.5	21	29	28	21	49	5.6	21	26
Massachusetts	0	0	0	5.0	0	5.0	5.0	0	5.0	0	0	0
Michigan	8.8	.9	9.7	46	0	46	55	.9	56	2.1	.1	2.2
Minnesota	2.4	0	2.4	217	0	217	220	0	220	57	0	57
Mississippi	2.9	0	2.9	.5	0	.5	3.4	0	3.4	.8	0	.8
Missouri	25	.1	25	.1	0	.1	25	.1	25	2.5	0	2.5
Montana	2.6	13	15	3.6	0	3.6	6.2	13	19	1.1	0	1.1
Nebraska	1.2	4.7	5.9	130	0	130	131	4.7	136	0	0	0
Nevada	45	12	57	3.5	0	3.5	49	12	61	49	12	61
New Hampshire	.1	0	.1	2.7	0	2.7	2.8	0	2.8	.6	0	.6
New Jersey	7.8	0	7.8	103	0	103	110	0	110	8.8	0	8.8
New Mexico	77	0	77	2.4	0	2.4	80	0	80	48	0	48
New York	11	1.5	13	34	15	49	45	16	62	13	4.4	17
North Carolina	68	0	68	28	0	28	96	0	96	6.4	0	6.4
North Dakota	3.0	0	3.0	.7	0	.7	3.7	0	3.7	3.0	0	3.0
Ohio	203	0	203	40	0	40	243	0	243	140	0	140
Oklahoma	2.2	243	245	.5	0	.5	2.8	243	246	2.7	0	2.7
Oregon	1.0	0	1.0	.6	0	.6	1.5	0	1.5	.2	0	.2
Pennsylvania	211	0	211	41	0	41	252	0	252	25	0	25
Rhode Island	0	0	0	6.8	0	6.8	6.8	0	6.8	.7	0	.7
South Carolina	8.0	0	8.0	3.6	0	3.6	12	0	12	1.2	0	1.2
South Dakota	15	0	15	23	0	23	38	0	38	9.5	0	9.5
Tennessee	8.2	0	8.2	82	0	82	90	0	90	9.9	0	9.9
Texas	93	491	584	46	0	46	139	491	630	138	0	138
Utah	37	5.0	42	3.6	93	96	41	98	138	16	94	109
Vermont	.3	0	.3	3.4	0	3.4	3.7	0	3.7	.7	0	.7
Virginia	23	0	23	68	0	68	91	0	91	11	0	11
Washington	2.4	0	2.4	.6	0	.6	3.0	0	3.0	.4	0	.4
West Virginia	527	0	527	0	0	0	527	0	527	369	0	369
Wisconsin	.2	0	.2	0	0	0	.2	0	.2	0	0	0
Wyoming	75	19	95	26	0	26	101	19	121	35	0	35
Puerto Rico	1.9	0	1.9	.7	0	.7	2.6	0	2.6	.8	0	.8
Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,020	1,210	3,240	1,280	438	1,720	3,310	1,650	4,960	1,160	393	1,550

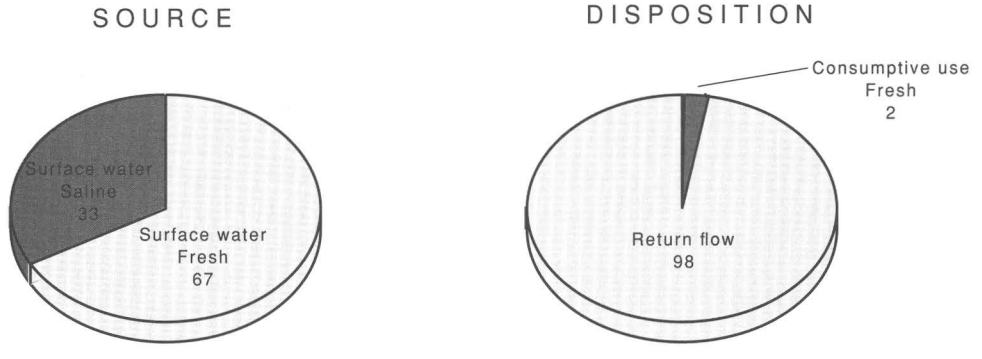
Thermoelectric Power

The thermoelectric power category includes water used in the generation of electric power with fossil-fuel, nuclear, or geothermal energy. The estimates of water withdrawals for thermoelectric power should be reliable because relatively complete files on power generation are maintained by Federal and State agencies. The Electric Power Annual is prepared by the U.S. Department of Energy, Energy Information Administration, and contains information about electric power net generation. Most of the water withdrawn by thermoelectric plants is used for condenser and reactor cooling. Plants vary widely as to the techniques used in the disposal of the cooling water after it is passed through the condensers. Less water is required when cooling water is recycled through cooling towers or ponds, but a higher percentage of the cooling water is evaporated (consumptive use), usually more than 60 percent. When the water withdrawn for cooling is used only once before it is returned to a surface water body, significantly more water is required, but evaporation is low (less than 3 percent). Water-withdrawal estimates generally were made based on power generation. Consumptive use estimates were based on coefficients ranging from 1 to 100 percent of withdrawals.

The quantity of water used for thermoelectric power generation during 1990 was 131,000 Mgal/d of freshwater (the same quantity as in 1985), and an additional 64,500 Mgal/d of saline water (tables 23, 24) (15 percent more than in 1985). Thermoelectric power accounts for 39 percent of total freshwater use for all offstream categories and represents 48 percent of combined fresh and saline withdrawals. Fossil-fuel thermoelectric plants accounted for about 73 percent of total thermoelectric withdrawals; nuclear plants, 27 percent; and geothermal plants, less than 1 percent. Saline ground water was only reported for geothermal plants in California (41 Mgal/d), Nevada (32 Mgal/d), North Dakota (0.3 Mgal/d), and Utah (7.9 Mgal/d), and is not listed in the tables or included in the totals. Thermoelectric fresh and saline withdrawals were about 1.4 times the water withdrawn for irrigation, the next largest category.

The source and disposition of water for thermoelectric power are shown in the chart below. Surface water was the source for more than 99 percent of total thermoelectric withdrawals, and about 33 percent of the surface-water withdrawal was saline. Thermoelectric power plants furnish most of their own water; less than 0.1 percent is obtained from public supplies. About 2 percent of the water withdrawn for thermoelectric power (fossil fuel, nuclear) during 1990 was consumptively used as a result of once-through, cooling-tower, or pond cooling.

About five times more water was used in 1990 for thermoelectric power generation in the eastern part of the United States than in the western part to generate about twice as much power. The Mid Atlantic and South Atlantic-Gulf water-resources regions, where surface water is plentiful, led the nation in both fresh and saline withdrawals (figure 23). By State, New York, Illinois, California, Florida, Texas, Ohio, and New Jersey accounted for about 43 percent of total thermoelectric withdrawals (figure 27). Illinois and Ohio led the nation in freshwater withdrawals for themoelectric power generation (figure 28).



