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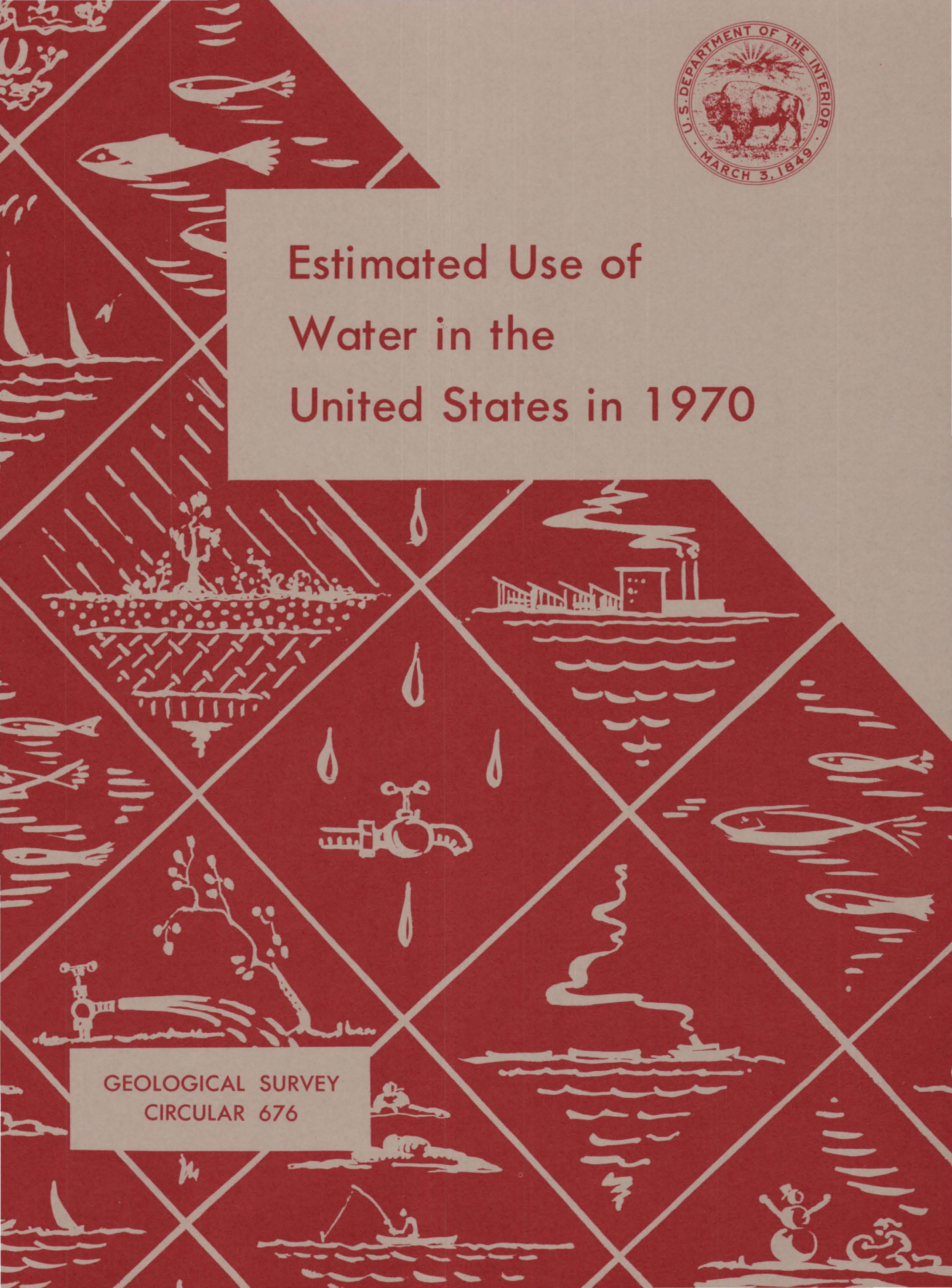

GEOLOGICAL SURVEY
CIRCULAR 676

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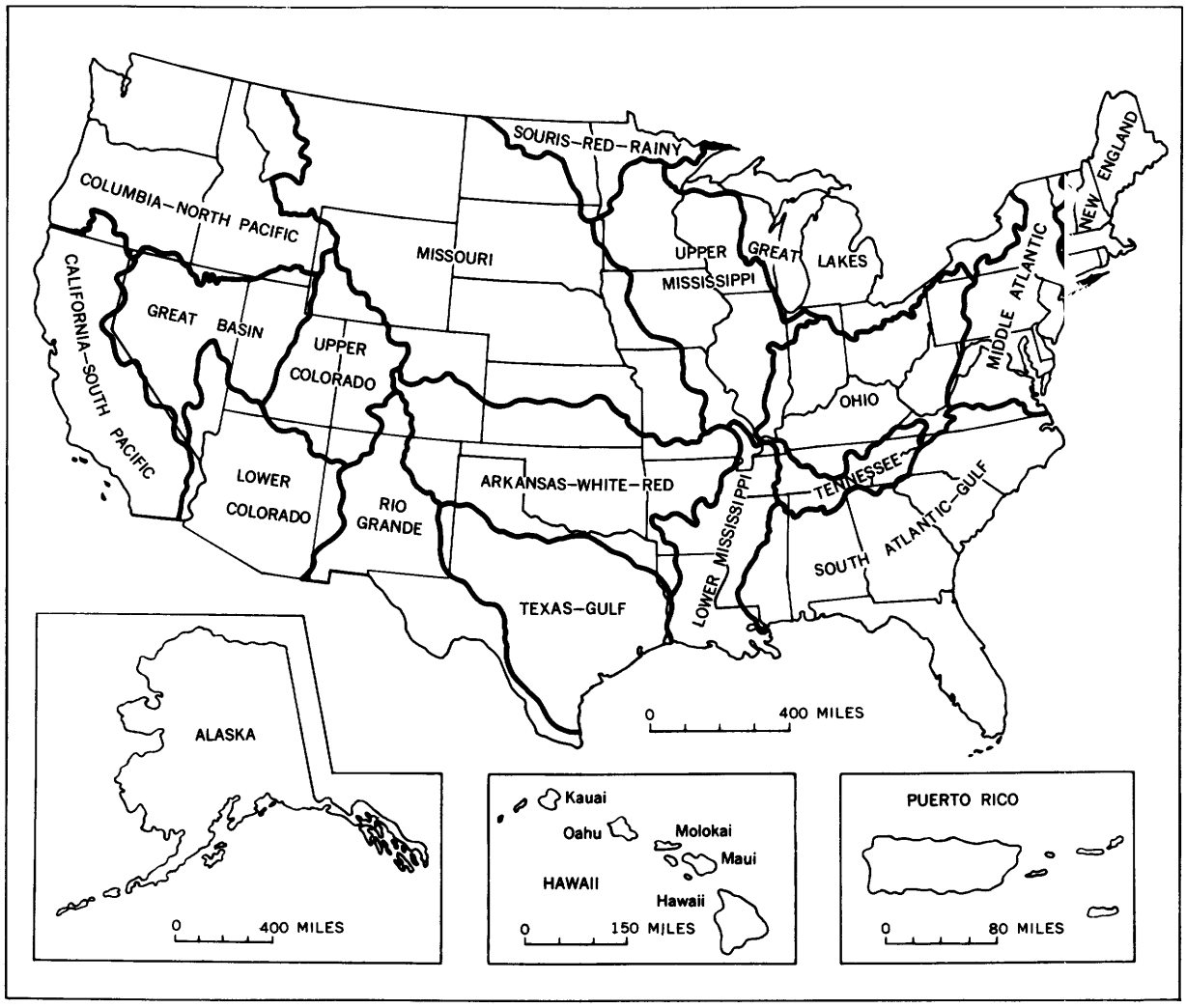

Map of the United States showing Water Resources Council regions, 1970.

Estimated Use of Water in the United States in 1970

By C. Richard Murray and E. Bodette Reeves

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ABSTRACT

Estimates of water use in the United States in 1970 indicate that an average of about 370 bgd (billion gallons per day)—about 1,800 gallons per capita per day—was withdrawn for the four principal off-channel uses which are (1) public-supply (for domestic, commercial, and industrial uses), (2) rural (domestic and livestock), (3) irrigation, and (4) self-supplied industrial (including thermoelectric power). In 1970, withdrawals for these uses exceeded by 19 percent the 310 bgd estimated for 1965. Increases in the various categories of off-channel water use since 1965 were: approximately 25 percent for self-supplied industry (mainly in electric-utility thermoelectric plants), 13 percent for public supplies, 13 percent for rural supplies, and 8 percent for irrigation. Industrial water withdrawals included 54 bgd of saline water, a 20 percent increase in 5 years. The fifth principal withdrawal use, hydroelectric power (an in-channel use), amounted to 2,800 bgd, a 5-year increase of 22 percent. In computing total withdrawals, recycling within a plant (reuse) is not counted, but withdrawal of the same water by a downstream user (cumulative withdrawals) is counted. The quantity of fresh water consumed—that is, water made unavailable for further possible withdrawal because of evaporation, incorporation in crops and manufactured products, and other causes—was estimated to average 87 bgd for 1970, an increase of about 12 percent since 1965.

Estimates of water withdrawn from the principal sources indicated that 68 bgd came from fresh ground water, 1 bgd came from saline ground water, 250 bgd came from fresh surface water, 53 bgd came from saline surface water, and 0.5 bgd was reclaimed sewage.

The average annual streamflow—simplified measure of the total available water supply—is approximately 1,200 bgd in the conterminous United States. Total water withdrawn in 1970 for off-channel uses (withdrawals other than for hydroelectric power) amounted to about 30 percent of the average annual streamflow; 7 percent of the 1,200 bgd basic supply was consumed. However, comparisons of Water Resources Council regions indicate that the rate of withdrawal was higher than the locally dependable supply in the Middle Atlantic, Texas-Gulf, Rio Grande, Lower Colorado, and California-South Pacific regions. Consumption amounted to nearly 25 percent of withdrawals in the conterminous United States; however, fresh-water consumption amounted to only 14 percent of off-channel withdrawals in the 31 Eastern States and ranged from 30 percent to nearly 70 percent of off-channel withdrawals in the Water Resources Council regions in the West. In the Rio Grande and Lower Colorado regions, fresh-water consumption in 1970 exceeded the estimated dependable supply of fresh water.

INTRODUCTION

Quantitative assessments of water withdrawn for use in the United States have been compiled by the U.S. Geological Survey for every fifth year since 1950; the purpose of this report is to present the data assembled on water use in 1970. The district offices of the Geological Survey furnished statistical data showing amounts of water withdrawn and consumed in States and regions (frontispiece) for five major categories of withdrawal use. The quantitative assessments form a time series which shows trends in water use and is of value in appraising present—and planning future—utilization of the Nation's water resources.

Each type of use has characteristically different effects on the return flow's reuse potential, which is a measure of the quality and quantity of water available for subsequent use. For example, irrigation return flow may be contaminated by pesticides and fertilizers, and often, because of the high consumptive use, the mineral content of the return flow is greatly increased (degradation). Thus, irrigation return flow amounts, on the average, to only about a third of the water diverted for use and has little reuse potential. In contrast, nearly 90 percent of the water withdrawn for manufacturing and other industries, such as mining and construction, is returned to water sources for additional use. The nature and concentration of industrial water pollutants varies widely in place and time, and the ratio of the return flow to the original quantity diverted also varies. Almost 99 percent of the inflow to thermoelectric plants is discharged from the plants; the principal change in the water is an increase in its temperature.

PREVIOUS INVESTIGATIONS

Numerous reports on the subject of water use have been published in recent years. Generally these pertain either to a specific use or cover a particular area for which data on the various categories of water use are

given. Since 1950, the U.S. Geological Survey has compiled available information into quinquennial reports of water use in the United States (MacKichan, 1951, 1957; MacKichan and Kammerer, 1961; Murray, 1968). The information collected for 1965 was also used for several other reports (Water Resources Council, 1968; Murray, 1969a; Todd, 1970).

Titles of representative reports of investigations of water use by State agencies are included in the list of references beginning on page 14. These reports are often the result of a cooperative project by a State agency and the U.S. Geological Survey. Some of the reports treat water use within the framework of the total water resources picture. One type of water-use study that has received considerable attention in recent years is systems analysis of water-use data for forecasting future water demands; about 15 reports in the list of references are in this category.

A report on land and water uses in the United States in 1964 was prepared by the U.S. Department of Agriculture (1968). The Bureau of Reclamation (1971a, b) published its 65th annual summary of land and water use on project lands. A census of agriculture was taken in 1969 by the U.S. Bureau of the Census; it is currently being published by county-unit reports. Their census of irrigation taken in the same year is scheduled to be published in 1972 by State-unit reports. Ruttan (1965) reported a study of irrigation as a major water-use activity and emphasized the economic demand for irrigated acreage. Trelease and others (1970) published results of a study of consumptive use of irrigation water in Wyoming.

The U.S. Bureau of the Census (1971a) reports on population in 1970 and the U.S. Department of Agriculture (1971) inventory of livestock and poultry contained data of importance in estimating the quantities of water used for rural domestic and livestock purposes.

Reports on public supplies have been published by the U.S. Public Health Service (1964) and the American Water Works Association (1964a, b), but updating of the information is needed. More recent reports by the U.S. Public Health Service (1970a, b) and McCabe and others (1970) give results of a survey of the quality of water being furnished by representative community water-supply systems. The Department of Housing and Urban Development is particularly interested in residential water supplied by public water systems (Linaweaver and others, 1967). Public supplies is a subject often treated briefly in reports on urban hydrology as in a report by Schneider and Spieker (1969).

The latest report of a series on water use in manufacturing was published by the U.S. Bureau of the Census (1971b) for the year 1968 as a companion volume to the 1967 census of manufacturing establishments. Reports on water use in mining are produced similarly as companion volumes to the census of mineral industries by the U.S. Bureau of the Census (1971c). Bramer and Motz (1968) reported on an economic analysis of industrial water use and the development of a generalized methodology by which the costs of industrial water may be established.

Cootner and Löf (1965) reported on their economic projection model which takes into account the main factors that regulate the demand for water by thermoelectric plants. By use of the model, they projected water use in 1980 for thermoelectric plants in Arkansas, Louisiana, Oklahoma, and Texas. A report on the effect of thermal water discharged from powerplants was prepared by the Federal Power Commission (1969), which also published data on hydroelectric power resources in the United States (1968), and continued the publication of monthly statistics on electric power produced in the United States (1970).

PRESENT INVESTIGATION

The district offices of the U.S. Geological Survey compiled water-use data for 391 areas from Federal, State, and local sources of information. The data were then assembled and combined by States (including Puerto Rico) and 21 Water Resources Council regions. The tables produced show quantities of water used and consumed for five major categories of withdrawal use (1) public supply (domestic, commerce, and industry), (2) rural (domestic and livestock), (3) irrigation, (4) self-supplied industrial, and (5) hydroelectric power. (See tables 5 to 18.) Water used by electric utilities for thermoelectric power generation (both fossil fuel and nuclear energy) is part of the industrial use, but, because of the magnitude of thermoelectric-power water use, it is also listed separately as a subcategory (tables 9 and 16). Similarly, the two subcategories of rural use and the two for public supply are shown separately. These categories and subcategories have been used in the earlier Geological Survey water-use circulars and can be aggregated or disaggregated to obtain comparative figures for the various categories of water use—such as the threefold division into domestic, agricultural, and industrial—appearing in other water-use reports. The authors estimated much of the information on water used for hydroelectric power generation by using statistics from two Federal Power Commission (1968, 1970) reports showing power generated in the 50 States and the gross static head and other pertinent information for individual plants.

TERMINOLOGY

The terms and units used in this report are similar to those used in previous reports in this series, such as in the report for 1965 (Murray, 1968). When the term "water use" appears in this report, withdrawal use (the amount of water withdrawn from its source) is implied; this is equivalent to "intake" or "water requirement" as

used in industry and agriculture, respectively. The principal requisite for withdrawal use is that water must be taken from a ground-water or surface-water source and conveyed to the place of use. If the water is used more than once by recycling, it will do the work of a greater quantity of water; the amount of this greater quantity, which is commonly called the "gross water use," is not evaluated in this report. If, however, the water is returned to a stream, lake, aquifer, or other source and then withdrawn anew, the summation of successive withdrawals gives the total or "cumulative withdrawal" use.

