TRENDS IN WATER USE, 1950-1995

These national water-use compilations began in 1950 and are conducted at 5-year intervals. 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 compilations (public supply, rural use, irrigation, industrial, thermoelectric power, hydroelectric power). Self-supplied domestic withdrawals are combined with livestock withdrawals in this section to compare to the rural-use category listed in some previous water-use circulars; and self-supplied industrial withdrawals are combined with commercial and mining withdrawals to compare to "other industries," which were listed with thermoelectric power generation under "industrial" in some previous water-use circulars.

Estimates in table 31summarize the water use—withdrawals, source of water, reclaimed wastewater, consumptive use, and instream use (hydroelectric power)—at 5-year intervals from 1950 to 1995. Table 31 also shows the percentage change in the 1990 and 1995 summary estimates.

Estimates in table 31 and figure 33 show that after continual increases in the Nation's total water withdrawals for offstream use for the years reported from 1950 to 1980, withdrawals declined from 1980 to 1995. The 1995 estimate of total withdrawals (402,000 Mgal/d) is 2 percent less than the 1990 estimate and nearly 10 percent less than the 1980 estimate, which is the peak year of water use documented in this 5-year compilation series. This decline in water withdrawals occurred even though population increased 16 percent from 1980 to 1995.

The "Public supply" and "Rural domestic and livestock" categories are the only two categories to show continual increases from 1950 to 1995, largely because of continual increases in population (figure 34). The 4-percent increase in public-supply withdrawals from 1990 to 1995, compared to a 7-percent increase in population served by public supply, indicates that conservation programs have been effective in lowering public supply per-capita use from about 184 gal/d in 1990 to 179 gal/d in 1995. The 13-percent increase in rural domestic and livestock withdrawals is attributable to an increase in livestock withdrawals, especially animal specialities withdrawals, which were 43 percent higher during 1995 than during 1990. Rural (self-supplied) domestic withdrawals were the same in 1995 (3,390 Mgal/d) as in 1990.

More water (fresh, saline) continues to be withdrawn for thermoelectric power generation than for any other category (figure 34). Withdrawals for thermoelectric power generation peaked in 1980 at 210,000 Mgal/d and fluctuated around 190,000 Mgal/d during 1985, 1990, and 1995.

The estimate of total self-supplied withdrawals (fresh, saline) for "other" industrial uses for 1995 is 29,100 Mgal/d, or about 3 percent less than for 1990. Industrial withdrawals declined from 1980 to 1995 after remaining about the same for the years reported between 1965 and 1980. In fact, self-supplied withdrawals for "other" industrial use during 1995 are the lowest in this series since records began in 1950. Lower industrial withdrawals are the result of new industries and technologies that require less water, improved plant efficiencies, increased water recycling, changes in laws and regulations to reduce the discharge of pollutants, and conservation measures.

Total irrigation withdrawals were about the same during 1955 and 1960, then steadily increased for the individual years reported from 1965 to 1980, and gradually decreased from 1980 to 1995 (figure 34; table 31). Estimated irrigation withdrawals during 1995 (134,000 Mgal/d) were about 2 percent less than during 1990 and 1985. Irrigation application rates vary from year to year and depend on annual rainfall, surface water availability, energy costs, farm commodity prices, application technologies, and conservation practices. The average amount of water applied per acre for irrigation in the United States during 1995 was about 2.1 acre-feet, which is about the same as in 1990, slightly less than the 1985 average of 2.2 acre-feet, and well below the 1975 and 1980 average of 2.5 acre-feet. This decline in application rates is the result of implementation of improved and more efficient irrigation systems and techniques. Also, application rates in the more humid Eastern United States tend to be lower than in the dryer Western United States and the amount of irrigated acreage continues to increase in the Eastern United States.

The total number of acres irrigated in the United States steadily increased for the individual years reported from 1950 to 1980 and remained fairly constant at around 58 million acres for the years reported from 1980 to 1995. The increase in acres irrigated from 1950 to 1980 was the result of increases in both the Western and Eastern United States. Acres irrigated in the 19 western states decreased from 1980 to 1995 as a result of irrigated acreage being replaced by dry land farming and urban development, and irrigation water rights being sold to municipal water suppliers. Acres irrigated in the eastern United States, however, continued to increase more than offsetting the decrease in the western states.

Instream use (hydroelectric power) during 1995 was 4 percent less than during 1990. Water used for hydroelectric power generation increased steadily from 1950 to 1975, but, during 1980, it was about the same as during 1975. Hydroelectric power water use during 1985, 1990, and 1995 fluctuated above 3,000 billion gallons per day. Changes in hydroelectric power water use are closely related to the availability of surface water. The use of reclaimed wastewater is estimated to have been about 1,020 Mgal/d in 1995, which is 36 percent more than the estimated 750 Mgal/d used in 1990.