THERMOELECTRIC POWER SOURCE AND DISPOSITION, 1990, IN PERCENT

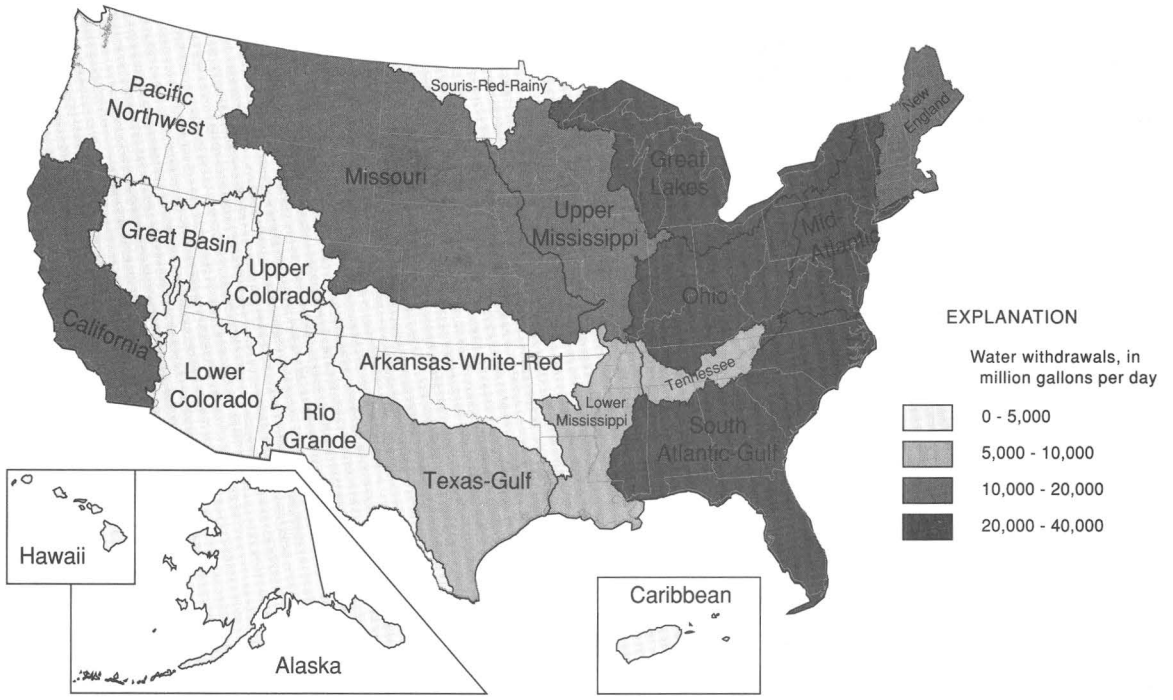


Figure 26. Thermoelectric power water withdrawals (fresh, saline) by water-resources region, 1990.

Table 23. Thermoelectric power water use by water-resources region, 1990

[Figures may not add to totals because of independent rounding. Mgal/d = million gallons per day; kWh = kilowatthour]

REGION	ALL THERMOELECTRIC POWER WATER USE, in Mgal/d									POWER GENERATED, in million kWh
	Self-supplied withdrawals, by source and type				Public-supply deliveries	Total use				
	Ground water	Surface water				Withdrawals and deliveries	Consumptive use			
	Fresh	Fresh	Saline	Total	Fresh	Fresh	Fresh	Saline	Total	
New England	2.9	2,400	9,090	11,500	6.6	2,410	48	182	230	93,000
Mid Atlantic	4.6	12,200	25,000	37,200	1.1	12,200	187	226	413	279,000
South Atlantic-Gulf	41	19,700	10,700	30,300	6.1	19,700	272	1.6	273	404,000
Great Lakes	3.2	22,800	0	22,800	.1	22,800	476	0	476	179,000
Ohio	65	23,800	0	23,800	.9	23,900	881	0	881	436,000
Tennessee	0	7,070	0	7,070	0	7,070	15	0	15	60,800
Upper Mississippi	21	16,500	0	16,500	5.8	16,500	635	0	635	194,000
Lower Mississippi	75	5,570	1,060	6,620	.7	5,640	87	42	129	73,500
Souris-Red-Rainy	0	26	0	26	0	26	.6	0	.6	338
Missouri Basin	50	9,980	0	9,980	7.0	10,000	195	0	195	159,000
Arkansas-White-Red	31	4,500	0	4,500	26	4,550	144	0	144	132,000
Texas-Gulf	46	4,660	3,150	7,820	7.1	4,720	207	9.4	217	192,000
Rio Grande	16	1.8	0	1.8	0	18	12	0	12	7,780
Upper Colorado	0	177	0	177	0	177	165	0	165	91,400
Lower Colorado	47	62	.4	62	.8	110	107	.4	107	54,000
Great Basin	7.2	24	0	24	0	31	31	0	31	17,300
Pacific Northwest	10	345	0	345	0	355	21	0	21	21,600
California	4.6	241	11,400	11,600	13	258	6.4	6.5	13	80,100
Alaska	4.7	26	0	26	1.0	32	3.2	0	3.2	3,820
Hawaii	95	0	1,550	1,550	.4	96	1.7	15	17	8,320
Caribbean	2.6	0	2,570	2,570	3.3	5.9	1.1	1.1	2.1	15,000
Total	525	130,000	64,500	194,000	80	131,000	3,500	484	3,980	2,500,000

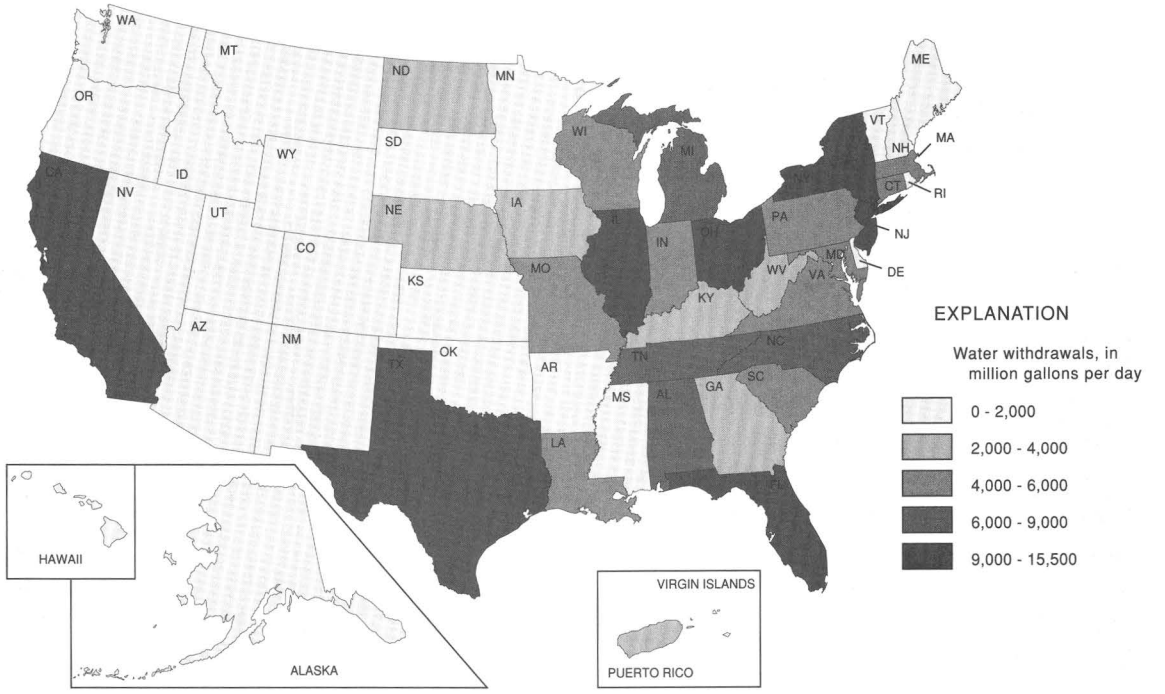


Figure 27. Thermoelectric power water withdrawals (fresh, saline) by State, 1990.

Figure 28. Thermoelectric power freshwater withdrawals by State, 1990.

Table 24. Thermoelectric power water use by State, 1990

[Figures may not add to totals because of independent rounding. Mgal/d = million gallons per day; kWh = kilowatthour]