The terms "water consumed," "consumptive use," or "consumption," as used in this report, refer to that part of the water withdrawn that is no longer available because it has been either evaporated, transpired, incorporated into products and crops, consumed by man or livestock, or otherwise removed from the water environment. Water that is discharged into salt water bodies after being used, and is not recoverable from a practical standpoint, is not classed as consumed. Water with more than 1,000 milligrams of dissolved solids per liter of solution is classed as "saline" irrespective of the nature of the minerals present. In order for water to be classified as "reclaimed sewage" (also referred to as "other water" to distinguish it from that withdrawn from ordinary ground and surface water sources), the effluent from a sewage treatment plant must be diverted before it reaches a natural waterway and becomes part of the streamflow.

Water obtained from a water utility that serves the general public is classed as a "public supply;" if a public supply is either not available or not used, the water is "self-supplied." Individual families and small communities not served by a water utility are classed as "rural" with regard to water use.

In this report, water used to generate hydroelectric power (synonomous with "waterpower" in earlier reports) is included with withdrawal uses because of its diversion through powerplants. The term "off-channel uses" has been used to represent all withdrawal uses other than water withdrawn for hydroelectric power generation. The term "in-channel uses" encompasses all uses taking place within the river channel itself and therefore includes water used for hydroelectric power generation. The term "nonwithdrawal uses" includes water used for navigation, sport fishing, fresh-water discharge into estuarine areas in order to maintain proper salinity, and the disposition and dilution of waste water. The evaluation of nonwithdrawal uses is outside the scope of this report.

Water-use data are reported as the average daily quantities used derived from the annual use. The use is generally expressed in million gallons per day to two significant figures; however, irrigation use is also given in units of 1,000 acre-feet per year. An acre-foot of water is the amount required to cover an acre (43,560 sq ft) to the depth of 1 foot (43,560 cu ft). A thousand of such units per year is very roughly equal to a flow of a million gallons per day for a year (1,000 acre-ft per yr equals 0.89 mgd). Common equivalents of these units are given in table 1.

Table 1.—*Hydraulic equivalents*

[Equivalent values, to three significant figures, are on the same horizontal line]

Million gallons per day (mgd)	Billion gallons per day (bgd)	Thousand acre-feet per year	Thousand cubic feet per second	Thousand gallons per minute	Million cubic meters per day
1.0	0.001	1.12	0.00155	0.694	0.00379
1,000	1.0	1,120	1.55	694	3.79
.893	.000893	1.0	.00138	.620	.00338
646	.646	724	1.0	449	2.45
1.44	.00144	1.61	.00223	1.0	.00545
264	.264	296	.409	184	1.0

WITHDRAWAL USES

Withdrawal use in this report embraces both off-channel and in-channel use and signifies that the water is physically withdrawn from a source; the locus of use can be either off-channel or in-channel. The subdivisions of off-channel uses in this report, which are (1) public supply (for domestic, commercial, and industrial uses), (2) rural (domestic and livestock), (3) irrigation, and (4) self-supplied industrial (including thermoelectric power generation), follow historical patterns of classification. Furthermore, with certain modifications of the subcategories they can be used readily in many water-use models. The classification of water used for developing hydroelectric power as a withdrawal use might be considered puristic, but, like other withdrawal uses, an actual withdrawal amenable to measurement takes place. Frequently, the quantities of the water withdrawn that return to a source after use (return flow) are difficult to measure; however, estimates of the amounts that do not return to a source (water consumed) are shown in most of the water-use tables which follow the text. Consumption of water for hydroelectric power generation is considered to be negligible and therefore is not shown.

PUBLIC SUPPLIES

The quantity of water withdrawn for public supplies in 1970 was estimated as 27 bgd (billion gallons per day) or an average of 166 gpd (gallons per day) for each individual served. (See tables 5 and 12.) Included in this quantity was water lost in the distribution systems and water supplied for carrying out public services such as firefighting, street washing, and water for municipal parks and swimming pools. It is estimated that losses and public uses accounted for about 30 percent of

withdrawals. In 1970, public-supply systems served about 165 million people, about 80 percent of the population—a slight increase in percentage since 1965. Because of economic factors (including convenient access) many industrial and commercial establishments use public supplies, especially where the volume of water they require is small and the quality of the water must be high. Some large water-using industries also use public water systems for principal or auxiliary water supplies. Among the commercial users are institutions and facilities, both civilian and military, which are operated by various levels of government, local or Federal. Commerce and industry received approximately one-third of the public-supply withdrawals in 1970—8.8 bgd—the same proportion as in 1965. The 5.9 bgd of water consumed (not available for reuse) by public water supplies again amounted to 22 percent of withdrawals. Water utilities supplied by surface-water sources, although relatively few in number, continue to furnish almost twice as much water as the utilities using ground-water sources.

RURAL USES

The number of people who had their own supply of domestic water was 41 million in 1970—a decrease of a million since 1965. However, the quantity of water used increased to 2.6 bgd from 2.3 bgd (13 percent) during the 5-year period. Similarly, the quantity of water used by livestock increased from 1.7 bgd to 1.9 bgd (12 percent). Only about 4 percent of the rural domestic water was surface water, but some 42 percent of the water used for livestock was surface water. Equal quantities of rural domestic and livestock water were consumed in 1970 (1.7 bgd); these were 65 and 90 percent of withdrawals, respectively. Frequently the high consumptive use for livestock results from failure to limit the amounts of water being supplied. In some instances, water from flowing artesian wells and unbraked windmills is allowed to run over the land surface where the water is either evaporated or transpired by nonproductive vegetation before it can rejoin a water source and be available for reuse.

The per capita rate for rural domestic use is about 63 gpd; this represents a quantity intermediate between estimated low withdrawal rates in homes without running water and estimated high withdrawal rates in rural homes that have running water and are equipped with modern high-water-requirement appliances.

Advance reports on the decennial census of population of the U.S. Bureau of the Census (1971a) were available for reference in estimating the rural domestic water use, and the livestock and poultry inventory of the U.S. Department of Agriculture (1971) was available for reference in estimating rural livestock water use.

IRRIGATION

The quantity of water withdrawn for irrigation in the United States and Puerto Rico in 1970 was estimated at 140 million acre-feet. (See tables 3, 7, and 14, and figs. 1, 3, and 10.) This was an average rate of 130 bgd, and the water was used on approximately 50 million acres of farmland. This represents an increase in water use of about 8 percent over the 1965 estimate and an increase in acreage of about 14 percent. It is to be expected that there will normally be large differences in water use from year to year where irrigation is used primarily to supplement natural rainfall.

Reliable estimates for consumptive use and for conveyance losses are difficult to obtain in States in which irrigation is a relatively new practice. Thus, some of the estimates of these types of data may be only rough approximations of actual conditions. Nevertheless, it is likely that better estimates were made of water used per acre in 1970 (than in 1965) and, in particular, that the values given for water lost in conveyance in 1970 were more realistic because of progressively better records being kept by irrigation districts. A detailed study of consumptive use of irrigation water in Wyoming was made by Trelease and others (1970), and similar studies have been made for specific areas in some of the Western States.

The quantity of irrigation water estimated as consumed in 1970 was 82 million acre-feet (73 bgd); this was about 59 percent of the water withdrawn, the same proportion that was consumed in 1965. Conveyance loss was about 22 bgd or about 17 percent of 1970 irrigation withdrawals, 3 percent less than the estimate for 1965; the decrease is related to (1) increasing quantities of ground water being used in comparison with surface water and (2) the much shorter distance from the point of ground-water withdrawal to the area of use as compared with surface water. Of the water lost in conveyance, 30 percent (6-1/2 bgd) was estimated to be lost through evapotranspiration, and the remaining 70 percent lost through deep or shallow percolation. Surface water furnished about 65 percent of the irrigation water and, except for a small fraction of 1 percent that was reclaimed sewage, ground water furnished the remainder. These ratios are the same as they were in 1965. The nine western regions used 95 percent of the water withdrawn for irrigation. In the Eastern United States, the South Atlantic-Gulf and Lower Mississippi regions accounted for most of the water used for irrigation. Due to changes

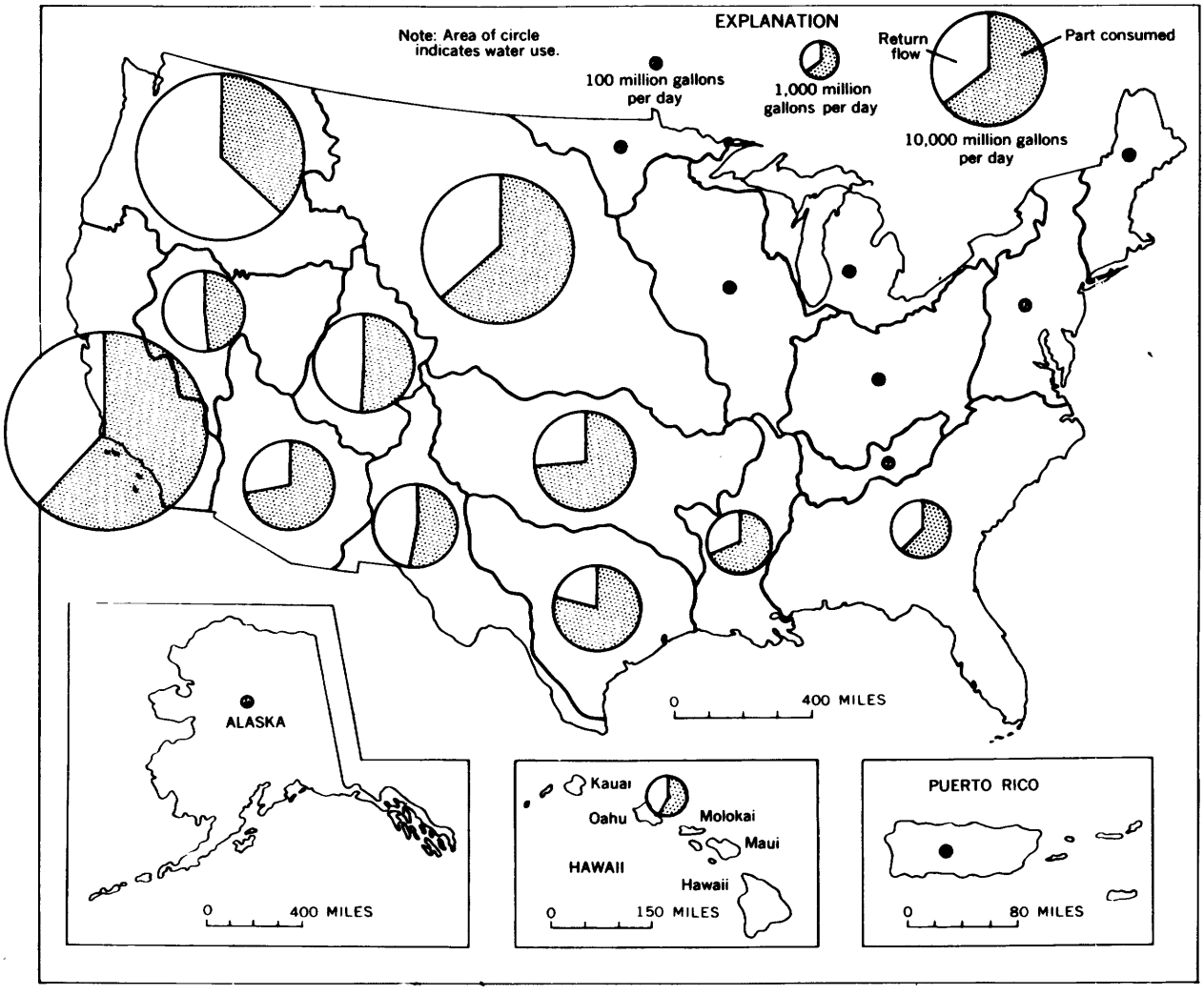

Figure 1.—Map of the United States showing irrigation water withdrawals, by regions, 1970.

made by the Water Resources Council, the western boundary of the Lower Mississippi region as delineated in 1970 was much farther west than in 1965.

SELF-SUPPLIED INDUSTRIAL WATER

More water is withdrawn for industrial water use than for any other category of withdrawal use. The amount used in 1970 increased 23 percent over that used in 1965. The amount of self-supplied industrial water used in the United States and Puerto Rico in 1970 was estimated as 210 bgd (tables 8 and 15) of which about 54 bgd was saline; the ratio of fresh water use to salt water use is the same as it was in 1965. More than 80 percent of the industrial water was withdrawn in the eastern part of the United States (figs. 2 and 3). Water used by thermoelectric powerplants in 1970 constituted about 78 percent of industrial uses. Of the total water withdrawn by self-supplied industry, 90 percent of the water was used for cooling, and 25 percent of all self-supplied industrial water was saline (fig. 4), the same proportions as in 1965.

No change in the relative proportion of source of supply was indicated in 1970 as ground water again supplied about 5 percent, surface water 95 percent, and reclaimed sewage only a fraction of 1 percent. The ratio of water withdrawn to water consumed was estimated to be approximately the same for fresh and saline water used by industry in 1970. For fresh-water uses, water consumed was about two-thirds of a percent by thermoelectric plants, about 10 percent by other industries, and about 3 percent by all industries. These ratios are higher than they were for total fresh- and saline-water consumption in 1965 (2 percent for all industrial water consumption).

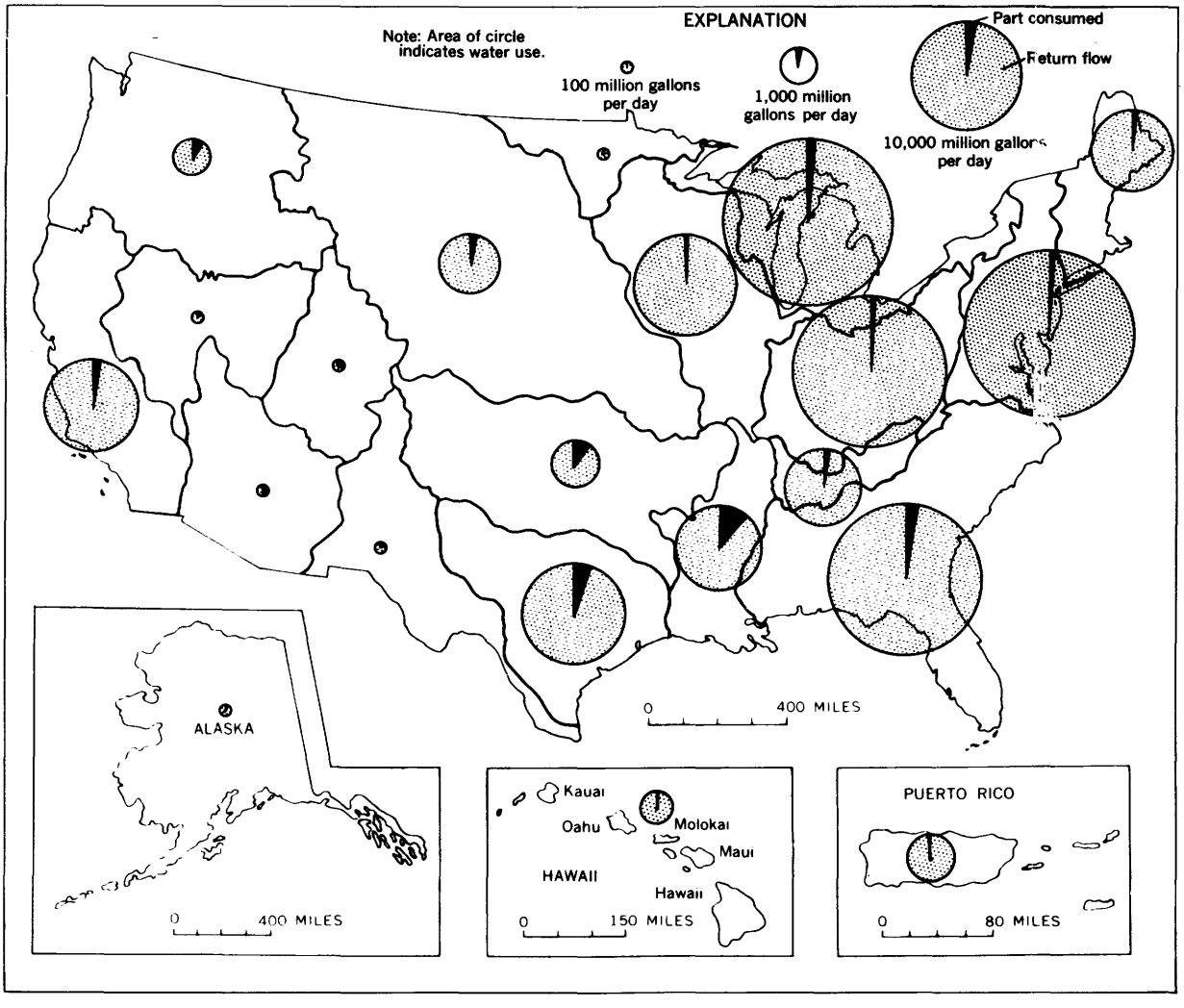

Figure 2.—Map of the United States showing self-supplied industrial water withdrawals, by regions, 1970.