Table 31. Trends of estimated water use in the United States, 1950-95

[Data for 1950-90 adapted from MacKichan (1951, 1957), MacKichan and Kammerer (1961), Murray (1968), Murray and Reeves (1972, 1977), and Solley and others (1983, 1988, 1993). 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 1985-95; 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	[4]1995	1990-95
Population, in millions	150.7	164.0	179.3	193.8	205.9	216.4	229.6	242.4	252.3	267.1	+6
Offstream use:											
Total withdrawals	180	240	270	310	370	420	[5]440	399	408	402	-2
Public supply	14	17	21	24	27	29	34	36.5	38.5	40.2	+4
Rural domestic and livestock	3.6	3.6	3.6	4.0	4.5	4.9	5.6	7.79	7.89	8.89	+13
Irrigation	89	110	110	120	130	140	150	137	137	134	-2
Industrial:											
Thermoelectric power use	40	72	100	130	170	200	210	187	195	190	-3
Other industrial use	37	39	38	46	47	45	45	30.5	29.9	29.1	-3
Source of water:											
Ground:											
Fresh	34	47	50	60	68	82	[5]83	73.2	79.4	76.4	-4
Saline	([6])	.6	.4	.5	1	1	.9	.652	1.22	1.11	-9
Surface:											
Fresh	140	180	190	210	250	260	290	265	259	264	+2
Saline	10	18	31	43	53	69	71	59.6	68.2	59.7	-12
Reclaimed wastewater	([6])	.2	.6	.7	.5	.5	.5	.579	.750	1.02	+36
Consumptive use	([6])	([6])	61	77	[7]87	[7]96	[7]100	[7]92.3	[7]94.0	[7]100	+6
Instream use:											
Hydroelectric power	1,100	1,500	2,000	2,300	2,800	3,300	3,300	3,050	3,290	3,160	-4

[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.

The general increase in water use from 1950 to 1980 and the decrease from 1980 to 1995 can be attributed, in part, to the following major factors:

- Most of the increases in water use from 1950 to 1980 were the result of expansion of irrigation systems and increases in energy development.
- The development of center-pivot irrigation systems and the availability of plentiful and inexpensive ground-water resources supported the expansion of irrigation systems.
- Higher energy prices in the 1970's, and large drawdown in ground-water levels in some areas increased the cost of irrigation water. In the 1980's, improved application techniques, increased competition for water, and a downturn in the farm economy reduced demands for irrigation water.
- The transition from water-supply management to water-demand management encouraged more efficient use of water.
- New technologies in the industrial sector that require less water, improved plant efficiencies, increased water recycling, higher energy prices, and changes in laws and regulations to reduce the discharge of pollutants resulted in decreased water use 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 contributed to reduced water demands.

Projections of future water use are beyond the scope of this report, although the trends established over the past 45 years from these national compilations 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. Higher water prices and active water conservation programs, however, may reduce the per-capita use rates. 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. 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, 1990, p. 85).

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.