STATE	ALL THERMOELECTRIC POWER WATER USE, in Mgal/d									POWER GENERATED, in million kWh
	Self-supplied withdrawals, by source and type				Public-supply deliveries	Total use				
	Ground water	Surface water				Withdrawals and deliveries	Consumptive use			
	Fresh	Fresh	Saline	Total	Fresh	Fresh	Fresh	Saline	Total	
Alabama	0.0	6,310	0.0	6,310	0.0	6,310	44	0.0	44	66,400
Alaska	4.7	26	0	26	1.0	32	3.2	0	3.2	3,820
Arizona	42	61	.4	62	0	103	100	.4	101	55,900
Arkansas	2.4	1,640	0	1,640	0	1,640	13	0	13	34,500
California	4.6	241	11,400	11,600	13	258	6.4	6.5	13	80,100
Colorado	21	94	0	94	13	127	41	0	41	30,000
Connecticut	.2	530	3,710	4,240	2.6	533	11	74	85	33,100
Delaware	.5	830	333	1,160	.9	831	5.0	1.5	6.6	6,640
D.C.	0	8.0	0	8.0	0	8.0	.6	0	.6	361
Florida	23	709	10,300	11,000	5.5	738	22	0	22	128,000
Georgia	5.2	3,020	33	3,060	0	3,030	98	0	98	92,700
Hawaii	95	0	1,550	1,550	.4	96	1.7	15	17	8,320
Idaho	6.1	0	0	0	0	6.1	1.5	0	1.5	0
Illinois	9.0	15,200	0	15,200	1.3	15,200	370	0	370	128,000
Indiana	12	5,950	0	5,950	0	5,960	119	0	119	97,300
Iowa	12	2,060	0	2,060	4.7	2,080	10	0	10	29,000
Kansas	13	1,290	0	1,290	.8	1,300	63	0	63	33,700
Kentucky	38	3,410	0	3,410	0	3,440	203	0	203	70,600
Louisiana	40	4,910	0	4,910	0	4,950	46	0	46	57,000
Maine	1.4	81	609	690	1.2	83	1.6	12	14	9,390
Maryland	1.8	419	4,550	4,970	0	421	4.2	54	59	29,100
Massachusetts	.5	1,010	3,490	4,500	2.8	1,020	20	70	90	36,200
Michigan	2.8	8,050	0	8,050	0	8,060	204	0	204	68,600
Minnesota	2.4	1,880	0	1,880	.5	1,880	323	0	323	42,700
Mississippi	43	342	316	658	.3	386	52	1.6	54	21,800
Missouri	32	4,540	1,060	5,600	.2	4,580	55	42	97	57,100
Montana	0	33	0	33	0	33	33	0	33	15,100
Nebraska	6.0	2,180	0	2,180	1.9	2,180	22	0	22	20,500
Nevada	12	22	0	22	.8	34	34	0	34	19,100
New Hampshire	.8	254	894	1,150	0	255	5.1	18	23	10,200
New Jersey	1.6	597	9,550	10,100	.2	599	.2	0	.2	36,500
New Mexico	9.9	40	0	40	.1	50	46	0	46	28,300
New York	0	6,990	8,470	15,500	0	6,990	171	170	340	105,000
North Carolina	0	7,210	0	7,210	.4	7,210	43	0	43	73,000
North Dakota	.1	2,390	0	2,390	0	2,390	26	0	26	26,900
Ohio	13	9,540	0	9,540	0	9,550	393	0	393	126,000
Oklahoma	1.8	88	0	88	1.5	91	48	0	48	41,500
Oregon	0	15	0	15	0	15	11	0	11	8,040
Pennsylvania	0	5,750	0	5,750	0	5,750	218	0	218	162,000
Rhode Island	0	0	393	393	0	0	0	7.9	7.9	591
South Carolina	1.4	4,820	0	4,820	0	4,820	55	0	55	48,200
South Dakota	.4	2.8	0	2.8	0	3.2	.1	0	.1	2,490
Tennessee	0	7,320	0	7,320	.5	7,320	0	0	0	64,300
Texas	54	7,070	3,150	10,200	22	7,150	247	9.4	257	224,000
Utah	0	87	0	87	0	87	86	0	86	31,600
Vermont	.4	518	0	518	.1	519	11	0	11	3,780
Virginia	.4	3,210	2,080	5,290	0	3,210	12	0	12	46,600
Washington	4.0	330	0	330	0	334	8.8	0	8.8	13,500
West Virginia	.4	3,710	0	3,710	.9	3,710	99	0	99	84,600
Wisconsin	2.4	5,090	0	5,090	0	5,100	51	0	51	40,900
Wyoming	1.0	183	0	183	0	184	54	0	54	35,800
Puerto Rico	2.6	0	2,470	2,470	2.8	5.4	1.1	0	1.1	14,500
Virgin Islands	0	0	103	103	.5	.5	0	1.1	1.1	460
Total	525	130,000	64,500	194,000	80	131,000	3,500	484	3,980	2,500,000

Table 25. Thermoelectric power water use by energy source and water-resources region, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

REGION	FOSSIL FUEL						NUCLEAR					
	Withdrawals, by source and type				Consumptive use		Withdrawals, by source and type				Consumptive use	
	Ground water	Surface water					Ground water	Surface water				
	Fresh	Fresh	Saline	Total	Fresh	Saline	Fresh	Fresh	Saline	Total	Fresh	Saline
New England	2.8	1,380	5,290	6,670	28	106	0.1	1,020	3,800	4,820	21	76
Mid Atlantic	3.6	9,130	13,400	22,500	111	180	.9	3,040	11,600	14,600	76	45
South Atlantic-Gulf	37	12,300	8,840	21,200	165	1.6	3.9	7,330	1,820	9,150	107	0
Great Lakes	3.1	15,200	0	15,200	245	0	.1	7,620	0	7,620	230	0
Ohio	65	23,800	0	23,800	852	0	0	65	0	65	30	0
Tennessee	0	5,130	0	5,130	14	0	0	1,930	0	1,930	1.0	0
Upper Mississippi	16	11,800	0	11,800	454	0	4.6	4,630	0	4,630	181	0
Lower Mississippi	44	4,480	1,060	5,540	50	42	30	1,090	0	1,090	37	0
Souris-Red-Rainy	0	26	0	26	.6	0	0	0	0	0	0	0
Missouri Basin	50	8,970	0	8,970	169	0	0	1,010	0	1,010	26	0
Arkansas-White-Red	31	3,570	0	3,570	125	0	0	923	0	923	18	0
Texas-Gulf	44	4,610	3,150	7,760	153	9.4	1.3	53	0	53	54	0
Rio Grande	16	1.8	0	1.8	12	0	0	0	0	0	0	0
Upper Colorado	0	177	0	177	165	0	0	0	0	0	0	0
Lower Colorado	47	19	.4	20	66	.4	.1	43	0	43	40	0
Great Basin	7.2	24	0	24	31	0	0	0	0	0	0	0
Pacific Northwest	4.0	34	0	34	1.6	0	6.1	311	0	311	19	0
California	4.5	241	5,910	6,150	6.2	5.9	.1	.1	5,500	5,500	.3	.6
Alaska	4.7	26	0	26	3.2	0	0	0	0	0	0	0
Hawaii	95	0	1,550	1,550	1.7	15	0	0	0	0	0	0
Caribbean	2.6	0	2,570	2,570	1.1	1.1	0	0	0	0	0	0
Total	478	101,000	41,700	143,000	2,650	362	48	29,100	22,700	51,800	841	122

Table 26. Thermoelectric power water use by energy source and State, 1990

[Figures may not add to totals because of independent rounding. All values in million gallons per day]