Water withdrawals for fish farming, fish hatcheries, and log ponds are considered industrial uses in this report. Industrial withdrawals for Arkansas and Alabama include appreciable quantities of water used for fish farming—300 mgd and 12 mgd, respectively.

THERMOELECTRIC POWER

In 1970, water used by thermoelectric plants amounted to about 170 bgd, an increase of about 33 percent over the 1965 estimate. This compares with a 49 percent increase in power production. Because of their large demand, thermoelectric plants furnish practically all of their own water; less than one-half of 1 percent is purchased from public supplies. Water used by electric-utility steamplants (tables 9 and 16) is tabulated separately from other industrial uses because of its magnitude. Not only does the power industry withdraw the largest quantity of water for off-channel use, but the rate of increase in usage by thermoelectric powerplants makes self-supplied industrial use the fastest growing of the major withdrawal uses (fig. 10.)

Some preliminary data by the Federal Power Commission (1970) on 1970 production, when compared with similar data in its 1965 report, show that electric utility production in 1970 reached a new record of almost 1,530 billion kw-hr (kilowatt-hours). Thermoelectric (fuel-burning) plants generated 1,282 billion kw-hr or 83.8 percent of the total. Included in this amount was nuclear plant production of 21.8 billion kw-hr, a 500 percent increase since 1965. Total utility production, including hydroelectric, was 45 percent above that in 1965. Utility hydroelectric production was up 28 percent, and thermoelectric production was up 49 percent from the 1965 levels. Combined utility

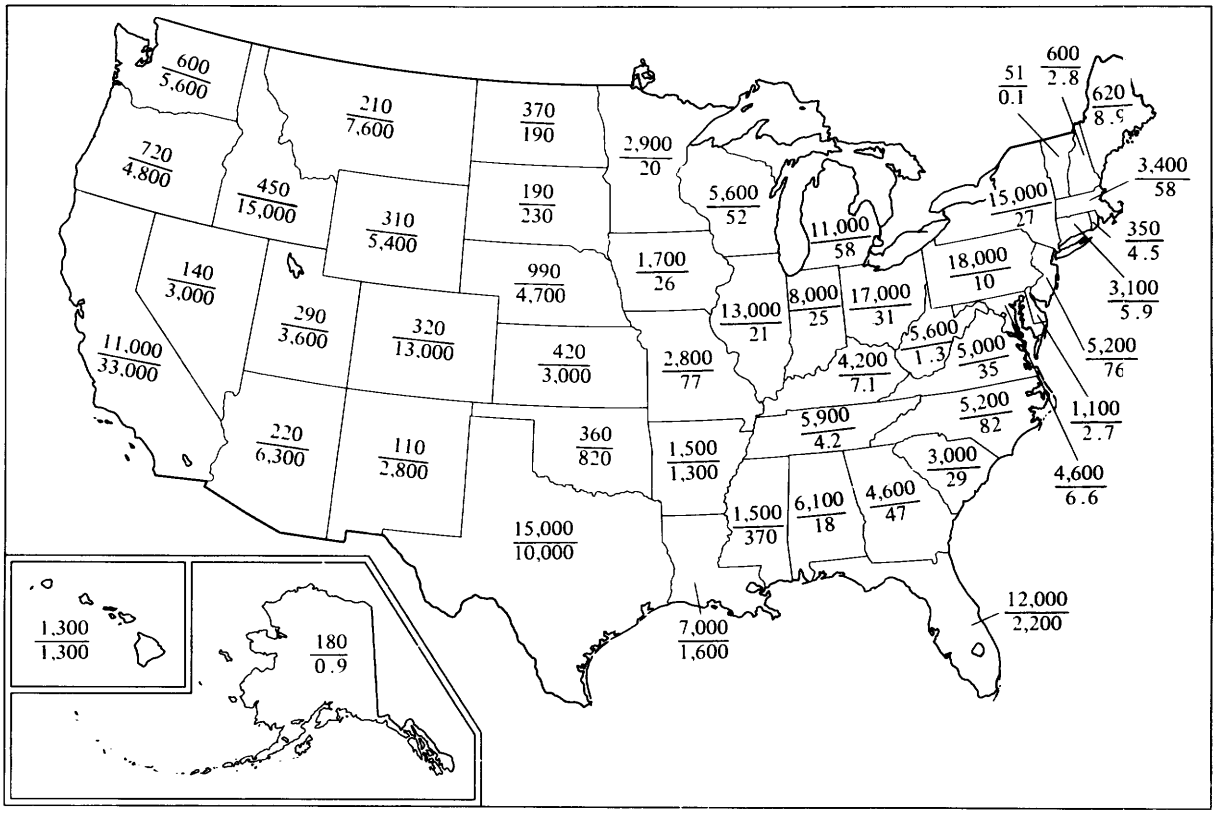

Figure 3.—Map of the United States showing self-supplied industrial water withdrawals (upper figure) and irrigation water withdrawals (lower figure), in million gallons per day, by States, 1970.

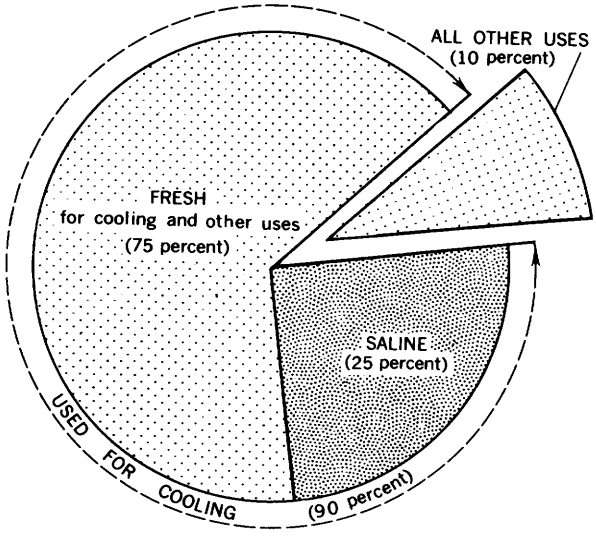

Figure 4.—Diagram showing characteristics of self-supplied industrial water use, 1970.

and industrial production of 1,638 billion kw-hr was 42 percent above the 1965 figure. Industrial production of more than 108 billion kw-hr in 1970 (about 6.6 percent of the combined total) was 6 percent more than industrial power generation in 1965. Water used by electric utilities in thermoelectric-power production is shown in tables 9 and 16, and that used by industrial establishments in generating their own thermoelectric power is included in "other self-supplied industrial uses" in tables 8 and 15.

In 1970 about 98 percent of the total water withdrawn by thermoelectric plants was used for condensing spent steam from generators. Plants vary widely as to the techniques used in disposal of the cooling water after it has passed through the condensers. Where water is expensive or scarce, cooling towers or ponds (Federal Power Commission, 1969) are employed so that the same water can be used repeatedly in the condensers. Prevention of thermal pollution of the receiving water body is another factor that has caused some plants to resort to water-cooling devices. The quantity of water consumed by steamplants will increase as reuse of water becomes more prevalent. About one-half of 1 percent of the water withdrawn in 1970 was consumed, compared with a third of 1 percent in 1965. Saline water constituted 28 percent of total withdrawals in both 1965 and 1970. It is likely that increasing amounts of saline water will be used in thermoelectric powerplants; as the number of inland sites with adequate fresh-water

supplies for additional powerplants decreases, more plants will be located along the coasts.

HYDROELECTRIC POWER

Hydroelectric power production in the United States increased 28 percent since 1965. The cumulative water withdrawal for hydroelectric power generation in 1970 was estimated as 2,800 bgd (2-1/3 times the average annual runoff in the conterminous United States). This compares with 2,300 bgd in 1965—an increase of about 22 percent for the 5-year period (tables 11 and 18).

It was necessary to calculate the quantity of water used for hydroelectric power generation in some States as had been done in previous water-use reports in this series. Calculations were based on data in two reports of the Federal Power Commission (1968, 1971); the gross static head of individual hydroelectric plants, the average annual power generation of each plant, and the average annual power production in each State were obtained from the 1968 report. The actual production of power in each State in 1970 was obtained from the 1971 report. Assumptions made were that each plant operated at an efficiency of 70 percent and, in 1970, produced power in the proportion that its average annual power generation was to the average annual power generation of the State in which it is located. New plants not listed in the Federal Power Commission's tables for January 1, 1968, were not considered in the estimates, and the power generated by new plants was attributed to the listed plants.

Estimated quantities of water used may differ because of the manner in which individual estimators consider the amount of water from pumped storage that passes through hydroelectric plants. In keeping with the past practice of considering only the initial water withdrawal of an industrial establishment, gross water use (the equivalent amount of water that would be required if no reuse or recirculation occurred in the plant) is normally not reported in this water-use report. However, with respect to hydroelectric power where water-use data are derived from the amount of power developed and the height from which the water falls (without information regarding the number of times the water is pumped back to the storage reservoir), gross water usage, rather than net withdrawal use, is obtained. As pumped storage becomes more prevalent, it will become an important factor in making water-use estimates. Although a very small quantity of water is evaporated in the generation of hydroelectric power, repeated reuse of water within a pumped-storage powerplant and the repeated reuse (cumulative withdrawals) which now occurs in successive plants downstream (2,800 bgd withdrawn compared with a total supply of 1,200 bgd), will cause some depletion of the available water supply. An estimated 11 bgd (Meyers, 1962) consumed by evaporation from principal reservoirs and regulated lakes (irrespective of purpose) in the 17 Western States, and classified as a nonwithdrawal use, is equivalent to about 13 percent of the consumption by all off-channel withdrawal uses in 1970. Total evaporation from reservoirs and regulated lakes throughout the United States is undoubtedly causing a considerably larger reduction in available water than that indicated for the Western States alone.

SUMMARY OF OFF-CHANNEL WATER WITHDRAWALS AND CONSUMPTION

The estimated withdrawal of 370 bgd for all off-channel uses (withdrawals for all purposes other than for hydroelectric power) in 1970 (tables 10 and 17) is about 19 percent greater than the 1965 withdrawal estimated by Murray (1968). It indicates an average per capita withdrawal use of 1,800 gpd for the United States and Puerto Rico. The percentages of off-channel withdrawal uses for the various categories in 1970 are shown in figure 5. Fresh water consumed in 1970 was estimated at 87 bgd, and the percentages of water consumed by the various categories of withdrawal uses are also shown in figure 5. The percentages are the same as in 1965. Geographically, 86 percent of the water was consumed in the 17 Western States, an increase of 1 percent since 1965, whereas only 14 percent was consumed in the 31 Eastern States (fig. 6). The great difference in per capita water use in the western regions and in eastern regions is shown in table 2.

Per capita domestic use of water from public supplies by the relatively smaller population of the Western States is 30 percent higher than that of the Eastern States; however, per capita use in the West is only about 13 percent higher than per capita use in the East when commercial and industrial uses of public supplies are included. For all off-channel withdrawal uses, per capita use in the West is more than twice that in the East. When water used for hydroelectric power development is

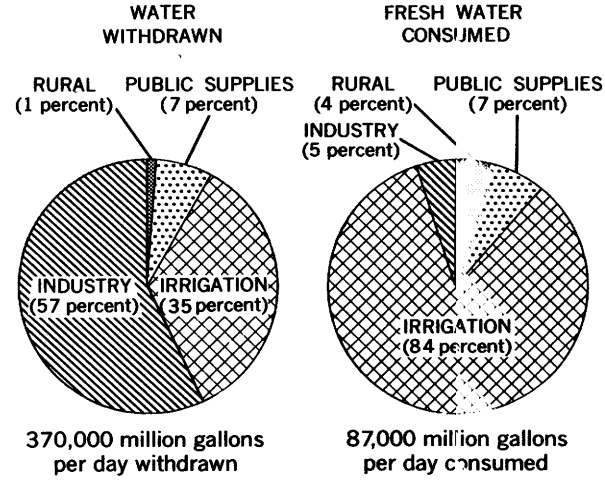

Figure 5.—Diagrams showing off-channel water withdrawals and fresh-water consumption in 1970, by category.

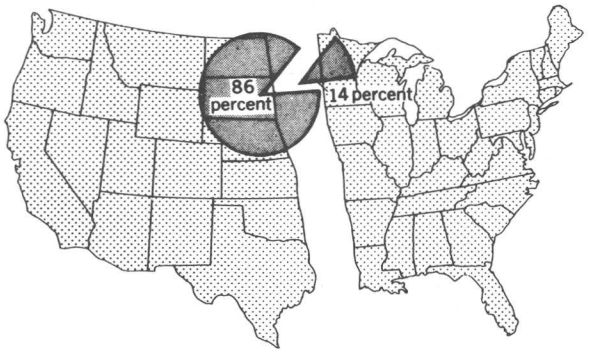

Figure 6.—Map showing fresh-water consumption in the 17 Western States compared with that in the 31 Eastern States, 1970.

included, per capita use in the West is three times that in the East. Similarly, per capita consumption of water in the West far exceeds that in the East, being about 16 times as great. These high consumptive and withdrawal uses and the scarcity of water are major factors in the supply-versus-demand problems in the West.

In 1970, an average of about 68 bgd of fresh ground water, 1 bgd of saline ground water, 250 bgd of fresh surface water, and 53 bgd of saline surface water was withdrawn for off-channel uses (tables 10 and 17). Withdrawals (excluding hydroelectric use) of ground water and surface water, by States, are shown in figure 7.

Table 2.—*Comparative per capita water withdrawals and water consumptions, (eastern and western Water Resources Council Regions and total United States), in gallons per day, 1970*

[All per capita data in this table have been rounded to two significant figures]

	Public supplies only			All withdrawal uses			
	Population served (millions)	All uses	Domestic and public uses only[1]	Total population 1970 (millions)	Excluding water-power	Including water-power	Fresh water consumed, all off-channel uses
9 eastern WRC regions.	114.4	160	100	145.5	1,400	10,000	81
9 western WRC regions.	47.4	180	130	56.6	2,900	30,000	1,300
50 States and District of Columbia.	162.6	170	110	203.2	1,800	16,000	430

[1]Includes water losses in systems.