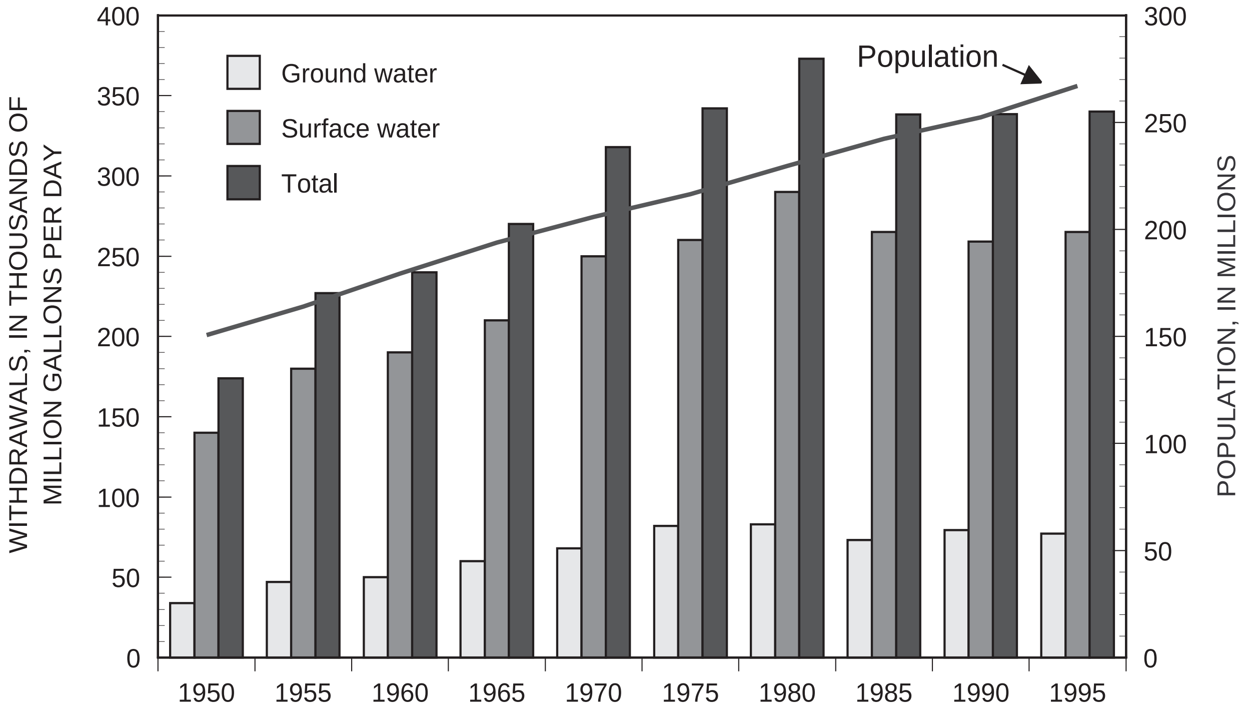

Figure 33. Trends in fresh ground- and surface-water withdrawals, and population, 1950-95.

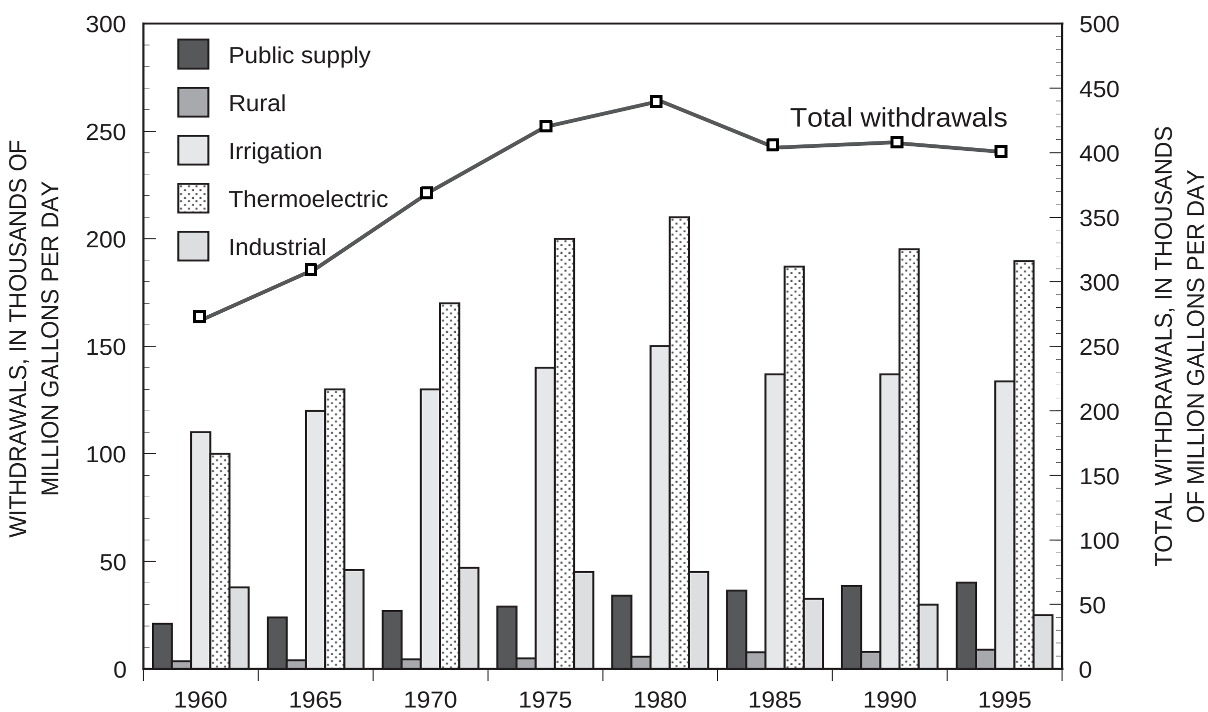

Figure 34. Trends in water withdrawals (fresh and saline) by water-use category and total (fresh and saline) withdrawals, 1960-95.