STATE	FOSSIL FUEL						NUCLEAR					
	Withdrawals, by source and type				Consumptive use		Withdrawals, by source and type				Consumptive use	
	Ground water	Surface water					Ground water	Surface water				
	Fresh	Fresh	Saline	Total	Fresh	Saline	Fresh	Fresh	Saline	Total	Fresh	Saline
Alabama	0.0	5,570	0.0	5,570	30	0.0	0.0	738	0.0	738	14	0.0
Alaska	4.7	26	0	26	3.2	0	0	0	0	0	0	0
Arizona	42	18	.4	19	60	.4	.1	43	0	43	40	0
Arkansas	2.4	737	0	737	12	0	0	902	0	902	1.1	0
California	4.5	241	5,910	6,150	6.2	5.9	.1	.1	5,500	5,500	.3	.6
Colorado	21	94	0	94	41	0	0	0	0	0	0	0
Connecticut	.1	155	1,390	1,540	3.1	28	.1	375	2,320	2,690	7.5	46
Delaware	.5	830	333	1,160	5.0	1.5	0	0	0	0	0	0
D.C.	0	8.0	0	8.0	.6	0	0	0	0	0	0	0
Florida	23	709	8,490	9,200	21	0	.3	0	1,820	1,820	1.0	0
Georgia	2.7	2,900	33	2,940	48	0	2.5	119	0	119	50	0
Hawaii	95	0	1,550	1,550	1.7	15	0	0	0	0	0	0
Idaho	0	0	0	0	0	0	6.1	0	0	0	1.5	0
Illinois	6.2	9,190	0	9,190	148	0	2.8	5,970	0	5,970	222	0
Indiana	12	5,950	0	5,950	119	0	0	0	0	0	0	0
Iowa	10	2,060	0	2,060	6.9	0	1.8	3.3	0	3.3	3.4	0
Kansas	13	1,270	0	1,270	46	0	0	22	0	22	17	0
Kentucky	38	3,410	0	3,410	203	0	0	0	0	0	0	0
Louisiana	40	3,820	0	3,820	32	0	.1	1,090	0	1,090	14	0
Maine	1.4	81	4.0	85	1.6	.1	0	0	605	605	0	12
Maryland	1.8	419	3,420	3,840	4.2	43	.1	0	1,130	1,130	0	11
Massachusetts	.5	889	3,160	4,050	18	63	0	124	324	448	2.5	6.5
Michigan	2.8	5,460	0	5,460	125	0	0	2,600	0	2,600	78	0
Minnesota	2.4	1,080	0	1,080	303	0	0	800	0	800	19	0
Mississippi	13	342	316	658	30	1.6	30	0	0	0	23	0
Missouri	32	4,530	1,060	5,590	40	42	0	15	0	15	15	0
Montana	0	33	0	33	33	0	0	0	0	0	0	0
Nebraska	6.0	1,180	0	1,180	11	0	0	1,000	0	1,000	11	0
Nevada	12	22	0	22	34	0	0	0	0	0	0	0
New Hampshire	.8	254	339	593	5.1	6.8	0	0	555	555	0	11
New Jersey	1.0	597	1,620	2,220	.2	0	.7	0	7,930	7,930	0	0
New Mexico	9.9	40	0	40	46	0	0	0	0	0	0	0
New York	0	5,870	6,770	12,600	117	136	0	1,130	1,700	2,830	53	34
North Carolina	0	3,250	0	3,250	25	0	0	3,960	0	3,960	17	0
North Dakota	.1	2,390	0	2,390	26	0	0	0	0	0	0	0
Ohio	13	9,400	0	9,400	375	0	0	138	0	138	18	0
Oklahoma	1.8	88	0	88	48	0	0	0	0	0	0	0
Oregon	0	.8	0	.8	.8	0	0	14	0	14	9.9	0
Pennsylvania	0	3,970	0	3,970	113	0	0	1,780	0	1,780	105	0
Rhode Island	0	0	393	393	0	7.9	0	0	0	0	0	0
South Carolina	.2	1,660	0	1,660	30	0	1.2	3,160	0	3,160	25	0
South Dakota	.4	2.8	0	2.8	.1	0	0	0	0	0	0	0
Tennessee	0	6,020	0	6,020	0	0	0	1,300	0	1,300	0	0
Texas	53	7,020	3,150	10,200	193	9.4	1.3	53	0	53	54	0
Utah	0	87	0	87	86	0	0	0	0	0	0	0
Vermont	.4	.1	0	.1	0	0	0	518	0	518	11	0
Virginia	.3	1,880	1,230	3,110	12	0	.2	1,330	846	2,170	0	0
Washington	4.0	34	0	34	.8	0	0	296	0	296	8.1	0
West Virginia	.4	3,710	0	3,710	99	0	0	0	0	0	0	0
Wisconsin	2.3	3,480	0	3,480	35	0	.1	1,620	0	1,620	16	0
Wyoming	1.0	183	0	183	54	0	0	0	0	0	0	0
Puerto Rico	2.6	0	2,470	2,470	1.1	0	0	0	0	0	0	0
Virgin Islands	0	0	103	103	0	1.1	0	0	0	0	0	0
Total	478	101,000	41,700	143,000	2,650	362	48	29,100	22,700	51,800	841	122

INSTREAM USE

Hydroelectric Power

Water used for hydroelectric power generation is classified as an instream use and refers to the water used in the generation of electricity at plants where the turbine generators are driven by falling water. Estimates of water used for hydroelectric power generation may vary because of the way individual estimates are made of the quantities of water passed through the plants. If the water is passed through the plants only one time, then accurate estimates of water use can be obtained by streamflow measurements and gate openings. However, it is difficult to define and obtain net water use at pumped-storage hydroelectric plants because the same water is recycled a number of times. Pumped-storage plants usually generate electric energy during peak-load periods by using water previously pumped into an elevated storage reservoir during off-peak periods when excess generating capacity is available to do so. When additional generating capacity is needed, the water can be released from the pumped-storage reservoir through a conduit to turbine generators located in a power plant at a lower level.

Estimates of hydroelectric power water use and power generation, as with the thermoelectric power category, are based on more information and fewer extrapolations than for the other water-use categories. Most of the information was obtained from hydroelectric utility companies. If information was not available from utilities, then records of the power generated were obtained from the U.S. Department of Energy's Energy Information Administration (1991). The power-generation data were multiplied by water-use coefficients to obtain estimates of hydroelectric power water use. In this report, it is assumed that none of the water used for hydroelectric power generation is consumptively used. Although the quantity of water evaporated in the actual generation of hydroelectric power (consumptive use) is very small, considerable depletion of the available water supply for hydroelectric power generation occurs as an indirect result of evaporation from reservoirs and repeated reuse of water within a pumped-storage power facility.

Water used for hydroelectric power generation during 1990 was an estimated 3,290,000 Mgal/d (tables 27, 28), or 8 percent more than during 1985. This total is 2.6 times the average annual runoff in the conterminous United States. (Graczyk and others, 1988). It is possible for the hydroelectric power water use to exceed average annual runoff because some water is used several times as it passes through several hydroelectric dams on a river.

Fresh surface water provides virtually all water for hydroelectric power generation. The Pacific Northwest water-resources region had by far the largest use of water for hydroelectric power generation during 1990, more than double the use in the Great Lakes region (figure 29), and accounted for about 38 percent of the water used for hydroelectric power generation in the Nation. Almost one half of the water used for hydroelectric power generation in the United States occurred in Washington, Oregon (figure 30), primarily on the Columbia River system, and New York on the Niagara and the St. Lawrence River systems.

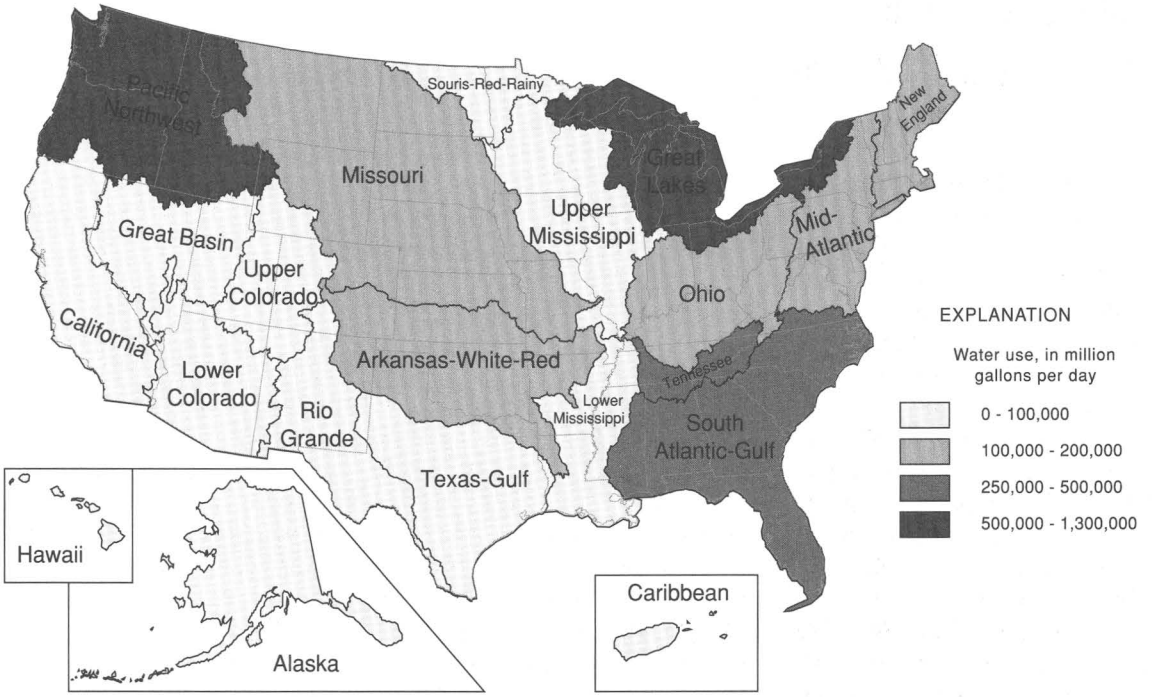


Figure 29. Hydroelectric power water use by water-resources region, 1990.