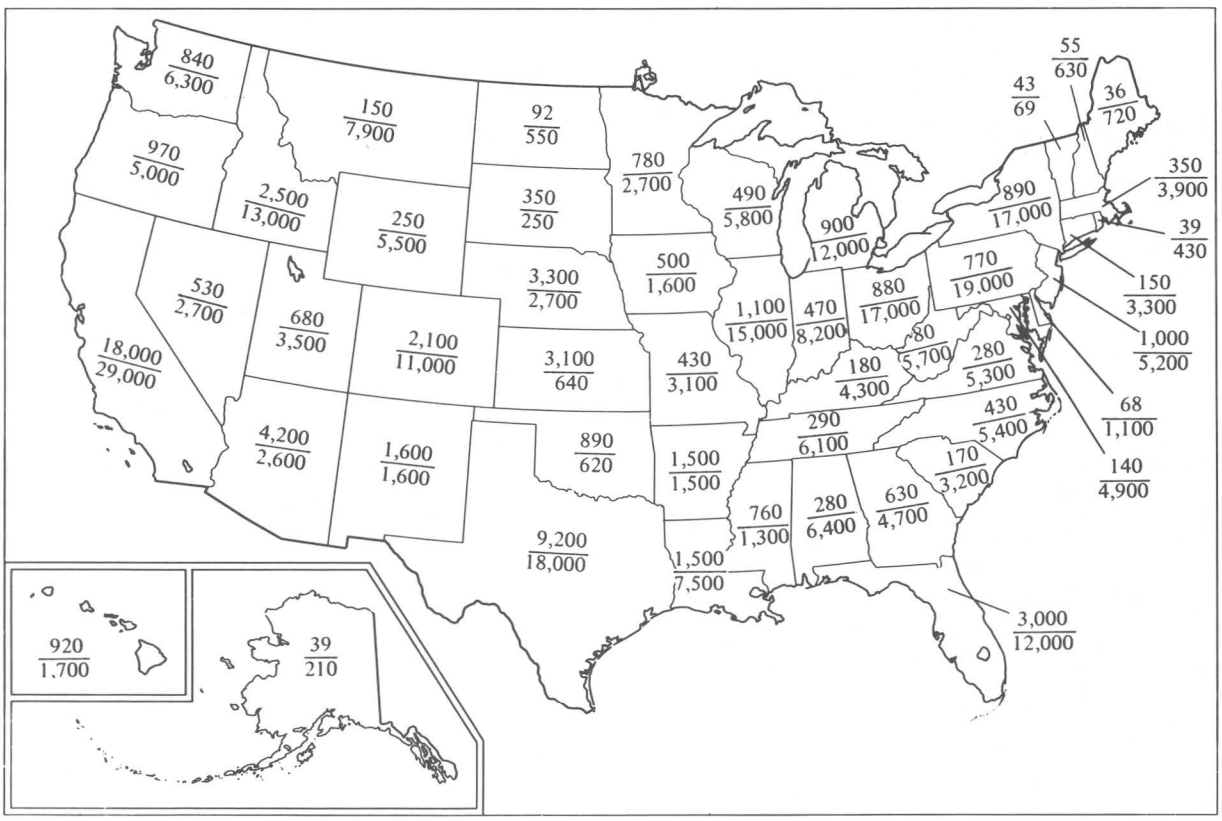

Figure 7.—Map showing off-channel water withdrawals from ground-water sources (upper figure) and from surface-water sources (lower figure), in million gallons per day, by States, 1970.

NONWITHDRAWAL USES

Nonwithdrawal uses, or water use not dependent on diversion of water from ground- or surface-water sources, usually are classified as flow uses or as onsite uses. Flow uses mentioned in the section on terminology are navigation, sport fishing habitat, fresh water sweetening of saline estuaries, and the disposition and dilution of waste water. All of these uses depend on water running freely in a defined channel. Onsite uses may occur (1) when water is present in a watercourse, lake, reservoir, or other body of water, or (2) they may occur when water is used to improve natural conditions. Evaporation from powerplant reservoirs, which results from establishment and operation of a withdrawal type water project, is an example of the first type of onsite use, and use of water for wetlands improvement for wildlife habitat is an example of the second type. Thus, nonwithdrawal uses are important in maintaining the environment and water must be provided for them. Quantitative estimates are more difficult to make for nonwithdrawal uses than for withdrawal uses; however, methods and procedures for determining nonwithdrawal uses will have to be devised for effective water-resources management because such uses affect the quantity and quality of the available water resources for all uses. Evaluation of the magnitude of nonwithdrawal uses is not within the scope of this report.

TRENDS IN WATER USE, 1950–70

Table 3 shows the quantities of water withdrawn and consumed in the United States for 1950, 1955, 1960, 1965, and 1970. The quantities derived from fresh- and saline-water sources, ground- and surface-water sources, and from reclaimed sewage are shown. The percentage increases (or decreases) for the various categories of water use and sources of supply for the period 1965 to 1970 are also indicated. Data in table 3 for the period 1950 to 1965 were adapted from previous water-use circulars by MacKichan (1951, 1957), MacKichan and Kammerer (1961), and Murray (1968).

Figures 8 through 10 show steady rates of increase in water uses with only surface water used for irrigation showing an irregular trend; the amount of surface water used for irrigation declined from 1950 to 1960, but increased about 9 percent between 1960 and 1965 and there was an equal increase in the period 1965–70. The average amount of water required per acre for irrigation in 1970 (2.8 acre-ft per acre) was slightly less than in 1965 and 1960. However, the acreage irrigated was about 13 percent greater than in 1965; this is about the same increase that took place from 1960 to 1965.

The quantities of water withdrawn and consumed in 1970 were compared with projections and estimates made in the past by Picton (1960), Eliasberg (1960), the Water Resources Council (1968), and Wollman and Bonem (1971). In general, water withdrawals for 1970 are lower than would be expected from some forecasts; this is especially true of water used for irrigation and industrial uses other than for power. However, the 160 bgd used by thermoelectric plants is higher than most forecasts and is the result of rather phenomenal growth in power production; an average value of nearly 49 gallons of water was reported withdrawn for the generation of each kilowatt-hour of power; this is only slightly less than the 52 gallons per killowatt-hour used in 1959 (Federal Power Commission, 1961).

Table 3.—*Changes in water withdrawals and consumption in the United States, in billion gallons per day, 1950–70*

	1950	1955	1960	1965	1970	Percent increase or decrease, 1965–70
Total population (millions)	150.7	164	179.3	193.8	203.2	5
Public supplies	14	17	21	24	27	13
Rural domestic and livestock	3.6	3.6	3.6	4.0	4.5	13
Irrigation	[1]110	110	110	120	130	8
Thermoelectric power (electric utility) use	[2]40	72	100	130	170	33
Other self-supplied industrial use	[2]37	39	38	46	47	2
Total withdrawals	200	240	270	310	370	19
Fresh ground water	34	47	50	60	68	13
Saline ground water	----------	.65	.38	.47	1.0	113
Fresh surface water	[3]160	180	190	210	250	19
Saline surface water	[3]10	18	31	43	53	23
Reclaimed sewage	----------	.2	.1	.7	.5	-29
Water consumed by off-channel uses	----------	----------	61	77	87	13
Water used for hydroelectric power	1,100	1,500	2,000	2,300	2,800	22

[1] Including an estimated 30 bgd in irrigation conveyance losses.
[2] Estimated distribution of 77 bgd reported by MacKichan (1951).
[3] Distribution of 170 bgd of fresh and saline water reported by MacKichan (1951).

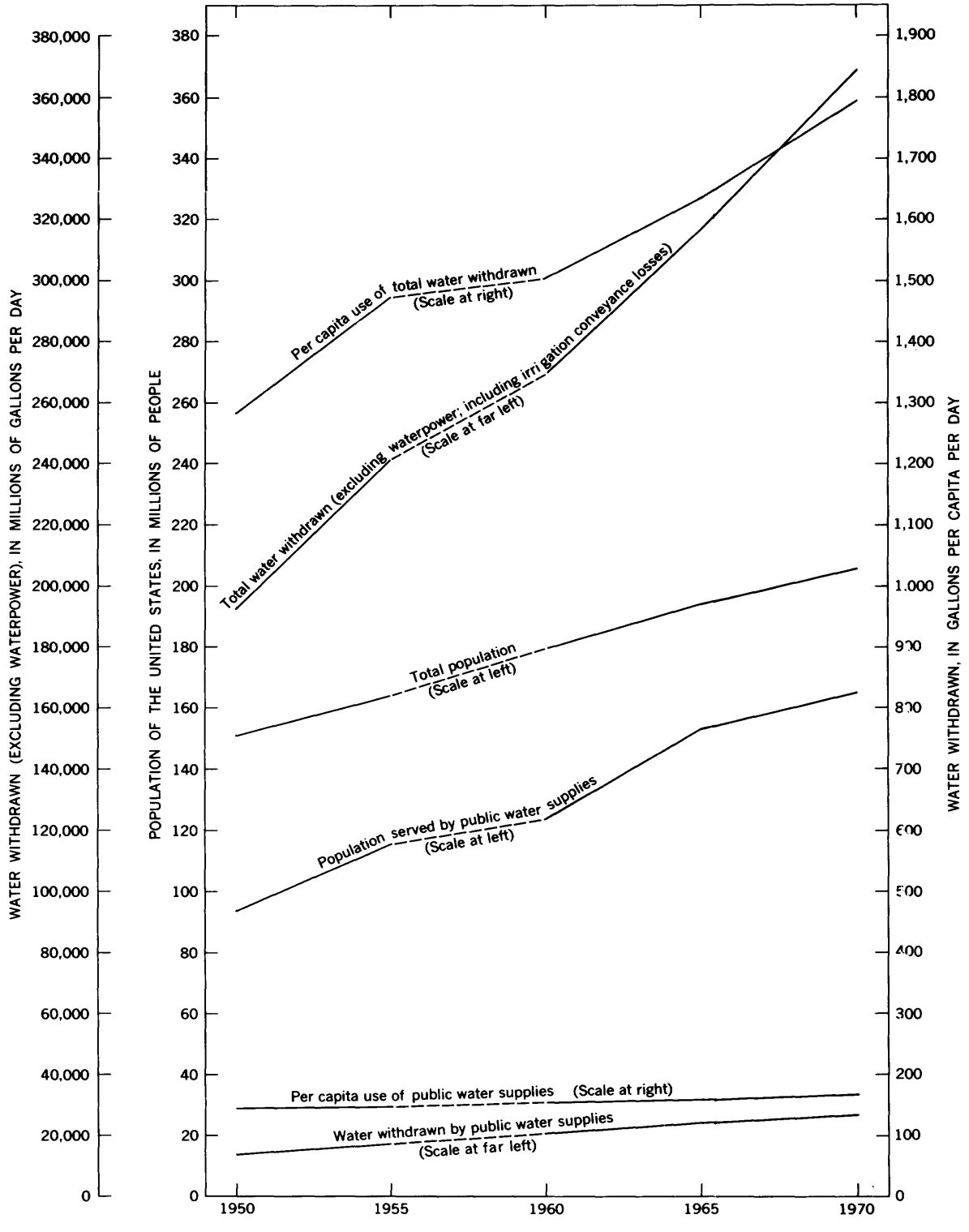

Figure 8.—Graph showing trends in population and withdrawals of water in the United States, 1950–70.

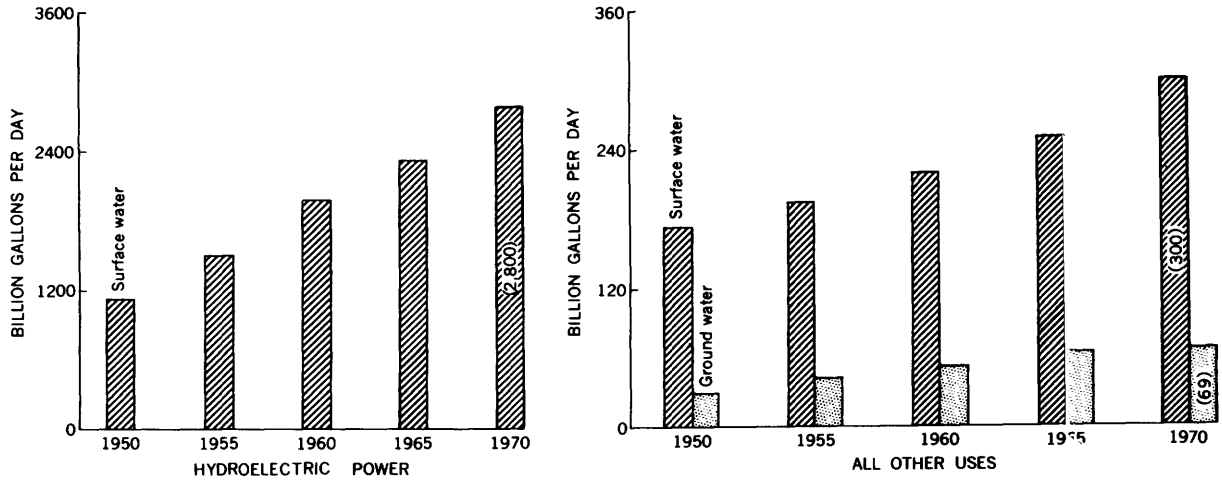

Figure 9.—Graphs showing trends in use of water for hydroelectric power and in all other withdrawal uses combined, 1950–70.

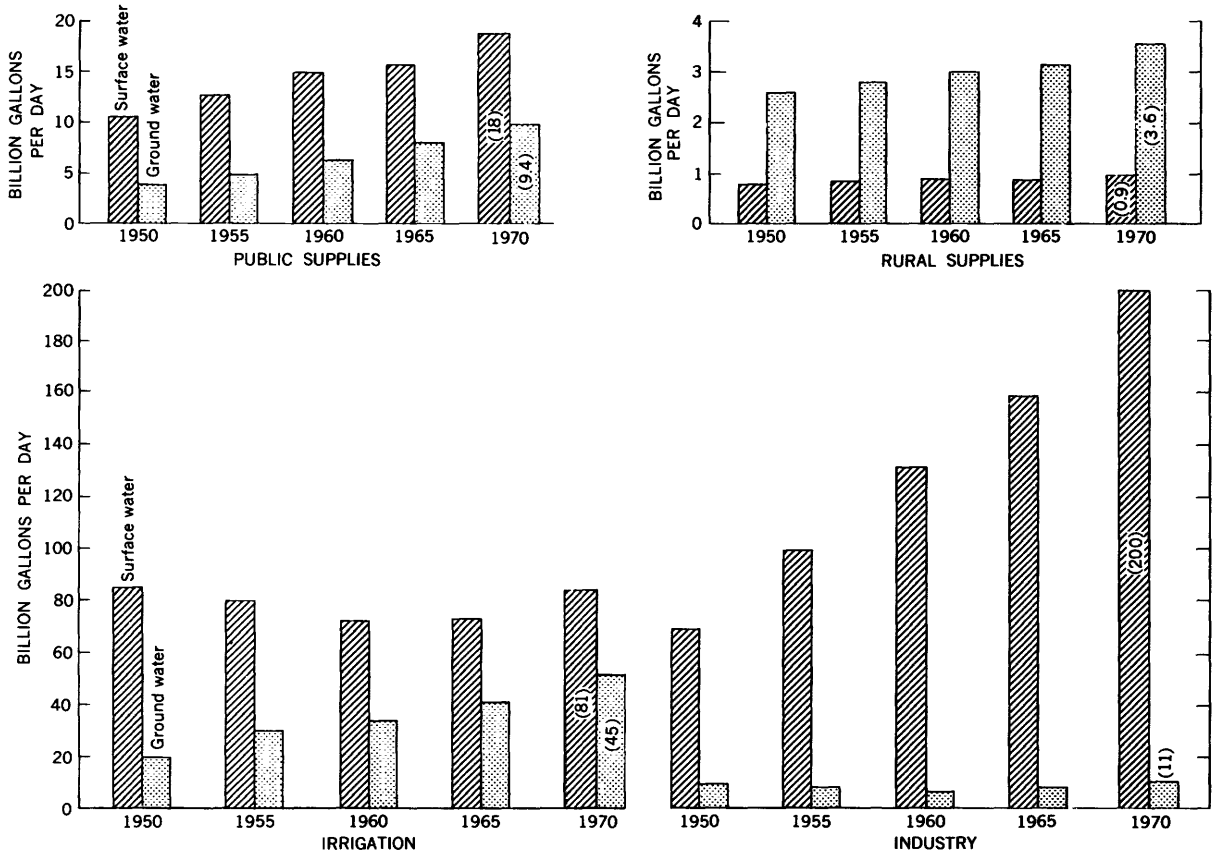

Figure 10.—Graphs showing trends in use of water for public supplies, rural supplies, irrigation, and self-supplied industry, 1950–70.

It appears that less water has been used than was forecast 10 years ago. Trends established over the period 1950–65 have not changed during the period 1965–70 (figs. 8–10).

SUPPLY COMPARED WITH CUMULATIVE, OFF-CHANNEL WATER WITHDRAWALS

Generally, demand for water must be met by the locally available supply. The quantity available in some areas is much the same year after year, but in other regions unpredictable differences occur that result in variations from year to year. In addition to the yearly differences, seasonal differences of available water are to be expected in most areas. Cumulative withdrawals decrease the streamflow, and return flows increase it, thereby producing a net balance of available surface supply at a given time and place. In order to compensate for the various irregularities in availability, water-resources management practices are established, such as storage of water in reservoirs and artificial ground-water recharge. Importation of water from regions with greater natural supplies is also practiced in some areas. Woodward (1957) made estimates of dependable supplies in 1955 (based on the minimum monthly flow at major points of use under existing conditions of development) and made a forecast of the dependable supply in 1980 (based on assumptions of future water-management practices).

Important methods of determining dependable supply are the statistical analysis of streamflow records and evaluating the degree to which reservoir storage assists streamflow in maintaining a satisfactory available supply. A number of papers on these subjects have been published. C.H. Hardison furnished water-supply data from such studies for the first national assessment of the Water Resources Council (1968). Table 4 shows cumulative, off-channel water withdrawals in 1970 compared with estimated dependable supply and with streamflow—both the total annual runoff and that runoff exceeded in 90 percent of the years. Comparisons of these data show a very favorable situation to exist in the South Atlantic-Gulf, Columbia-North Pacific, and Ohio (which includes the Cumberland River) regions—all are areas of abundant supply. A similar but less favorable relationship exists in the other seven eastern regions.

In the eastern regions (excluding the Great Lakes region) and in the Columbia-North Pacific region, values for "annual flows exceeded in 90 percent of the years" are high compared with dependable supplies (and off-channel withdrawals), which indicates that there is a natural dependability of supply. However, in the Souris-Red-Rainy region, the Missouri region, the Texas-Gulf region, the Rio Grande region, the Upper Colorado region, the Lower Colorado region, and the Great Basin region, the flows exceeded in 90 percent of the years are less than the dependable supplies and are less than the cumulative, off-channel water withdrawals in six of these seven regions (the exception is the Souris-Red-Rainy region), which indicates that these areas are most susceptible to drought and water shortages.

In the West, the Missouri and Arkansas-White-Red regions have moderately large water supplies and favorable supply-to-demand relationships. In the Texas-Gulf region, cumulative, off-channel water withdrawals form a large percentage of runoff, and are greater than the 1980 estimated dependable supply and greater than the annual flow exceeded in 90 percent of the years; 30 percent of the water withdrawn is consumed (excluding any saline-water consumption) which is high compared with consumption in the eastern regions. The situtation in the Rio Grande region is similar to that in the Texas-Gulf region; however, the supply is only a small fraction of that present in the latter region, and the consumption in the Rio Grande region is greater than the dependable supply. The small quantity of water available to the Upper Colorado region has been made dependable through water-management practices; however, much of the flow is withdrawn for off-channel uses and about half of this water is consumed. Both water withdrawals and consumption in the Lower Colorado region exceed the supply originating in the area; this is made possible by augmentation of the supply by inflow of water from the Upper Colorado region, importation of surface water, repeated withdrawals of the same surface water, and mining of ground water. Large ground-water withdrawals are characteristic of the Texas-Gulf, Rio Grande, Arkansas-White-Red, Lower Colorado, and California-South Pacific regions. These regions contrast sharply with numerous others in which fresh surface-water withdrawals approach total withdrawals in magnitude. Considering the small, naturally available water supply in the Great Basin region, off-channel water withdrawals and water consumption are high. In the California-South Pacific region, the amount of runoff is moderately high; however, a large percentage of the runoff is withdrawn. The cumulative, off-channel water withdrawal is nearly twice the dependable supply, and the amount of water consumed exceeds the amount of fresh surface water withdrawn and approaches Woodward's estimate of the dependable supply for 1980. Here again, mining of ground water, repeated withdrawals of the same surface water, and importation of surface water have made possible the high withdrawals and consumptions. In the Hawaii region, only about 20 percent of the runoff is used and 6 percent is consumed; withdrawals are principally from aquifers (ground water).

In addition to the need for an adequate water supply, water-quality conditions must be suitable if supply and demand are to be in balance. For this reason, it is necessary to anticipate the magnitude of the various categories of water use (with their attendant consumption) in the future. The different uses vary widely as to the degree to which they degrade the supply and affect the reuse potential of the return flows. Trends

established over the past 20 years indicate that the magnitude of withdrawals for 1980 may be about 220 bgd for thermeoelectric power, 137 bgd for irrigation, 52 bgd for self-supplied industry, 33 bgd for public supplies, and 5 bgd for rural domestic and stock purposes. However, these estimates are subject to large errors, and the current decrease in the rate of population growth will probably affect the magnitude of future withdrawals, especially those for public supplies. The estimated cumulative, off-channel, water withdrawal of 450 bgd in 1980 is less than that estimated about 10 years ago in the reports of Picton, Woodward, and Eliasberg. Wollman and Bonem (1971) indicated that extensive recirculation of water may greatly lower water withdrawals in 1980, and the Committee on Technologies and Water, National Academy of Sciences (1971), have also discussed technical developments which may affect water supply and water use in the future. The Committee placed emphasis on developments which would improve the supply and lower the demand.

Figure 11 shows relationships of supply, withdrawal use, and consumptive use for the conterminous United States. Similar comparisons for the 17 Western States are given in figure 12. The figures indicate that the aggregated, off-channel withdrawals of fresh water in the conterminous States are about 75 percent, and that consumption is about 20 percent, of the estimated dependable supply (435 bgd) for 1970 (obtained by interpolation from Woodward's values). In the Western States (nearly equivalent to the nine western regions), cumulative, off-channel withdrawals (161 bgd) are nearly 90 percent of the estimated dependable supply (185 bgd) for 1970 and consumption (74 bgd) is about 40 percent of that supply. Two factors limit the usefulness of these figures—the cumulative, off-channel withdrawal totals represent to an unspecified degree a number of repeated withdrawals of the same water by different users, and the withdrawal data also represent national or regional averages and, therefore, hide local

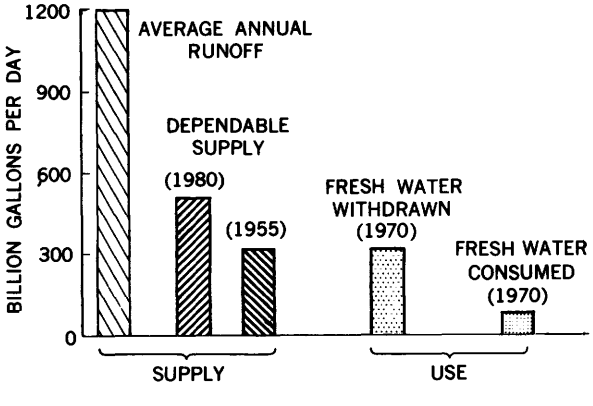

Figure 11.—Graph showing water supply and cumulative, off-channel water withdrawals in the 48 conterminous States.

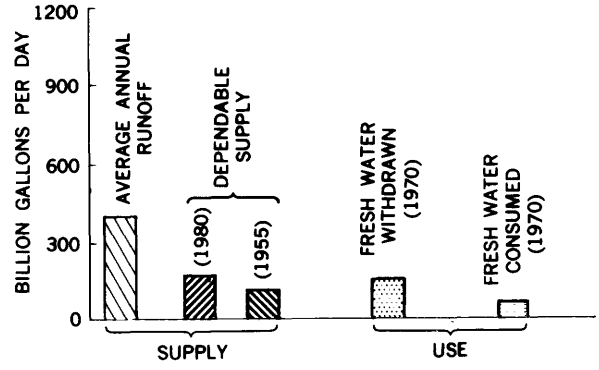

Figure 12.—Graph showing water supply and cumulative, off-channel water withdrawals in the 17 Western States.

water shortages. Such shortages often lead to reuse so that gross use can exceed the dependable supply; however, the recycling within a plant leads to increased consumption. Water that has been consumed is, of course, no longer available for reuse; therefore, consumption of 40 percent of the water in the West under the present regimen presages continuing and increasing water-supply problems. Also, loss (consumption) of a large percentage of the water in any region may cause serious impairment (degradation) in the quality of the remaining water and, in addition, the volume and flow (velocity) of the remaining water may be insufficient for essential non-withdrawal uses—even for those which have no quality-of-water constraints.

As long as there is no slackening of the rates of water withdrawal and water consumption, major attention must be given to water-management problems so that maximum benefits will be obtained from use of the Nation's water resources. In addition to increased storage facilities, artificial recharge of ground water, suppression of evaporation and unproductive transpiration, and interbasin transfer of water, improvements are needed in other techniques such as artificial induction of precipitation and desalination of water.

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Table 4.—*Supply compared with cumulative, off-channel water withdrawals, by regions, 1970*

Region	Area[1] (1,000's sq mi)	Average runoff[1]		Estimated dependable[2] supply, 1980 (bgd)	Withdrawals[3] 1970 (bgd)	Fresh water consumed 1970 (bgd)	Annual flow[1], in bgd, exceeded in 90 percent of years	Fresh surface water withdrawn[3], 1970 (bgd)
		Inches per year	Bgd					
New England	59	24	67	22	9.7	0.41	49	4.1
Middle Atlantic	102	18	84	36	45	1.4	68	25
South Atlantic-Gulf	270	15	197	75	35	3.3	129	20
Great Lakes	126	12	75	69	39	1.2	54	38
Ohio	163	16	125	48	36	.92	75	34
Tennessee	41	21	41	14	7.9	.24	28	7.7
Upper Mississippi	190	7.2	65	31	16	.76	36	14
Lower Mississippi	96	17	79	25	13	3.6	38	8.5
Souris-Red-Rainy	59	2.2	6.2	3	.3	.07	2	.2
Missouri	515	2.2	54	30	24	12	29	18
Arkansas-White-Red	265	6.0	73	20	12	6.8	36	5.2
Texas-Gulf	175	3.9	32	17	21	6.2	11	7.4
Rio Grande	136	.8	5.0	3	6.3	3.3	2	3.8
Upper Colorado	110	2.5	13	13	8.1	4.1	8	8.0
Lower Colorado	137	.5	3.2	2	7.2	5.0	1	2.8
Great Basin	185	1.0	7.5	9	6.7	3.2	3	5.5
Columbia-North Pacific	271	16	210	70	30	11	148	26
California-South Pacific	120	9.0	62	28	48	22	30	21
United States (conterminous)	3,020	8.3	1,200	515	365	87	747	249
Alaska	590	.....	.....	.....	.2	.02	.....	.2
Hawaii	6.4	44	13	.....	2.7	.81	.....	.8
Puerto Rico	3.4	.....	.....	.....	3.0	.17	.....	.4
Grand total	3,620	.....	.....	.....	371	88	.....	250

[1]Modified from Table 31, U.S. Geological Survey Circular 556, p. 52.

[2]Woodward (1957), p. 49, with minor modifications.

[3]Including some minor inter-regional diversions.

Table 5.—*Water used for public supplies, by States, 1970*

[Partial figures may not add to totals because of independent rounding]

State	Population served			Water withdrawn				Water delivered		Water consumed (mgd)
	Ground water (thousands)	Surface water (thousands)	All water (thousands)	Ground water (mgd)	Surface water (mgd)	All water (mgd)	Per capita (gpd)	Industrial and commercial uses (mgd)	Domestic use and losses[1] (mgd)	
Alabama	765	1,420	2,190	100	360	470	213	260	210	36
Alaska	62	64	126	24	35	60	473	7.0	53	11
Arizona	989	509	1,500	190	120	310	208	47	260	160
Arkansas	605	637	1,240	71	95	170	133	63	100	36
California	8,000	10,700	18,700	1,600	1,800	3,400	181	620	2,800	1,400
Colorado	306	1,670	1,980	79	310	390	197	91	300	97
Connecticut	590	1,900	2,490	86	270	360	143	170	190	120
Delaware	217	193	410	30	46	76	185	32	44	20
Florida	4,820	592	5,410	760	120	880	163	170	720	230
Georgia	825	1,350	2,170	190	350	540	250	310	240	130
Hawaii	662	32	694	120	12	140	197	26	110	46
Idaho	407	63	470	96	15	110	237	5.8	110	29
Illinois	3,880	6,790	10,700	720	1,500	2,200	204	570	1,600	210
Indiana	1,500	1,990	3,480	210	280	490	141	140	350	120
Iowa	1,520	505	2,030	180	73	250	123	60	190	37
Kansas	817	823	1,640	130	120	250	155	61	190	74
Kentucky	304	1,860	2,160	24	160	180	83	78	100	26
Louisiana	1,290	1,370	2,670	140	240	380	144	58	330	200
Maine	153	599	752	20	89	110	146	38	72	22
Maryland	368	2,750	3,120	42	380	420	136	85	340	23
Massachusetts	1,460	3,940	5,400	170	590	750	140	320	440	38
Michigan	1,360	5,500	6,870	230	920	1,200	168	640	520	95
Minnesota	1,500	1,250	2,750	160	180	340	125	140	210	34
Mississippi	1,180	213	1,390	160	30	190	134	63	120	70
Missouri	942	3,020	3,970	92	420	510	128	260	250	95
Montana	152	354	507	26	85	110	219	32	79	55
Nebraska	908	211	1,120	150	34	190	168	46	140	38
Nevada	265	176	441	81	54	130	305	39	95	46
New Hampshire	261	283	544	32	38	70	128	22	48	3.6
New Jersey	3,030	3,390	6,420	340	560	900	139	110	780	180

New Mexico	645	67	712	130	16	150	204	41	100	66
New York	4,150	12,300	16,500	460	2,200	2,600	161	790	1,900	450
North Carolina	660	2,020	2,680	80	380	460	170	120	340	91
North Dakota	189	206	395	24	26	50	126	1.6	48	28
Ohio	2,480	5,980	8,460	320	1,000	1,300	157	340	990	170
Oklahoma	551	1,450	2,000	72	190	260	130	86	170	100
Oregon	355	842	1,200	67	160	230	188	90	140	48
Pennsylvania	1,350	8,300	9,650	250	1,500	1,800	181	880	870	180
Rhode Island	213	634	847	18	85	100	122	62	41	5.2
South Carolina	221	1,010	1,230	55	240	300	242	120	180	45
South Dakota	284	126	410	42	18	60	145	19	41	16
Tennessee	1,190	1,930	3,120	160	240	400	129	140	260	43
Texas	4,580	4,660	9,250	690	740	1,400	155	470	970	510
Utah	502	444	945	150	130	280	294	25	250	130
Vermont	100	189	289	14	29	42	146	13	30	1.7
Virginia	477	3,040	3,520	74	320	390	111	160	230	42
Washington	1,070	1,780	2,860	290	610	910	317	470	440	160
West Virginia	380	794	1,170	36	140	180	150	71	110	.2
Wisconsin	1,540	1,570	3,110	220	270	480	155	230	250	48
Wyoming	130	120	250	24	25	49	197	13	37	12
District of Columbia	0	757	757	0	160	160	211	50	110	16
Puerto Rico	396	1,940	2,330	34	170	200	86	77	130	43
United States[2]	60,600	104,000	165,000	9,400	18,000	27,000	166	8,800	19,000	5,900

[1]Includes public use.
[2]Including Puerto Rico.