Table 27. Hydroelectric power water use by water-resources region, 1990

[Figures may not add to totals because of independent rounding.
Mgal/d = million gallons per day; kWh = kilowatthour]

REGION	WATER USE		POWER GENERATED, in million kWh
	Mgal/d	Thousand acre-feet per year	
New England	168,000	188,000	8,080
Mid Atlantic	192,000	215,000	11,700
South Atlantic-Gulf	275,000	308,000	18,500
Great Lakes	506,000	567,000	30,100
Ohio	147,000	165,000	5,860
Tennessee	294,000	330,000	19,700
Upper Mississippi	73,200	82,100	2,200
Lower Mississippi	26,600	29,800	1,250
Souris-Red-Rainy	1,280	1,430	45
Missouri Basin	109,000	122,000	12,600
Arkansas-White-Red	109,000	122,000	8,370
Texas-Gulf	12,100	13,600	953
Rio Grande	3,520	3,950	569
Upper Colorado	11,900	13,300	4,760
Lower Colorado	34,700	38,900	6,640
Great Basin	2,360	2,650	284
Pacific Northwest	1,250,000	1,400,000	142,000
California	69,000	77,300	23,700
Alaska	1,790	2,010	980
Hawaii	264	296	89
Caribbean	362	406	108
Total	3,290,000	3,690,000	299,000

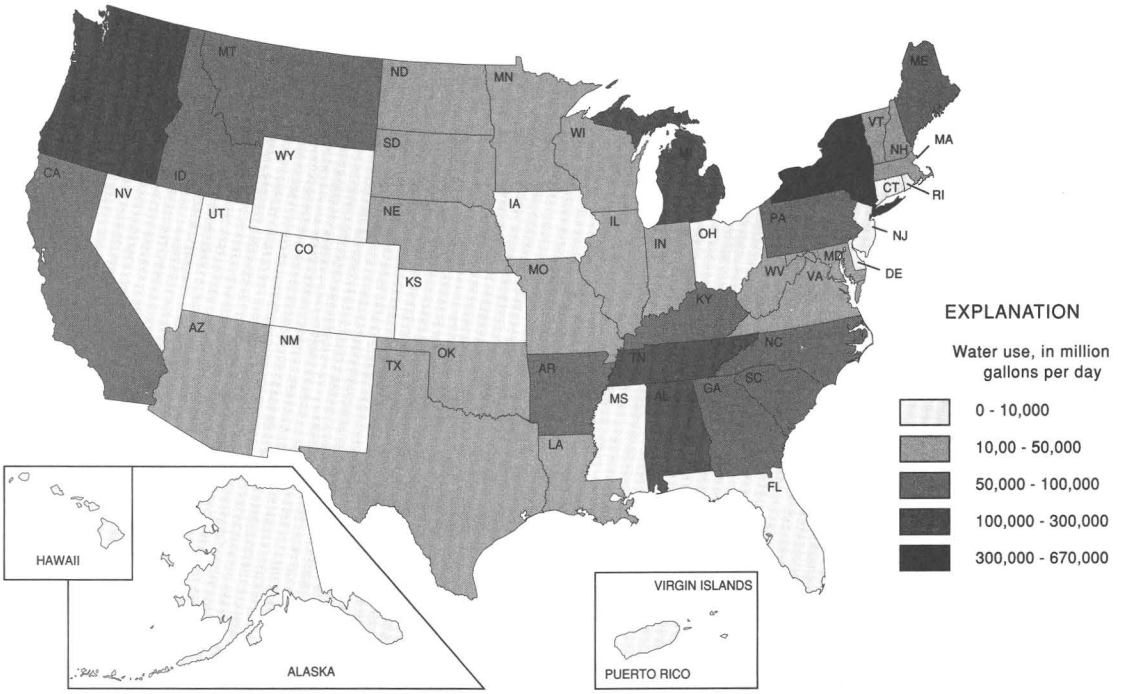


Figure 30. Hydroelectric power water use by State, 1990.

Table 28. Hydroelectric power water use by State, 1990

[Figures may not add to totals because of independent rounding.
Mgal/d = million gallons per day; kWh = kilowatthour]

STATE	WATER USE		POWER GENERATED, in million kWh
	Mgal/d	Thousand acre-feet per year	
Alabama	218,000	244,000	10,300
Alaska	1,790	2,010	980
Arizona	31,800	35,600	8,180
Arkansas	60,400	67,700	4,890
California	75,000	84,100	23,900
Colorado	4,160	4,660	1,320
Connecticut	6,870	7,700	452
Delaware	0	0	0
D.C.	0	0	0
Florida	7,260	8,140	173
Georgia	51,700	58,000	4,710
Hawaii	264	296	89
Idaho	67,800	76,000	7,450
Illinois	27,100	30,400	771
Indiana	11,600	13,000	441
Iowa	1,150	1,290	13
Kansas	1,300	1,460	12
Kentucky	83,000	93,000	2,880
Louisiana	21,700	24,300	697
Maine	82,700	92,700	3,960
Maryland	25,900	29,000	2,310
Massachusetts	24,500	27,500	1,090
Michigan	110,000	123,000	3,040
Minnesota	18,800	21,100	843
Mississippi	0	0	0
Missouri	13,900	15,600	2,190
Montana	66,800	74,900	10,700
Nebraska	12,900	14,500	833
Nevada	3,490	3,910	1,620
New Hampshire	46,000	51,600	1,980
New Jersey	167	187	17
New Mexico	964	1,080	215
New York	459,000	515,000	29,400
North Carolina	66,900	75,000	7,070
North Dakota	10,900	12,200	1,720
Ohio	7,800	8,740	173
Oklahoma	47,900	53,700	2,870
Oregon	481,000	539,000	40,800
Pennsylvania	68,000	76,200	3,190
Rhode Island	339	380	6.1
South Carolina	63,400	71,100	3,880
South Dakota	41,100	46,100	4,270
Tennessee	160,000	179,000	11,800
Texas	15,800	17,700	1,570
Utah	1,880	2,110	481
Vermont	17,700	19,800	1,100
Virginia	22,900	25,700	4,050
Washington	670,000	751,000	87,300
West Virginia	32,700	36,700	1,330
Wisconsin	44,000	49,300	1,150
Wyoming	4,350	4,880	611
Puerto Rico	362	406	108
Virgin Islands	0	0	0
Total	3,290,000	3,690,000	299,000

Wastewater Release

Wastewater Treatment

In addition to water withdrawals, public-supply deliveries, and consumptive use, the term "water use" also includes wastewater releases and return flow. Because quality as well as quantity considerations are increasingly important in water management, more information is needed concerning the location of wastewater-treatment facilities and the quantities of treated wastewater released from the facilities and returned to the hydrologic system.

The wastewater treatment category includes information on facilities engaged primarily in the collection, treatment, and disposal of wastewater conveyed through a sewer system. Return of treated water generally is to surface waters. Treatment facilities are separated into two categories in this report: publicly owned (municipal) treatment works and "other". Publicly-owned treatment works are publicly owned or receive some form of public funding, and receive and treat wastewater from various users such as domestic, commercial, and industrial. Other wastewater facilities are privately owned and include commercial and industrial facilities that treat their own wastewater. Information on the quantities of water treated and released from publicly owned treatment facilities and returned directly to the hydrologic system, or released for beneficial reuse (reclaimed wastewater), are given in this report, along with the number of public and other wastewater-treatment facilities.

The release information usually is obtained from wastewater-treatment facility operators, utility departments, or from discharge permit files maintained by State or Federal agencies. Return flows to surface water usually are regulated by State or Federal agencies. The number of wastewater-treatment facilities typically is available from permit files at State or Federal agencies. The reliability of the data varies by State depending on available information.

About 19,600 public-treatment facilities released about 35,300 Mgal/d of treated wastewater nationwide during 1990. (See tables 29, 30.) Nationally, an average of from 1 million to 2 million gallons of treated wastewater per public-treatment facility was returned daily to streams or other surface-water bodies. In addition, 928 Mgal/d of treated wastewater was reclaimed for beneficial uses such as irrigation of golf courses and public parks. The largest return flows occurred in regions (figure 31) and States (figure 32) that have large populations and large public-supply withdrawals. California and New York, which have large public-supply withdrawals, reported the largest releases of treated wastewater. California, Arizona, and Florida reported large uses of reclaimed wastewater.