Table 6.—*Water for rural use, in million gallons per day, by States, 1970*

[Partial figures may not add to totals because of independent rounding]

State	Domestic use				Livestock use				Domestic and livestock uses			
	Withdrawn			Water consumed	Withdrawn			Water consumed	Withdrawn			Water consumed
	Ground water	Surface water	All water		Ground water	Surface water	All water		Ground water	Surface water	All water	
Alabama	63	0	63	63	13	15	27	27	76	15	90	90
Alaska	4.5	1.6	6.1	.2	0	.1	.1	.1	4.5	1.7	6.2	.4
Arizona	22	0	22	16	20	8.4	28	28	42	8.4	50	44
Arkansas	49	0	49	49	16	19	34	34	64	19	83	83
California	120	8.6	120	71	38	53	91	49	150	62	220	120
Colorado	9.3	1.4	11	2.1	20	15	35	31	29	16	45	33
Connecticut	38	.8	39	39	2.1	.4	2.5	2.5	40	1.2	42	42
Delaware	11	0	11	1.2	1.6	.1	1.7	1.4	13	.1	13	2.6
Florida	160	0	160	130	18	12	30	30	180	12	200	160
Georgia	72	1.3	73	8.8	31	.1	31	31	100	1.4	100	40
Hawaii	.1	.4	.5	.4	1.4	5.9	7.3	6.6	1.5	6.3	7.8	7.0
Idaho	22	2.5	24	6.1	10	12	22	19	32	14	46	25
Illinois	14	3.2	17	12	32	10	42	42	46	13	60	54
Indiana	76	11	87	61	29	17	46	46	100	28	130	110
Iowa	47	.1	47	19	110	25	130	130	160	25	180	150
Kansas	48	3.7	52	49	31	47	79	77	79	51	130	130
Kentucky	48	6.4	55	44	3.7	36	40	40	52	42	94	84
Louisiana	67	0	67	67	11	11	22	22	78	11	89	89
Maine	11	1.1	12	3.3	1.1	1.7	2.8	2.6	12	2.8	14	5.9
Maryland	46	0	46	46	10	.5	11	11	57	.5	57	57
Massachusetts	28	0	28	2.7	1.3	.8	2.1	2.3	30	.8	30	5.0
Michigan	160	0	160	26	24	6.8	31	28	180	6.8	190	54
Minnesota	110	0	110	110	59	9	68	68	170	9.0	170	170
Mississippi	25	0	25	22	16	24	39	39	40	24	64	61
Missouri	29	10	39	18	28	86	110	100	58	96	150	120
Montana	3.3	.7	9.5	9.5	17	16	33	33	26	17	43	43
Nebraska	22	0	22	22	80	20	100	95	100	20	120	120
Nevada	5.8	.2	6.0	2.3	1.6	2.8	4.4	2.4	7.4	3.0	10	4.7
New Hampshire	11	.2	11	1.1	.5	.8	1.3	1.3	12	1.0	13	2.4
New Jersey	80	0	80	40	1.5	.9	2.4	2.1	81	.9	82	42

New Mexico	16	.6	17	8.1	12	32	44	43	29	33	61	51
New York	120	0	120	12	24	13	38	34	140	13	150	45
North Carolina	110	1.1	110	110	43	6.3	50	39	160	7.4	160	150
North Dakota	17	.1	17	17	9.6	6.2	16	16	26	6.3	32	32
Ohio	88	22	110	100	24	16	40	39	110	38	150	140
Oklahoma	24	4.1	28	25	6.7	46	52	52	31	50	80	78
Oregon	160	14	170	170	2.6	19	22	22	160	33	190	190
Pennsylvania	110	0	110	11	14	14	28	18	120	14	140	29
Rhode Island	4.6	0	4.6	.7	.1	.1	.2	.3	4.7	.1	4.8	1.0
South Carolina	46	0	46	46	4.0	4.9	8.9	9.0	50	4.9	55	55
South Dakota	15	1.0	16	11	81	27	109	93	96	28	120	100
Tennessee	39	0	39	9.9	5.4	29	34	34	45	29	73	44
Texas	95	0	95	95	96	52	150	150	190	52	240	240
Utah	23	.2	23	11	34	3.2	37	19	57	3.4	60	30
Vermont	10	.4	11	1.1	5.6	2.7	8.3	8.4	16	3.1	19	9.5
Virginia	73	1.6	74	45	12	17	29	23	84	19	100	68
Washington	43	12	55	19	4.2	2.1	6.3	4.4	48	14	62	24
West Virginia	17	.6	18	.2	.9	6.0	6.9	6.0	18	6.6	25	6.2
Wisconsin	74	0	74	7.3	56	15	71	71	130	15	140	78
Wyoming	5.7	.7	6.4	5.7	3.8	15	19	18	9.5	16	25	24
District of Columbia	0	0	0	0	0	0	0	0	0	0	0	0
Puerto Rico	.4	3.2	3.6	3.0	1.3	7.5	8.8	8.0	1.7	11	12	11
United States[1]	2,500	110	2,600	1,700	1,100	790	1,900	1,700	3,600	910	4,500	3,400

[1]Including Puerto Rico.

Table 7.—*Water used for irrigation, by States, 1970*

[Partial figures may not add to totals because of independent rounding]

State	Acres irrigated (1,000 acres)	Total water withdrawn (1,000 acre-feet per year)				Water consumed[1] (1,000 ac-ft/yr)	Conveyance loss (1,000 ac-ft/yr)	Total water withdrawn (million gallons per day)				Water consumed[1] (mgd)	Conveyance loss (mgd)
		Ground water	Surface water	Reclaimed sewage	All water			Ground water	Surface water	Reclaimed sewage	All water		
Alabama	27	6.0	14	0	20	20	0	5.4	12	0	18	18	0
Alaska	2.2	.5	.5	0	1.0	.9	0	.4	.4	0	.9	.8	0
Arizona	1,200	4,300	2,700	0	7,000	5,000	270	3,800	2,400	0	6,300	4,500	240
Arkansas	1,100	1,200	260	0	1,400	1,000	100	1,100	230	0	1,300	890	90
California	8,700	18,000	19,000	140	37,000	23,000	5,500	16,000	17,000	120	33,000	20,000	4,900
Colorado	4,600	2,100	12,000	90	14,000	7,400	1,600	1,900	11,000	80	13,000	6,600	1,400
Connecticut	14	.7	6.2	0	6.9	6.9	0	.5	5.4	0	5.9	5.9	0
Delaware	17	2.6	.7	0	3.3	3.3	0	2.2	.5	0	2.7	2.7	0
Florida	1,700	1,400	1,100	0	2,500	1,500	160	1,300	970	0	2,200	1,300	150
Georgia	150	7.6	45	0	53	53	0	6.6	40	0	47	47	0
Hawaii	160	610	760	64	1,400	840	250	550	680	57	1,300	750	220
Idaho	3,700	2,300	15,000	2.8	17,000	5,200	4,800	2,100	13,000	2.5	15,000	4,700	4,300
Illinois	36	17	7.2	0	24	24	0	15	6.0	0	21	21	0
Indiana	34	20	8.9	0	29	29	0	18	7.4	0	25	25	0
Iowa	54	26	3.8	0	30	30	0	23	3.1	0	26	26	0
Kansas	1,800	3,100	230	0	3,300	2,600	48	2,800	200	0	3,000	2,300	43
Kentucky	25	.4	7.8	0	8.2	8.2	0	.4	6.7	0	7.1	6.8	0
Louisiana	670	870	880	0	1,700	1,300	480	770	780	0	1,600	1,100	430
Maine	22	.2	9.9	0	10	10	0	.2	8.7	0	8.9	8.8	0
Maryland	16	2.5	4.9	.2	7.6	7.5	0	2.1	4.3	.2	6.6	6.6	0
Massachusetts	34	21	44	0	65	49	0	18	40	0	58	43	0
Michigan	100	25	41	0	66	66	0	22	36	0	58	58	0
Minnesota	50	14	9.5	0	23	23	0	12	8.0	0	20	20	0
Mississippi	200	240	180	0	420	210	42	220	160	0	370	190	37
Missouri	180	79	8.2	0	87	62	6.7	70	6.9	0	77	55	5.5
Montana	2,200	71	8,500	.1	8,600	6,000	2,500	63	7,600	.1	7,600	5,400	2,200
Nebraska	4,100	3,000	2,300	0	5,300	3,900	1,400	2,700	2,100	0	4,700	3,500	1,300
Nevada	830	430	2,900	4.8	3,400	1,600	1,800	380	2,600	4.2	3,000	1,400	1,600
New Hampshire	3.3	0	3.3	0	3.3	2.5	0	0	2.8	0	2.8	2.0	0
New Jersey	170	63	22	0	85	78	0	56	20	0	76	70	0

New Mexico	1,100	1,500	1,700	25	3,200	1,500	170	1,300	1,500	22	2,800	1,300	160
New York	75	16	15	0	31	31	0	14	13	0	27	27	0
North Carolina	470	56	36	0	92	92	0	50	32	0	82	82	0
North Dakota	74	30	190	0	210	150	66	26	170	0	190	130	.59
Ohio	32	11	25	0	35	32	0	9.0	22	0	31	28	0
Oklahoma	620	810	110	0	920	640	22	720	99	0	820	570	20
Oregon	1,900	710	4,700	3.6	5,400	2,600	1,700	630	4,200	3.1	4,800	2,300	1,500
Pennsylvania	35	.9	11	0	12	12	0	.8	9.4	0	10	10	0
Rhode Island	3.8	.5	4.7	0	5.2	3.9	0	.4	4.1	0	4.5	3.4	0
South Carolina	42	10	22	0	32	32	0	8.9	20	0	29	29	0
South Dakota	150	35	230	0	260	147	88	31	200	0	230	130	79
Tennessee	9.3	1.8	3.6	0	5.4	4.6	0	1.3	2.9	0	4.2	3.8	0
Texas	8,300	8,800	2,800	17	12,000	9,100	540	7,800	2,500	15	10,000	8,100	480
Utah	1,300	470	3,500	58	4,100	2,200	710	420	3,200	52	3,600	2,000	630
Vermont	.3	0	.1	0	.1	.1	0	0	.1	0	.1	.1	0
Virginia	80	6.1	34	0	40	38	0	5.2	30	0	35	34	0
Washington	1,400	390	5,900	0	6,300	2,500	1,200	350	5,300	0	5,600	2,200	1,000
West Virginia	2.6	0	1.6	0	1.6	1.6	0	0	1.3	0	1.3	1.3	0
Wisconsin	100	37	22	0	60	45	1.2	33	20	0	52	40	.7
Wyoming	1,700	140	5,900	8.7	6,000	2,600	1,700	130	5,200	7.7	5,400	2,300	1,500
District of Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0
Puerto Rico	91	75	82	0	160	110	47	67	73	0	140	98	42
United States[2]	50,000	51,000	91,000	410	140,000	82,000	25,000	45,000	81,000	370	130,000	73,000	22,000

[1]Excluding conveyance losses by evapotranspiration.
[2]Including Puerto Rico.

Table 8.—*Self-supplied industrial water use, in million gallons per day, by States, 1970*

[Partial figures may not add to totals because of independent rounding]

State	Thermoelectric power (electric utility) use						Other uses									All industrial uses		
	Water withdrawn				Water consumed		Water withdrawn							Water consumed		Water withdrawn		Fresh water consumed
	Fresh ground water	Surface water		Total fresh water[1]			Ground water		Surface water		Reclaimed sewage	All water				Fresh[1]	Saline	
		Fresh	Saline		Fresh	Saline	Fresh	Saline	Fresh	Saline		Fresh	Saline	Fresh	Saline			
Alabama	2.6	4,800	200	4,800	25	.4	93	5.0	910	96	0	1,000	100	59	6.1	5,800	300	84
Alaska	1.4	68	1.0	70	0	0	8.0	0	100	0	0	110	0	4.2	0	180	1.0	4.2
Arizona	40	2.0	0	42	32	0	150	0	24	0	0	180	0	86	0	220	0	120
Arkansas	4.0	950	0	950	3.0	0	330	0	200	0	0	520	0	210	0	1,500	0	220
California	300	1,200	8,200	1,500	24	66	410	180	28	440	3.5	440	620	170	31	2,000	8,800	190
Colorado	30	83	0	110	8.0	0	55	7.0	130	9.0	0	180	16	45	3.3	300	16	53
Connecticut	0	1,100	1,800	1,100	2.0	0	20	1.0	55	130	0	75	140	6.0	0	1,100	2,000	8.0
Delaware	.7	1.4	720	2.1	0	0	22	0	64	300	0	87	300	1.4	0	89	1,000	1.4
Florida	13	1,700	9,300	1,700	20	86	710	87	190	46	0	900	130	140	1.3	2,600	9,500	160
Georgia	6.7	3,900	140	3,900	39	1.1	330	0	300	0	0	630	0	160	0	4,500	140	200
Hawaii	82	46	860	130	0	0	160	13	100	3.2	9.4	270	16	4.6	0	400	870	4.6
Idaho	0	0	0	0	0	0	340	0	110	0	0	450	0	16	0	450	0	16
Illinois	7.0	11,000	0	11,000	5.0	0	250	40	1,700	0	0	1,900	40	76	0	13,000	40	81
Indiana	1.0	4,800	0	4,800	5.0	0	140	4.4	3,100	0	0	3,200	4.4	130	0	8,000	4.4	130
Iowa	0	1,400	0	1,400	20	0	150	0	130	0	0	280	0	5.3	0	1,700	0	25
Kansas	38	220	0	260	32	0	120	0	37	0	0	160	0	57	0	420	0	89
Kentucky	1.9	3,800	0	3,800	21	0	87	15	280	0	0	370	15	40	0	4,200	15	61
Louisiana	36	2,700	140	2,800	170	25	460	41	2,900	740	0	3,400	780	600	78	6,100	920	770
Maine	1.0	20	180	21	0	0	3.0	0	400	24	0	400	24	24	1.4	420	200	24
Maryland	0	510	2,700	510	0	0	43	0	450	820	130	620	820	52	0	1,100	3,500	52
Massachusetts	0	580	2,100	580	1.0	1.0	140	0	390	160	0	530	160	53	16	1,100	2,300	54
Michigan	0	9,800	0	9,800	0	0	70	400	1,600	0	0	1,700	400	120	120	11,000	400	120
Minnesota	280	1,400	0	1,700	.2	0	160	0	1,100	0	0	1,200	0	85	0	2,900	0	85
Mississippi	35	410	490	450	35	0	310	0	190	49	0	500	49	53	0	950	540	88
Missouri	6.0	2,400	0	2,500	13	0	200	.2	110	0	0	310	.2	29	0	2,800	.2	42
Montana	0	60	0	60	0	0	34	0	120	0	0	150	0	22	0	210	0	22
Nebraska	270	620	0	890	8.4	0	100	0	.7	0	0	100	0	3.7	0	990	0	12
Nevada	7.1	49	0	57	7.5	0	39	6.2	31	0	0	70	6.2	41	.4	130	6.2	48
New Hampshire	0	250	160	250	0	0	12	0	180	0	0	190	0	9.6	0	440	160	9.6
New Jersey	8.0	1,000	3,200	1,000	26	0	550	0	450	0	0	1,000	0	70	0	2,000	3,200	96

New Mexico	8.6	20	0	29	27	0	72	0	14	0	0	86	0	51	0	110	0	78
New York	130	4,700	8,500	4,800	9.6	17	140	1.7	1,300	64	2.3	1,400	66	120	9.5	6,200	8,600	130
North Carolina	1.0	4,300	170	4,300	30	0	140	0	480	0	0	620	0	120	0	5,000	170	150
North Dakota ...	1.0	350	.9	350	1.2	.8	4.7	9.6	5.2	0	0	9.9	9.6	1.9	2.8	360	10	3.1
Ohio	49	13,000	0	13,000	14	0	390	0	3,300	0	0	3,700	0	110	0	17,000	0	120
Oklahoma	3.8	180	0	180	28	0	32	37	95	13	0	130	50	48	50	310	50	76
Oregon	0	22	0	22	.1	0	110	0	[2]590	0	0	[2]700	0	26	0	[2]720	0	26
Pennsylvania ...	0	12,000	0	12,000	8.9	0	400	0	5,000	50	0	5,400	50	220	0	18,000	50	230
Rhode Island ...	0	0	310	0	0	0	15	.4	23	0	0	38	.4	3.8	0	38	310	3.8
South Carolina	.7	2,600	68	2,600	14	0	53	0	300	32	0	350	32	33	0	2,900	100	47
South Dakota ..	.7	2.7	0	3.4	.6	0	14	170	2.6	0	0	17	170	1.9	17	20	170	2.5
Tennessee	0	4,900	0	4,900	62	0	88	0	960	0	0	1,000	0	47	0	5,900	0	110
Texas	60	5,800	3,800	5,900	120	24	480	0	1,200	3,600	6.0	1,700	3,600	680	840	7,500	7,400	800
Utah	0	87	0	87	3.8	0	56	3.5	140	5.5	0	190	9.0	45	3.0	280	9.0	48
Vermont	1.0	4.0	0	5.0	0	0	12	0	34	0	0	46	0	2.3	0	51	0	2.3
Virginia	0	3,100	770	3,100	.8	0	120	0	920	80	0	1,000	80	7.4	0	4,200	850	8.2
Washington	0	4.3	0	4.3	0	0	150	0	410	37	0	560	37	100	4.1	560	37	100
West Virginia ...	0	5,000	0	5,000	1.1	0	25	0	630	0	0	660	0	57	0	5,600	0	58
Wisconsin	0	5,300	0	5,300	0	0	110	0	220	0	0	330	0	10	0	5,600	0	10
Wyoming	1.0	200	0	200	5.3	0	67	21	20	0	0	87	21	6.0	.3	290	21	11
District of Columbia	0	1,100	0	1,100	0	0	.8	0	.6	0	0	1.4	0	.3	0	1,100	0	.3
Puerto Rico	.4	0	2,100	.4	.4	0	40	1.5	180	360	0	220	360	18	0	220	2,400	19
United States[3].	1,400	120,000	46,000	120,000	820	220	8,000	1,000	31,000	7,100	150	39,000	8,100	4,100	1,200	160,000	54,000	4,900

[1]Included 670 mgd from public supplies.
[2]Excludes 600 mgd used for log ponds.
[3]Including Puerto Rico.