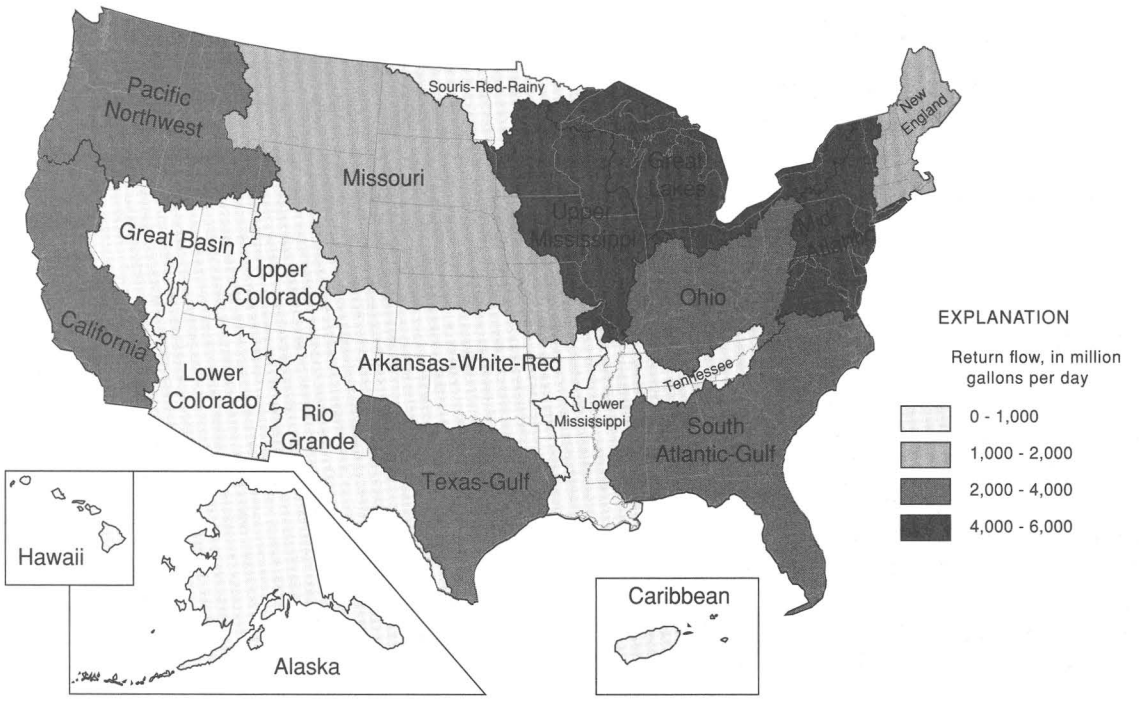


Figure 31. Wastewater treatment return flow by water-resources region, 1990.

Table 29. Wastewater treatment water releases by water-resources region, 1990

[Figures may not add to totals because of independent rounding.
Mgal/d = million gallons per day]

REGION	NUMBER OF FACILITIES		PUBLIC RELEASES	
	Public	Other	Return flow, in Mgal/d	Reclaimed wastewater, in Mgal/d
New England	320	621	1,720	0.0
Mid Atlantic	1,423	2,409	5,740	63
South Atlantic-Gulf	2,349	2,744	3,590	238
Great Lakes	1,097	996	5,160	0
Ohio	2,317	3,179	2,850	0
Tennessee	213	464	519	.1
Upper Mississippi	2,395	1,683	4,070	0
Lower Mississippi	891	974	702	0
Souris-Red-Rainy	260	68	34	0
Missouri Basin	1,970	1,412	1,290	6.4
Arkansas-White-Red	1,200	1,160	874	13
Texas-Gulf	2,737	2,708	2,000	50
Rio Grande	216	136	161	4.4
Upper Colorado	123	110	86	.4
Lower Colorado	150	97	625	230
Great Basin	112	84	366	52
Pacific Northwest	630	828	2,180	11
California	1,049	833	2,990	255
Alaska	21	39	57	0
Hawaii	26	128	144	5.8
Caribbean	92	2	138	0
Total	19,591	20,675	35,300	928

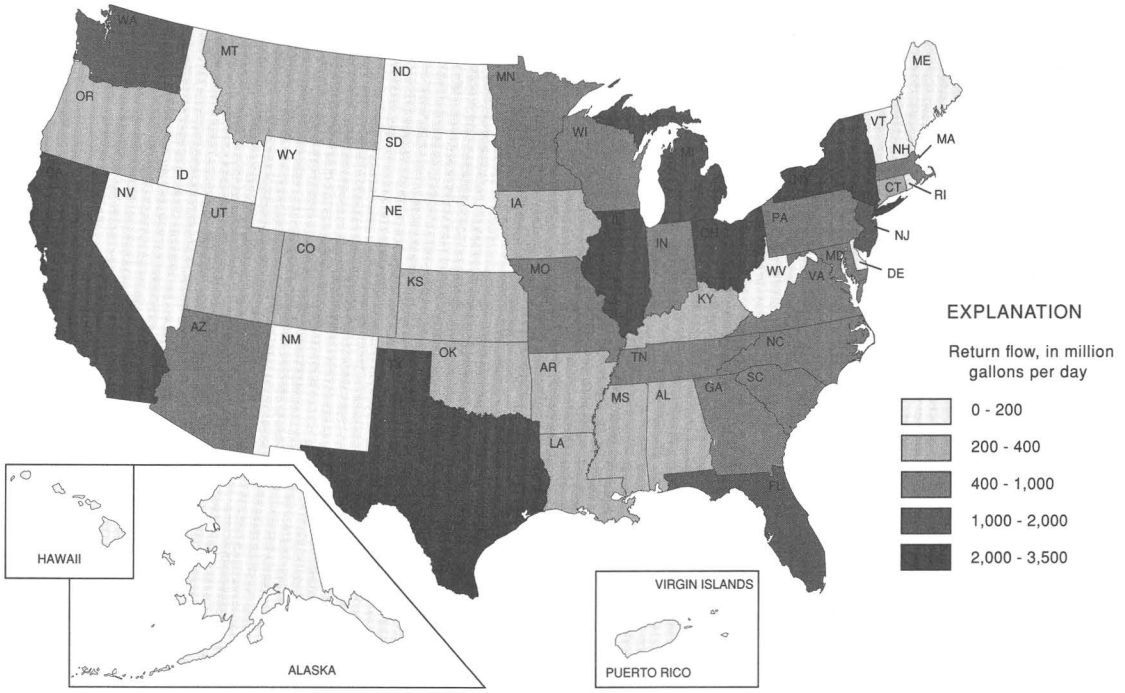


Figure 32. Wastewater treatment return flow by State, 1990.

Table 30. Wastewater treatment water releases by State, 1990

[Figures may not add to totals because of independent rounding.
Mgal/d = million gallons per day]

STATE	NUMBER OF FACILITIES		PUBLIC RELEASES	
	Public	Other	Return flow, in Mgal/d	Reclaimed wastewater, in Mgal/d
Alabama	104	0.0	391	0.0
Alaska	21	39	57	0
Arizona	119	53	546	226
Arkansas	328	533	268	0
California	1,055	859	2,990	259
Colorado	223	179	361	7.1
Connecticut	98	46	364	0
Delaware	15	0	105	0
D.C.	1	21	317	0
Florida	780	271	1,350	174
Georgia	403	223	750	34
Hawaii	26	128	144	5.8
Idaho	134	0	132	0
Illinois	920	493	2,670	0
Indiana	542	320	838	0
Iowa	706	463	362	0
Kansas	432	164	220	7.7
Kentucky	223	1,465	341	0
Louisiana	484	520	326	0
Maine	65	25	129	0
Maryland	157	869	411	63
Massachusetts	92	455	964	0
Michigan	246	756	2,590	0
Minnesota	522	381	593	0
Mississippi	244	214	290	0
Missouri	1,108	1,347	998	0
Montana	228	118	202	0
Nebraska	257	278	166	0
Nevada	71	68	152	13
New Hampshire	38	76	145	0
New Jersey	231	979	1,030	0
New Mexico	54	63	93	3.7
New York	543	338	3,470	0
North Carolina	546	576	578	16
North Dakota	302	103	30	0
Ohio	1,040	45	2,320	0
Oklahoma	388	137	321	0
Oregon	202	124	373	11
Pennsylvania	631	0	976	0
Rhode Island	19	16	110	0
South Carolina	385	1,502	414	14
South Dakota	220	0	45	0
Tennessee	226	551	735	0
Texas	3,159	3,113	2,160	56
Utah	68	37	319	39
Vermont	29	29	38	0
Virginia	384	445	487	0
Washington	256	675	1,610	0
West Virginia	573	1,254	185	0
Wisconsin	525	116	638	0
Wyoming	76	206	48	0
Puerto Rico	82	0	132	0
Virgin Islands	10	2	5.8	0
Total	19,591	20,675	35,300	928