Table 9.—*Water used for electric utility generation of thermoelectric power, in million gallons per day, by States, 1970*

[Partial figures may not add to totals because of independent rounding]

State	Condenser cooling					Other uses					Water consumed	
	Self-supplied			Public supplies	Self-supplied and public supplies	Self-supplied			Public supplies	Self-supplied and public supplies		
	Fresh ground water	Surface water				Fresh ground water	Surface water					
		Fresh	Saline				Fresh	Saline			Fresh	Saline
Alabama	0	4,600	190	0	4,800	2.6	250	4.0	0	260	25	0.4
Alaska	.9	2.5	1.0	0	4.4	.5	66	0	0	66	0	0
Arizona	40	2.0	0	0	42	0	0	0	0	0	32	0
Arkansas	3.0	950	0	0	950	1.0	1.0	0	0	2.0	3.0	0
California	300	1,200	8,200	130	9,900	0	1.0	0	10	11	24	66
Colorado	30	83	0	0	110	0	.1	0	.1	.2	8.0	0
Connecticut	0	1,000	1,800	0	2,900	0	5.0	0	3.0	8.0	2.0	0
Delaware	.6	1.4	720	2.0	730	.1	0	0	.3	.4	0	0
Florida	12	1,700	9,300	2.6	11,000	1.0	0	0	2.5	3.5	20	86
Georgia	4.4	3,900	140	0	4,000	2.3	28	1.1	9.5	40	39	1.1
Hawaii	82	46	860	0	980	0	0	0	0	0	0	0
Idaho	0	0	0	0	0	0	0	0	0	0	0	0
Illinois	0	11,000	0	1.0	11,000	7.0	320	0	3.0	320	5.0	0
Indiana	1.0	4,700	0	26	4,700	0	110	0	1.0	110	5.0	0
Iowa	0	1,300	0	7.7	1,400	0	42	0	.2	42	20	0
Kansas	38	220	0	0	260	0	0	0	0	0	32	0
Kentucky	1.0	3,600	0	0	3,600	.9	230	0	.7	240	21	0
Louisiana	34	2,600	140	0	2,700	1.8	140	7.2	0	140	170	25
Maine	0	20	180	0	200	1.0	0	0	1.0	2.0	0	0
Maryland	0	500	2,700	0	3,200	0	12	3.0	1.0	16	0	0
Massachusetts	0	550	2,100	0	2,700	0	29	0	2.5	32	1.0	1.0
Michigan	0	9,700	0	0	9,700	0	49	0	0	49	0	0
Minnesota	280	1,400	0	0	1,700	0	.2	0	0	.2	.2	0
Mississippi	34	400	490	0	920	1.0	12	0	0	13	35	0
Missouri	4.0	2,400	0	2.0	2,500	2.0	5.0	0	3.0	10	13	0
Montana	0	60	0	0	60	0	0	0	0	0	0	0
Nebraska	270	620	0	84	970	0	0	0	0	0	8.4	0
Nevada	7.1	49	0	0	56	0	.1	0	0	.1	7.5	0
New Hampshire	0	250	160	0	410	0	0	0	0	0	0	0
New Jersey	0	1,000	3,200	0	4,200	8.0	0	0	18	26	26	0

New Mexico	8.6	19	0	.1	28	0	.9	0	0	.9	27	0
New York	0	4,400	8,500	22	13,000	130	260	0	3.9	390	9.6	17
North Carolina	0	4,300	170	0	4,500	1.0	41	0	0	42	30	0
North Dakota	1.0	350	.9	0	350	0	0	0	0	0	1.2	.8
Ohio	46	13,000	0	300	13,000	3.0	590	0	16	610	14	0
Oklahoma	2.8	180	0	7.8	190	1.0	.1	0	.5	1.6	28	0
Oregon	0	22	0	0	22	0	0	0	0	0	.1	0
Pennsylvania	0	12,000	0	1.9	12,000	0	270	0	7.0	280	8.9	0
Rhode Island	0	0	310	0	310	0	0	0	0	0	0	0
South Carolina	0	2,500	68	0	2,600	.7	25	0	0	26	14	0
South Dakota	.7	2.7	0	.2	3.6	0	0	0	0	0	.6	0
Tennessee	0	4,500	0	0	4,500	0	340	0	0	340	62	0
Texas	58	5,800	3,800	3.7	9,600	1.9	2.1	.3	.1	4.4	120	24
Utah	0	87	0	.5	87	0	.2	0	.4	.6	3.8	0
Vermont	0	0	0	0	0	1.0	4.0	0	0	5.0	0	0
Virginia	0	3,100	770	0	3,900	0	0	0	0	0	.8	0
Washington	0	4.0	0	0	4.0	0	.3	0	0	.3	0	0
West Virginia	0	4,800	0	0	4,800	0	120	0	0	120	1.1	0
Wisconsin	0	5,300	0	0	5,300	0	0	0	0	0	0	0
Wyoming	.4	200	0	0	200	.6	1.0	0	0	1.6	5.3	0
District of Columbia	0	1,000	0	0	1,000	0	60	0	0	60	0	0
Puerto Rico	.2	0	2,100	.5	2,100	.2	0	0	1.3	1.5	.4	0
United States[1]	1,300	120,000	46,000	590	170,000	170	3,000	16	85	3,300	820	220

[1]Including Puerto Rico.

Table 10.—*Summary of water withdrawn, except for hydroelectric power, in million gallons per day, by States, 1970*

[Partial figures may not add to totals because of independent rounding]

State	Population (thousands)	Per capita use (gpd)	Water withdrawn (including irrigation conveyance losses)										Conveyance losses	Fresh water consumed[1]
			Ground water			Surface water			Reclaimed sewage	All sources				
			Fresh	Saline	Fresh and saline	Fresh	Saline	Fresh and saline		Fresh	Saline	Fresh and saline		
Alabama	3,444	1,900	280	5.0	280	6,100	290	6,400	0	6,400	300	6,700	0	230
Alaska	302	830	39	0	39	210	1.0	210	0	250	1.0	250	0	16
Arizona	1,772	3,900	4,200	0	4,200	2,600	0	2,600	0	6,800	0	6,800	240	4,800
Arkansas	1,923	1,600	1,500	0	1,500	1,500	0	1,500	0	3,000	0	3,000	90	1,200
California	19,953	2,400	18,000	180	18,000	20,000	8,700	29,000	130	39,000	8,800	48,000	4,900	22,000
Colorado	2,207	6,000	2,100	7.0	2,100	11,000	9.0	11,000	80	13,000	16	13,000	1,400	6,800
Connecticut	3,032	1,200	150	1.0	150	1,400	2,000	3,300	0	1,500	2,000	3,500	0	180
Delaware	548	2,200	68	0	68	110	1,000	1,100	0	180	1,000	1,200	0	26
Florida	6,789	2,300	2,900	87	3,000	3,000	9,400	12,000	0	5,900	9,500	15,000	150	1,900
Georgia	4,590	1,200	630	0	630	4,500	140	4,700	0	5,200	140	5,300	0	420
Hawaii	770	3,500	910	13	920	850	860	1,700	66	1,800	870	2,700	220	810
Idaho	713	22,000	2,500	0	2,500	13,000	0	13,000	2.5	16,000	0	16,000	4,300	4,700
Illinois	11,114	1,400	1,000	40	1,100	15,000	0	15,000	0	16,000	40	16,000	0	360
Indiana	5,194	1,700	470	4.4	470	8,200	0	8,200	0	8,600	4.4	8,600	0	390
Iowa	2,825	750	500	0	500	1,600	0	1,600	0	2,100	0	2,100	0	240
Kansas	2,249	1,700	3,100	0	3,100	640	0	640	0	3,800	0	3,800	43	2,600
Kentucky	3,219	1,400	170	15	180	4,300	0	4,300	0	4,500	15	4,500	0	180
Louisiana	3,643	2,500	1,500	41	1,500	6,700	880	7,500	0	8,100	920	9,100	430	2,200
Maine	994	760	36	0	36	520	200	720	0	560	200	760	0	61
Maryland	3,922	1,300	140	0	140	1,300	3,500	4,900	130	1,600	3,500	5,200	0	140
Massachusetts	5,689	740	350	0	350	1,600	2,300	3,900	0	2,000	2,300	4,200	0	140
Michigan	8,875	1,500	500	400	900	12,000	0	12,000	0	13,000	400	13,000	0	330
Minnesota	3,805	900	780	0	780	2,700	0	2,700	0	3,400	0	3,400	0	310
Mississippi	2,217	950	760	0	760	810	540	1,300	0	1,600	540	2,100	37	410
Missouri	4,677	750	430	.2	430	3,100	.9	3,100	0	3,500	1.1	3,500	5.5	310
Montana	694	12,000	150	0	150	7,900	0	7,900	0	8,000	0	8,000	2,200	5,500
Nebraska	1,484	4,100	3,300	0	3,300	2,700	0	2,700	0	6,000	0	6,000	1,300	3,700
Nevada	489	6,700	520	6.2	530	2,700	0	2,700	4.2	3,300	6.2	3,300	1,600	1,500
New Hampshire	738	940	55	0	55	470	160	630	0	530	160	700	0	18
New Jersey	7,168	870	1,000	0	1,000	2,000	3,200	5,200	0	3,100	3,200	6,300	0	380

New Mexico	1,016	3,100	1,600	0	1,600	1,600	0	1,600	22	3,200	0	3,200	160	1,500
New York	18,191	970	890	1.7	890	8,200	8,600	17,000	2.3	9,100	8,600	18,000	0	660
North Carolina ..	5,082	1,200	430	0	430	5,300	170	5,400	0	5,700	170	5,900	0	480
North Dakota ...	618	1,000	82	9.6	92	550	.9	550	0	630	10	650	59	200
Ohio	10,652	1,700	880	0	880	17,000	0	17,000	0	18,000	0	18,000	0	460
Oklahoma	2,559	590	860	37	890	610	13	620	0	1,500	50	1,500	20	830
Oregon	2,091	2,800	970	0	970	5,000	0	5,000	3.1	5,900	0	5,900	1,500	2,600
Pennsylvania	11,794	1,700	770	0	770	19,000	50	19,000	0	20,000	50	20,000	0	450
Rhode Island	950	490	38	.4	39	110	310	430	0	150	310	460	0	13
South Carolina ..	2,591	1,300	170	0	170	3,100	100	3,200	0	3,300	100	3,400	0	180
South Dakota ...	666	910	180	170	350	250	0	250	0	440	170	600	79	250
Tennessee	3,924	1,600	290	0	290	6,100	0	6,100	0	6,400	0	6,400	0	200
Texas	11,197	2,400	9,200	0	9,200	10,000	7,400	18,000	21	19,000	7,400	27,000	480	9,600
Utah	1,059	4,000	680	3.5	680	3,500	5.5	3,500	52	4,200	9.0	4,200	630	2,200
Vermont	445	250	42	0	42	69	0	69	0	110	0	110	0	13
Virginia	4,648	1,200	280	0	280	4,400	850	5,300	0	4,700	850	5,500	0	150
Washington	3,409	2,100	840	0	840	6,300	37	6,300	0	7,100	37	7,200	1,000	2,500
West Virginia	1,744	3,300	80	0	80	5,700	0	5,700	0	5,800	0	5,800	0	66
Wisconsin	4,418	1,400	490	0	490	5,800	0	5,800	0	6,300	0	6,300	.7	180
Wyoming	332	17,000	230	21	250	5,500	0	5,500	7.7	5,700	21	5,800	1,500	2,400
District of Columbia	757	1,700	.8	0	.8	1,300	0	1,300	0	1,300	0	1,300	0	16
Puerto Rico	2,712	1,100	140	1.5	140	430	2,400	2,900	0	580	2,400	3,000	42	170
United States[2].	205,897	1,800	68,000	1,000	69,000	250,000	53,000	300,000	520	320,000	54,000	370,000	22,000	87,000

[1]Excluding irrigation conveyance losses by evapotranspiration.

[2]Including Puerto Rico.

Table 11.—*Water used for hydroelectric power, by States, 1970*

State	Mgd	1,000 acre-feet per year	State	Mgd	1,000 acre-feet per year	State	Mgd	1,000 acre-feet per year
Alabama	130,000	150,000	Maine	80,000	90,000	Oregon	350,000	390,000
Alaska	780	870	Maryland	23,000	25,000	Pennsylvania	30,000	34,000
Arizona	20,000	23,000	Massachusetts	17,000	19,000	Rhode Island	58	65
Arkansas	25,000	28,000	Michigan	59,000	66,000	South Carolina	41,000	46,000
California	84,000	94,000	Minnesota	18,000	20,000	South Dakota	59,000	66,000
Colorado	4,000	4,500	Mississippi	0	0	Tennessee	130,000	150,000
Connecticut	6,600	7,400	Missouri	9,000	10,000	Texas	9,300	10,000
Delaware	0	0	Montana	72,000	80,000	Utah	3,000	3,300
Florida	11,000	13,000	Nebraska	29,000	32,000	Vermont	15,000	16,000
Georgia	45,000	50,000	Nevada	4,200	4,800	Virginia	16,000	18,000
Hawaii	330	370	New Hampshire	22,000	24,000	Washington	720,000	810,000
Idaho	84,000	94,000	New Jersey	120	130	West Virginia	25,000	28,000
Illinois	10,000	12,000	New Mexico	430	480	Wisconsin	66,000	74,000
Indiana	18,000	21,000	New York	270,000	300,000	Wyoming	6,500	7,200
Iowa	35,000	39,000	North Carolina	88,000	98,000	District of Columbia	6.0	6.7
Kansas	520	590	North Dakota	14,000	15,000	Puerto Rico	610	680
Kentucky	79,000	88,000	Ohio	370	410			
Louisiana	0	0	Oklahoma	20,000	22,000	United States[1]	2,800,000	3,100,000

[1]Including Puerto Rico.

Table 12.—*Water used for public supplies, by regions, 1970*

[Partial figures may not add to totals because of independent rounding]

Water Resources Council region	Population served			Water withdrawn				Water delivered		Water consumed (mgd)
	Ground water (thousands)	Surface water (thousands)	All water (thousands)	Ground water (mgd)	Surface water (mgd)	All water (mgd)	Per capita (gpd)	Industrial and commercial uses (mgd)	Domestic use and losses[1] (mgd)	
New England	2,720	7,360	10,100	330	1,100	1,400	139	610	790	190
Middle Atlantic	8,670	24,900	33,600	1,100	4,100	5,200	154	1,600	3,600	750
South Atlantic-Gulf	7,960	6,560	14,500	1,300	1,400	2,700	187	980	1,700	590
Great Lakes	4,000	19,400	23,400	700	3,700	4,400	188	1,700	2,700	500
Ohio	4,710	10,300	15,000	620	1,500	2,100	139	710	1,400	270
Tennessee	532	1,550	2,080	64	240	300	146	120	180	36
Upper Mississippi	6,350	4,530	10,900	870	690	1,600	143	560	990	190
Lower Mississippi	3,170	1,260	4,430	390	220	610	137	150	460	240
Souris-Red-Rainy	192	209	402	20	25	48	118	6.2	41	19
Missouri	2,850	3,860	6,710	430	590	1,000	152	300	720	250
Arkansas-White-Red	1,780	3,160	4,940	250	490	730	149	210	520	250
Texas-Gulf	3,970	3,950	7,920	590	550	1,100	144	370	780	380
Rio Grande	876	499	1,370	180	130	310	228	110	200	150
Upper Colorado	80	116	196	28	30	58	294	8.1	49	19
Lower Colorado	1,220	576	1,790	250	140	390	219	66	330	190
Great Basin	546	558	1,100	160	160	320	289	45	270	140
Columbia-North Pacific	1,840	2,800	4,630	460	830	1,300	278	580	710	260
California-South Pacific	8,030	10,700	18,700	1,600	1,800	3,400	181	620	2,800	1,400
Alaska	62	64	126	24	35	60	473	7.0	53	11
Hawaii	662	32	694	120	12	140	197	26	110	46
Puerto Rico	396	1,940	2,330	34	170	200	86	77	130	43
United States[2]	60,600	104,000	165,000	9,400	18,000	27,000	166	8,800	19,000	5,900

[1]Includes public use.
[2]Including Puerto Rico.