TRENDS IN WATER USE, 1950-1990

To facilitate the following discussion of trends in water use, the estimates for some categories used in this report have been combined to correspond to the categories used in previous water-use circulars in this series (public supply, rural use, irrigation, industrial, thermoelectric power, hydroelectric power). Self-supplied domestic withdrawals were combined with livestock withdrawals in this section of the report to compare to the rural use category listed in previous water-use circulars; and self-supplied industrial withdrawals were combined with commercial and mining withdrawals to compare to "other" industries, which were listed with thermoelectric power generation under self-supplied industrial in previous water-use circulars.

Data in table 31 summarize the estimated water use—withdrawals, source of water, reclaimed wastewater, consumptive use, and instream use (hydroelectric power)—at 5-year intervals from 1950 to 1990. Table 31 also shows the percentage increase or decrease in the summarized estimates between 1985 and 1990.

After continual increases in estimates of the Nation's water use from 1950 to 1980, offstream and instream uses were less during 1985 than during 1980. Total offstream use during 1990 was 2 percent more than the 1985 estimate, but still 8 percent less than the 1980 estimate. Instream use during 1990 was 8 percent more than the 1985 estimate, or about the same as the 1975 and 1980 estimates, as shown graphically in figure 33. For most water-use categories, the general slackening in the rate of increase that had been indicated by the estimates compiled for 1975 and 1980 changed to a decrease in water use between 1980 and 1985 (figure 34). Total withdrawals were about 10 percent less during 1985 than during 1980, and the 2 percent increase from 1985 to 1990 is the result of increases in surface- and ground-water withdrawals of 1 and 9 percent, respectively. The fact that the 1990 withdrawal estimates are only slightly higher than the 1985 estimates tends to confirm the overall decline in water use from the peak of 1980.

Two exceptions to this decreasing trend are the "Public supply" and "Thermoelectric power" categories. Withdrawals for both of these categories were about 5 percent more during 1990 than during 1985. The 5-percent increase in public-supply withdrawals corresponds to a 4-percent increase in population served, and the increase in thermoelectric power water use reflects increases in power production.

Total irrigation withdrawals were about the same during 1960 as during 1955, then increased progressively for the years reported from 1965 to 1980. Estimated irrigation withdrawals during 1985 reversed that trend, however, and were 9 percent less than during 1980 and were about the same during 1990 as 1985. The increase in estimated ground-water withdrawals from 1985 to 1990 was partly the result of decreased availability of surface water. Surface-water withdrawals for irrigation increased progressively for the

years reported from 1960 to 1985 and decreased 6 percent from 1985 to 1990. The average amount of water applied per acre for irrigation in the United States during 1985 and 1990 was about 2.7 acre-ft and less than the 2.9 acre-ft applied during 1975 and 1980. The rate of increase in the number of acres irrigated has been decreasing. The acreage reported for 1970 was about 14 percent more than in 1965; for 1975, 8 percent more than for 1970; for 1980, 7 percent more than for 1975; for 1985, about 1 percent less than for 1980; and for 1990, about the same as for 1985.

Table 31. ***Trends of estimated water use in the United States, 1950-90.***

[Data for 1950-80 adapted from MacKichan (1951, 1957), MacKichan and Kammerer (1961), Murray (1968), Murray and Reeves (1972, 1977), and Solley and others (1983, 1988). The water-use data are in thousands of million gallons per day and are rounded to two significant figures for 1950-80, and to three significant figures for 1985-90; percentage change is calculated from unrounded numbers]

	Year									Percentage change
	[1]1950	[1]1955	[2]1960	[2]1965	[3]1970	[4]1975	[4]1980	[4]1985	[4]1990	1985-90
Population, in millions	150.7	164.0	179.3	193.8	205.9	216.4	229.6	242.4	252.3	+4
Offstream use:										
Total withdrawals	180	240	270	310	370	420	[5]440	399	408	+2
Public supply	14	17	21	24	27	29	34	36.5	38.5	+5
Rural domestic and livestock	3.6	3.6	3.6	4.0	4.5	4.9	5.6	7.79	7.89	+1
Irrigation	89	110	110	120	130	140	150	137	137	-.3
Industrial:										
Thermoelectric power use	40	72	100	130	170	200	210	187	195	+4
Other industrial use	37	39	38	46	47	45	45	30.5	29.9	-2
Source of water:										
Ground:										
Fresh	34	47	50	60	68	82	[5]83	73.2	79.4	+8
Saline	([6])	.6	.4	.5	1	1	.9	.652	1.22	+87
Surface:										
Fresh	140	180	190	210	250	260	290	265	259	-2
Saline	10	18	31	43	53	69	71	59.6	68.2	+14
Reclaimed wastewater	([6])	.2	.6	.7	.5	.5	.5	.579	.750	+30
Consumptive use	([6])	([6])	61	77	[7]87	[7]96	[7]100	[7]92.3	[7]94.0	+2
Instream use:										
Hydroelectric power	1,100	1,500	2,000	2,300	2,800	3,300	3,300	3,050	3,290	+8

[1]48 States and District of Columbia.
[2]50 States and District of Columbia.
[3]50 States and District of Columbia, and Puerto Rico.
[4]50 States and District of Columbia, Puerto Rico, and Virgin Islands.
[5]Revised
[6]Data not available.
[7]Freshwater only.

To compare self-supplied industrial withdrawals during 1990 with comparable withdrawals for "other" industrial uses during earlier years, the 1990 estimates for industrial withdrawals need to be combined with those for commercial and mining withdrawals. Estimates of total self-supplied withdrawals (fresh, saline) for "other" industrial uses during 1990 were 29,900 Mgal/d, or about 2 percent less than during 1985, which was 34 percent less than during 1980, after remaining about the same during 1970, 1975, and 1980. In fact, self-supplied withdrawals for "other" industrial use during 1990 were the lowest reported in this series since records began in 1950. Surface-water withdrawals for industrial uses during 1990 totaled 21,800 Mgal/d, an 8-percent decrease from 1985; ground-water withdrawals totaled about 8,000 Mgal/d, a 20-percent increase from 1985.

More water continues to be withdrawn for thermoelectric power generation than for any other category, even though about the same quantity of freshwater was withdrawn for this use during 1990 as during 1985 (figure 34). The 4-percent increase in total withdrawals for thermoelectric power from 1985 to 1990 is the result of a 15-percent increase in saline-water withdrawals.

Water used for hydroelectric power generation had been increasing steadily from 1950 to 1975, but, during 1980, it was about the same as during 1975. Water use for hydroelectric power generation during 1985 was 7 percent less than during 1980, and then was 8 percent more during 1990 than during 1985. Changes in hydroelectric power water use are closely related to the availability of surface water.

Even though population increased 4 percent between 1985 and 1990, withdrawal and consumptive-use estimates increased only 2 percent between 1985 and 1990. This is in contrast to 1970 and 1975, when the rate of increase in withdrawals was more than double the rate of population growth.

The trends in water use from 1950 to 1990 can be attributed in part to the following factors:

- Availability of water in a particular year, especially from precipitation and streamflow, strongly affects the quantity of water use for irrigation and hydroelectric power generation.
- Streamflows generally were less plentiful during 1990 than during 1985 because of less precipitation, especially in the West; this increased the dependence on ground water in many areas and the need to irrigate in some areas.
- Withdrawals from the ground-water system can influence the pumping lift, availability, or quality of the water. Each of these factors, in turn, can influence the cost of water and make users, especially irrigators, more selective and efficient in their use of ground water.