Table 13.—*Water for rural use, in million gallons per day, by regions, 1970*

[Partial figures may not add to totals because of independent rounding]

Water Resources Council region	Domestic use				Livestock use				Domestic and livestock uses			
	Withdrawn			Water consumed	Withdrawn			Water consumed	Withdrawn			Water consumed
	Ground water	Surface water	All water		Ground water	Surface water	All water		Ground water	Surface water	All water	
New England	94	2.1	96	47	7.0	4.7	12	12	100	6.8	110	59
Middle Atlantic	340	1.5	340	130	46	33	79	65	380	34	420	190
South Atlantic-Gulf	460	1.9	470	360	110	51	160	150	580	53	630	510
Great Lakes	270	7.1	280	78	62	24	86	82	340	31	370	160
Ohio	240	33	270	180	58	84	140	140	290	120	410	310
Tennessee	51	.9	52	31	11	20	31	30	62	21	83	62
Upper Mississippi	200	5.7	210	130	200	60	260	250	400	65	460	380
Lower Mississippi	110	.4	110	100	22	33	55	55	130	34	170	160
Souris-Red-Rainy	19	.1	19	19	12	2.4	15	15	31	2.5	34	34
Missouri	110	11	120	96	270	170	440	410	380	180	560	500
Arkansas-White-Red	88	5.7	94	84	66	120	180	180	150	120	280	260
Texas-Gulf	80	0	80	80	71	42	110	110	150	42	190	190
Rio Grande	20	.7	20	13	17	20	37	36	37	20	57	49
Upper Colorado	6.2	1.2	7.4	2.9	6.5	12	19	17	13	14	26	20
Lower Colorado	24	0	24	17	18	10	29	28	43	10	53	45
Great Basin	27	.6	27	13	35	6.2	41	21	61	6.8	68	34
Columbia-North Pacific	220	29	250	200	18	34	52	47	240	63	300	250
California-South Pacific	120	8.6	130	73	38	54	93	50	160	63	220	120
Alaska	4.5	1.6	6.1	.2	0	.1	.1	.1	4.5	1.7	6.2	.3
Hawaii	.1	.4	.5	.4	1.4	5.9	7.3	6.6	1.5	6.3	7.8	7.0
Puerto Rico	.4	3.2	3.6	3.0	1.3	7.5	8.8	8.0	1.7	11	12	11
United States[1]	2,500	110	2,600	1,700	1,100	790	1,900	1,700	3,600	910	4,500	3,400

[1]Including Puerto Rico.

Table 14.—*Water used for irrigation, by regions, 1970*

[Partial figures may not add to totals because of independent rounding]

Water Resources Council region	Acres irrigated (1,000 acres)	Total water withdrawn (1,000 acre-feet per year)				Water consumed[1] (1,000 ac-ft/yr)	Conveyance loss (1,000 ac-ft/yr	Total water withdrawn (million gallons per day)				Water consumed[1] (mgd)	Conveyance loss (mgd)
		Ground water	Surface water	Reclaimed sewage	All water			Ground water	Surface water	Reclaimed sewage	All water		
New England	77	22	69	0	91	72	0	20	60	0	80	64	0
Middle Atlantic	310	87	57	.2	140	140	0	77	50	0	130	120	0
South Atlantic-Gulf	2,400	1,500	1,200	0	2,700	1,700	160	1,300	1,100	0	2,400	1,500	150
Great Lakes	160	42	60	0	100	99	.2	37	53	0	90	87	.1
Ohio	76	10	32	0	42	41	0	8.1	27	0	35	35	0
Tennessee	22	2.7	5.6	0	8.3	8.2	0	2.1	4.5	0	6.6	6.6	0
Upper Mississippi	190	79	41	0	120	110	1.2	69	35	0	100	95	.6
Lower Mississippi	2,000	2,300	1,300	0	3,600	2,500	620	2,000	1,200	0	3,200	2,200	550
Souris-Red-Rainy	13	9.6	5.0	0	15	13	1.2	8.5	4.2	0	13	12	1.0
Missouri	9,700	5,000	16,000	99	21,000	13,000	5,400	4,500	14,000	88	19,000	12,000	4,800
Arkansas-White-Red	5,400	6,600	2,600	7.0	9,200	6,700	350	5,900	2,300	6.2	8,200	6,000	310
Texas-Gulf	5,000	5,600	1,300	16	6,900	5,500	200	5,000	1,100	14	6,200	4,900	180
Rio Grande	2,500	2,300	4,000	20	6,300	3,400	660	2,000	3,500	17	5,600	3,000	590
Upper Colorado	2,000	60	8,700	0	8,800	4,500	1,200	53	7,800	0	7,900	4,000	1,100
Lower Colorado	1,300	4,400	2,900	5.9	7,300	5,200	340	3,900	2,600	5.1	6,500	4,700	300
Great Basin	1,900	850	5,700	59	6,600	3,300	2,200	760	5,100	53	5,900	2,900	2,000
Columbia-North Pacific	7,100	3,400	27,000	6.4	30,000	11,000	8,000	3,000	24,000	5.6	27,000	10,000	7,200
California-South Pacific	9,000	18,000	20,000	140	38,000	23,000	5,700	16,000	18,000	120	34,000	21,000	5,100
Alaska	2.2	.5	.5	0	1.0	.9	0	.4	.4	0	.9	.8	0
Hawaii	160	610	760	64	1,400	840	250	550	680	57	1,300	750	220
Puerto Rico	91	75	82	0	160	110	47	67	73	0	140	98	42
United States[2]	50,000	51,000	91,000	410	140,000	82,000	25,000	45,000	81,000	370	130,000	73,000	22,000

[1]Excluding conveyance losses by evapotranspiration.

[2]Including Puerto Rico.

Table 15.—*Self-supplied industrial water use, in million gallons per day, by regions, 1970*

[Partial figures may not add to totals because of independent rounding]

Water Resources Council region	Thermoelectric power (electric utility) use						Other uses									All industrial uses		
	Water withdrawn				Water consumed		Water withdrawn							Water consumed		Water withdrawn		Fresh water consumed
	Fresh ground water	Surface water		Total fresh water[1]			Ground water		Surface water		Reclaimed sewage	All water				Fresh[1]	Saline	
		Fresh	Saline		Fresh	Saline	Fresh	Saline	Fresh	Saline		Fresh	Saline	Fresh	Saline			
New England	1.0	1,900	4,600	1,900	3.0	1.0	180	1.4	1,100	320	0	1,200	320	96	18	3,100	4,900	99
Middle Atlantic	100	15,000	16,000	15,000	35	17	1,000	1.7	5,600	1,300	130	6,700	1,300	330	9.5	22,000	17,000	360
South Atlantic-Gulf	32	15,000	10,000	15,000	120	88	1,500	92	2,100	220	0	3,500	310	540	7.4	19,000	11,000	660
Great Lakes	38	26,000	0	26,000	14	0	300	400	8,300	1.0	0	8,600	400	450	120	35,000	400	460
Ohio	54	27,000	0	27,000	50	0	750	42	5,100	16	0	5,800	58	260	0	33,000	58	310
Tennessee	0	6,100	0	6,100	64	0	45	0	1,300	0	0	1,400	0	72	0	7,500	0	140
Upper Mississippi	290	12,000	0	12,000	23	0	630	19	1,100	0	0	1,700	19	75	0	14,000	19	98
Lower Mississippi	66	4,000	140	4,100	190	25	980	41	3,100	740	0	4,000	780	780	78	8,100	920	970
Souris-Red-Rainy	.6	140	0	140	.9	0	5.1	4.8	73	0	0	78	4.8	5.6	.6	220	4.8	6.5
Missouri	310	3,000	.9	3,300	34	.8	360	190	160	5.5	0	520	200	65	22	3,800	200	99
Arkansas-White-Red	46	1,900	0	1,900	82	0	250	38	370	18	5.0	630	55	210	50	2,600	55	290
Texas-Gulf	51	4,700	3,800	4,700	100	24	390	0	1,000	3,500	1.0	1,400	3,500	580	800	6,100	7,200	690
Rio Grande	15	6.0	0	21	17	0	110	0	97	150	0	210	150	97	45	230	150	110
Upper Colorado	0	100	0	100	22	0	12	4.4	52	0	0	64	4.4	21	.3	170	4.4	43
Lower Colorado	44	3.4	0	47	36	0	170	0	42	0	0	210	0	100	0	260	0	140
Great Basin	3.8	130	0	140	6.2	0	85	9.7	130	5.5	0	220	15	62	3.4	360	15	68
Columbia-North Pacific	0	26	0	26	.1	0	620	0	[3]1,100	37	0	[3]1,800	37	150	4.1	1,800	37	150
California-South Pacific	300	1,200	8,200	1,500	24	66	410	180	48	440	3.5	460	620	170	31	2,000	8,800	190
Alaska	1.4	68	1.0	70	0	0	8.0	0	100	0	0	110	0	4.2	0	180	1.0	4.2
Hawaii	82	46	860	130	0	0	160	13	100	3.2	9.4	270	16	4.6	0	390	870	4.6
Puerto Rico	.4	0	2,100	.4	.4	0	40	1.5	180	360	0	220	360	18	0	220	2,400	18
United States[2]	1,400	120,000	46,000	120,000	820	220	8,000	1,000	31,000	7,100	150	39,000	8,100	4,100	1,200	160,000	54,000	4,900

[1] Includes 670 mgd from public supplies.

[2] Including Puerto Rico.

[3] Excludes 600 mgd used for log ponds.

Table 16.—*Water used for electric utility generation of thermoelectric power, in million gallons per day, by regions, 1970*

[Partial figures may not add to totals because of independent rounding]

Water Resources Council region	Condenser cooling					Other uses					Water consumed	
	Self-supplied			Public supplies	Self-supplied and public supplies	Self supplied			Public supplies	Self-supplied and public supplies		
	Fresh ground water	Surface water				Fresh ground water	Surface water					
		Fresh	Saline				Fresh	Saline			Fresh	Saline
New England	0	1,900	4,600	0	6,500	1.0	35	0	6.5	42	3.0	1.0
Middle Atlantic	.6	15,000	16,000	25	31,000	100	460	3.0	27	590	35	17
South Atlantic-Gulf	24	15,000	10,000	2.6	25,000	7.6	200	5.1	12	220	120	88
Great Lakes	0	25,000	0	120	25,000	38	480	0	9.2	530	14	0
Ohio	48	26,000	0	200	26,000	5.7	960	0	13	980	50	0
Tennessee	0	5,700	0	0	5,700	0	400	0	0	400	64	0
Upper Mississippi	280	12,000	0	8.7	12,000	6.0	220	0	2.2	230	23	0
Lower Mississippi	62	3,900	140	2.0	4,100	3.8	160	7.2	2.0	180	190	25
Souris-Red-Rainy	.6	140	0	0	140	0	.2	0	0	.2	.9	0
Missouri	310	3,000	.9	85	3,400	2.6	8.3	0	1.1	12	34	.8
Arkansas-White-Red	45	1,900	0	7.8	1,900	1.0	15	0	.5	16	82	0
Texas-Gulf	49	4,700	3,800	3.7	8,500	1.7	1.8	.3	.1	3.9	100	24
Rio Grande	15	6.0	0	.1	21	.2	0	0	0	.2	17	0
Upper Colorado	0	100	0	0	100	0	2.2	0	0	2.2	22	0
Lower Colorado	44	3.3	0	0	47	0	.1	0	0	.1	36	0
Great Basin	3.8	130	0	.5	140	0	0	0	.4	.4	6.2	0
Columbia-North Pacific	0	26	0	0	26	0	.3	0	0	.3	.1	0
California-South Pacific	300	1,200	8,200	130	9,900	0	1.0	0	10	11	24	66
Alaska	.9	2.5	1.0	0	4.4	.5	66	0	0	66	0	0
Hawaii	82	46	860	0	980	0	0	0	0	0	0	0
Puerto Rico	.2	0	2,100	.5	2,100	.2	0	0	1.3	1.5	1.5	0
United States[1]	1,300	120,000	46,000	590	170,000	170	3,000	16	85	3,300	820	220

[1]Including Puerto Rico.

Table 17.—*Summary of water withdrawn, except for hydroelectric power, in million gallons per day, by regions, 1970*

[Partial figures may not add to totals because of independent rounding]

Water Resources Council region	Population (thousands)	Per capita use (gpd)	Water withdrawn including irrigation conveyance losses										Conveyance losses	Fresh water consumed[1]
			Ground water			Surface water			Reclaimed sewage	All sources				
			Fresh	Saline	Fresh and saline	Fresh	Saline	Fresh and saline		Fresh	Saline	Fresh and saline		
New England	11,520	840	630	1.4	640	4,100	4,900	9,000	0	4,700	4,900	9,700	0	410
Middle Atlantic	38,401	1,200	2,600	1.7	2,600	25,000	17,000	42,000	130	28,000	17,000	45,000	0	1,400
South Atlantic-Gulf	23,445	1,500	4,700	92	4,800	20,000	11,000	30,000	0	24,000	11,000	35,000	150	3,300
Great Lakes	29,104	1,400	1,400	400	1,800	38,000	1.0	38,000	0	39,000	400	39,000	.1	1,200
Ohio	20,009	1,800	1,700	42	1,800	34,000	16	34,000	0	35,000	58	36,000	0	920
Tennessee	3,234	2,400	170	0	170	7,700	0	7,700	0	7,900	0	7,900	0	240
Upper Mississippi	12,733	1,300	2,200	19	2,300	14,000	0	14,000	0	16,000	19	16,000	.6	760
Lower Mississippi	6,265	2,100	3,600	41	3,600	8,500	880	9,400	0	12,000	920	13,000	550	3,600
Souris-Red-Rainy	808	390	68	4.8	73	250	0	250	0	310	4.8	320	1.0	71
Missouri	8,489	2,900	5,900	190	6,100	18,000	6.4	18,000	88	24,000	200	24,000	4,800	12,000
Arkansas-White-Red	6,670	1,800	6,600	38	6,700	5,200	18	5,200	11	12,000	55	12,000	310	6,800
Texas-Gulf	9,499	2,200	6,200	0	6,200	7,400	7,200	15,000	15	14,000	7,200	21,000	180	6,200
Rio Grande	1,617	3,900	2,400	0	2,400	3,800	150	3,900	17	6,200	150	6,300	590	3,300
Upper Colorado	404	20,000	110	4.4	110	8,000	0	8,000	0	8,100	4.4	8,100	1,100	4,100
Lower Colorado	2,223	3,300	4,500	0	4,500	2,800	0	2,800	5.1	7,200	0	7,200	300	5,000
Great Basin	1,213	5,500	1,100	9.7	1,100	5,500	5.5	5,500	53	6,700	15	6,700	2,000	3,200
Columbia-North Pacific	6,468	4,700	4,300	0	4,300	26,000	37	26,000	5.6	30,000	37	30,000	7,200	11,000
California-South Pacific	20,009	2,400	18,000	180	18,000	21,000	8,700	30,000	120	39,000	8,800	48,000	5,100	22,000
Alaska	302	830	39	0	39	210	1.0	210	0	250	1.0	250	0	16
Hawaii	770	3,500	910	13	920	850	860	1,700	66	1,800	870	2,700	220	810
Puerto Rico	2,712	1,100	140	1.5	140	430	2,400	2,900	0	580	2,400	3,000	42	170
United States[2]	205,897	1,800	68,000	1,000	69,000	250,000	53,000	300,000	520	320,000	54,000	370,000	22,000	87,000

[1] Excluding irrigation conveyance losses by evapotranspiration.

[2] Including Puerto Rico.

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Table 18.—*Water used for hydroelectric power, by regions, 1970*

Water Resources Council region	Mgd	1,000 acre-feet per year	Water Resources Council region	Mgd	1,000 acre-feet per year	Water Resources Council region	Mgd	1,000 acre-feet per year
New England	130,000	150,000	Souris-Red-Rainy	2,000	2,200	Great Basin	3,800	4,200
Middle Atlantic	140,000	160,000	Missouri	180,000	200,000	Columbia-North Pacific	1,200,000	1,300,000
South Atlantic-Gulf	230,000	260,000	Arkansas-White-Red	41,000	46,000	California-South Pacific	85,000	96,000
Great Lakes	270,000	300,000	Texas-Gulf	8,900	9,900	Alaska	780	870
Ohio	130,000	150,000	Rio Grande	890	1,000	Hawaii	330	370
						Puerto Rico	610	680
Tennessee	220,000	250,000	Upper Colorado	12,000	13,000			
Upper Mississippi	110,000	120,000	Lower Colorado	16,000	18,000	United States[1]	2,800,000	3,100,000
Lower Mississippi	3,000	3,300						

[1]Including Puerto Rico.