- Higher energy prices, improved application techniques, increased competition for water, declines in farm commodity prices, and a downturn in the farm economy in the 1980's reduced demands for irrigation water.
- New technologies requiring less water, improved plant efficiencies, increased water recycling, higher energy prices, the economic slowdown, and changes in laws and regulations to reduce the discharge of pollutants resulted in decreased requirements for industrial water and less water being returned to the natural system after use.
- The enhanced awareness by the general public to water resources and active conservation programs in many States have reduced water demands.

Several agencies and commissions have made projections of national water use to the year 2000 and beyond. The most recent study by the United States Department of Agriculture Forest Service (1989) projects water withdrawals and consumptive use to the year 2040. The projections by these agencies and commissions vary greatly reflecting the availability of reliable data and reflecting different assumptions for future population growth, economic conditions, energy-resources development, and environmental regulations.

Projections of future water use are beyond the scope of this report, although the trends established over the past 40 years provide some basis for estimating future water demands. It seems likely that water withdrawals for public supply and domestic uses will continue to increase as population increases. However, higher water prices and active water conservation programs may reduce the per-capita use rate. With increased competition for water for instream uses, such as river-based recreation, esthetic enjoyment, fish and wildlife habitat, and hydroelectric power, along with higher municipal uses, irrigators will have increasing difficulty competing economically for available water supplies. Municipal and industrial users can afford to pay much more for water than the farmers. Thus, a leveling in the rate of agricultural water use combined with growing population and urbanization suggests that, for the foreseeable future, new balances will have to be struck in water use between the rural and urban areas, especially in the western United States (Moore and others, 1990, p. 97). It seems likely that, for the foreseeable future, industrial water use and use per unit of production will continue to decline in most sectors, although probably not as sharply as in the recent past (David and others, 1990, p. 85).

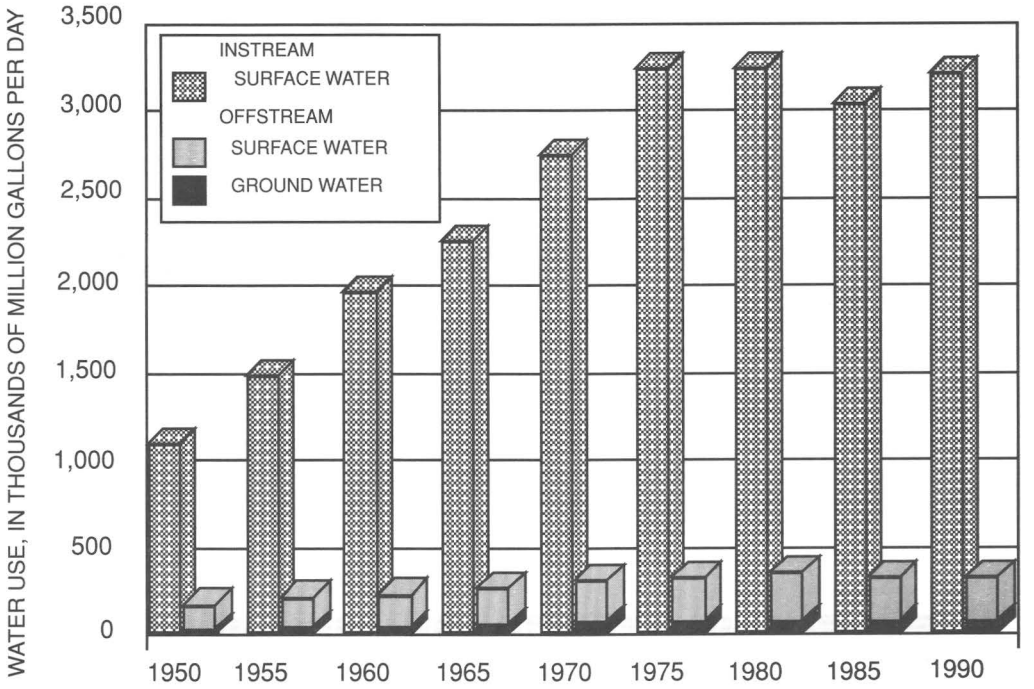


Figure 33. Trends in offstream and instream water uses, 1950-90.

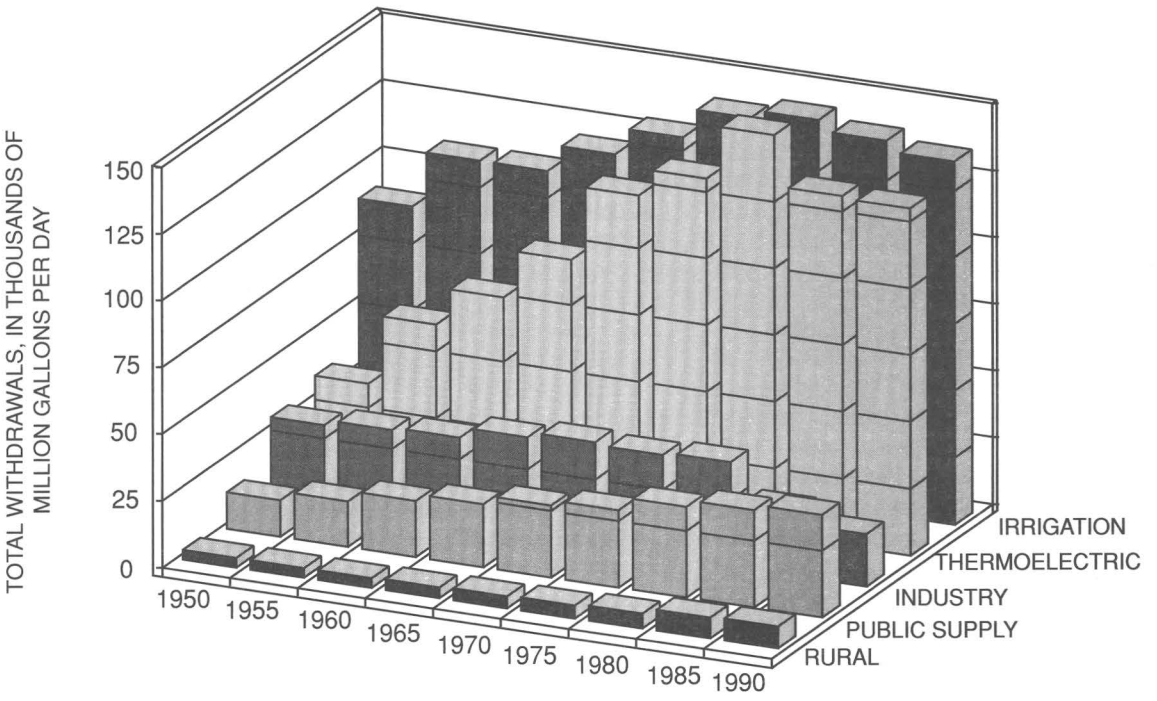


Figure 34. Trends in freshwater withdrawals by water-use category for rural, public supply, industry, thermoelectric, and irrigation,1950-90.

Water management in the United States has traditionally focused on manipulating the country's vast supplies of freshwater to meet the needs of users. The effects of this "supply management" approach have been felt in every sector of the economy, from municipal water supply to irrigation. Increasing development costs, capital shortages, government fiscal restraint, less favorable storage reservoir sites, and increasing concern for the environment have forced water managers to begin to rethink traditional approaches to water management and to experiment with new ones. Experts on the subject of western water agree that the West is in transition from the era of water development to an era of water management and conservation (Wilkinson, 1985). Attention now and in the future will be centered on optimizing the use of existing surface-water projects rather than on the further development of large storage reservoirs and major aqueducts, on developing more efficient water application techniques, and on developing other water conservation measures such as lining irrigation canals and installing more efficient plumbing fixtures in homes and office buildings.

Regardless of which projection proves correct, major attention needs to be given to water-management problems to ensure that maximum benefits will be obtained from use of the Nation's water resources. This has become more evident, because, in addition to the need for an adequate water supply, water-quality conditions need to be suitable if supply and demand are to be kept in balance.

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