PREPARED IN COOPERATION WITH THE
MAINE DEPARTMENT OF CONSERVATION, MAINE GEOLOGICAL SURVEY
MAINE DEPARTMENT OF HEALTH SERVICES

WATER-RESOURCES INVESTIGATIONS REPORT 93-4098
Loiselle, M.C., Horn, M.A., and Medalie, L., 1993
Estimated withdrawals and use of freshwater in Maine, 1990

INTRODUCTION

In 1977, the Congress of the United States, recognizing the need for accurate, comprehensive, and comparable information on water use, directed the U.S. Geological Survey (USGS) to establish a National Water-Use Information Program to complement other USGS programs on the availability and quality of the Nation's water resources. The Water-Use Program is a cooperative project between USGS offices and various State agencies who are responsible for water-resources management. Currently (1993), a cooperative water-use program is in place in Maine and in the other five States in New England. These six individual programs are closely coordinated to promote development of uniform water-use data bases.

This report was prepared in cooperation with the Maine Department of Conservation, the Maine Geological Survey, and the Maine Department of Health Services. It is based on data for Maine that were compiled for a national report (Solley and others, 1993). National compilations of water-use information have been done every 5 years since 1950. The 1990 report is one of six reports being prepared for the New England States.

The purpose of this report is to provide information on water use in Maine to Federal and State agencies, water-resource professionals, and individuals interested in water-conservation issues. The report focuses on freshwater withdrawals and instream use for hydroelectric-power generation during 1990. The only significant saline withdrawals in the State were for cooling water for the Maine Yankee nuclear power plant and the W.F. Wyman thermoelectric power plant. Water withdrawals and use are reported in million gallons per day and are generally derived by dividing total annual withdrawals and use by 365 days. This procedure does not alter the values reported for water-use activities that are fairly constant throughout the year, such as domestic withdrawals; however, for water-use activities with significant seasonal variations (such as snowmaking, sand-and-gravel mining, and irrigation), the average daily withdrawal rate is smaller than the actual daily withdrawal rate during the season of activity. Data are aggregated by river basin, which is the most commonly used water-resource planning unit in New England. In most cases, however, river-basin boundaries do not coincide with State boundaries, and the data reported here are only for the part of each river basin within Maine. The river basins are equivalent to hydrologic cataloging units that were delineated by the USGS in cooperation with the U.S. Water Resources Council. A complete description of the units can be found in Seaber and others (1987).

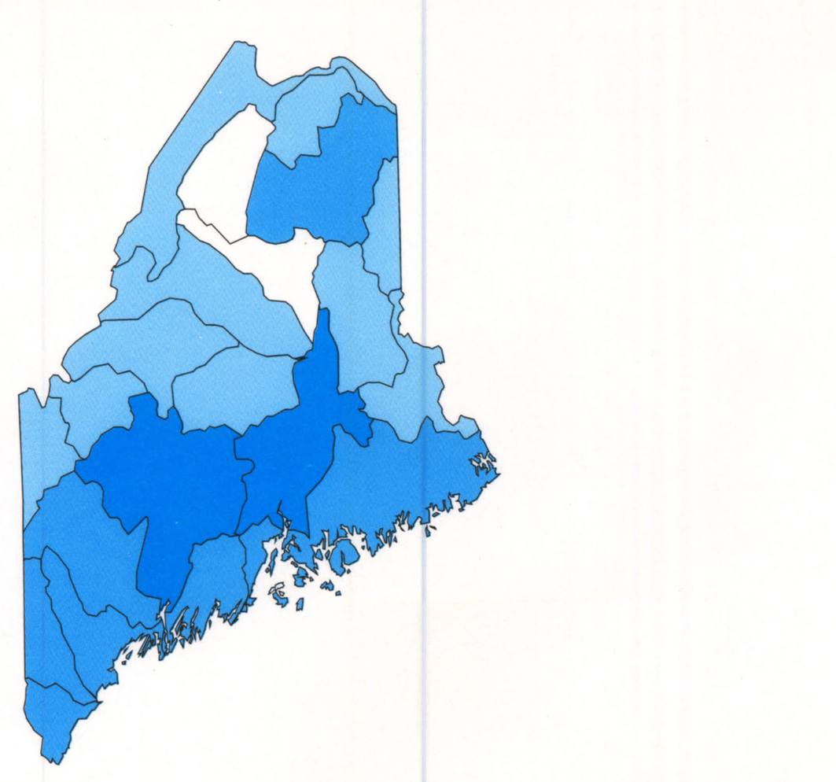
Most of the data in this report were estimated because Maine does not have a water-use permit or registration program through which water-use data could be collected routinely. Some site-specific information was supplied by owners for public supply and some commercial and industrial withdrawals. These data have been supplemented by estimates derived in one of two ways. For thermoelectric power, mining, and some commercial withdrawals and hydroelectric instream use, site-specific information, such as production data or amount of power generated, has been multiplied by a coefficient. For domestic, agricultural, some commercial, and some industrial withdrawals, aggregated data, such as census population data, have been multiplied by a coefficient (U.S. Department of Commerce, 1989).

REFERENCES CITED

Seaber, P.R., Kapinos, F.P., and Knapp, G.L., 1987, Hydrologic unit maps: U.S. Geological Survey Water-Supply Paper 2294, 63 p.
Solley, W.B., Pierce, R.R., and Perlman, H.A., 1993, Estimated use of water in the United States in 1990: U.S. Geological Survey Circular 1081, 76 p.
U.S. Department of Commerce, 1989, 1987 census of agriculture, volume 1--geographic area series, part 19--Maine State and county data: Washington D.C., Bureau of the Census, publication AC87-A-19, 217 p.

CONVERSION FACTORS

Multiply	by	To obtain
million gallons per day	0.04381	cubic meter per second
square mile	2.590	square kilometer



EXPLANATION
WATER WITHDRAWALS IN MILLION GALLONS PER DAY
0 - 1
1.1 - 10
10.1 - 100
101 - 1,000
1,001 - 10,000
GREATER THAN 10,000
RIVER BASIN BOUNDARY

EXPLANATION
River basin boundary
County boundary
5 River Basin, identified in Table 1

0 20 40 MILES
0 20 40 KILOMETERS

Base from U.S. Geological Survey data, 1:2,000,000, 1972

Index maps of Maine showing river basins (larger map) and total freshwater withdrawals by river basin (smaller map), 1990.

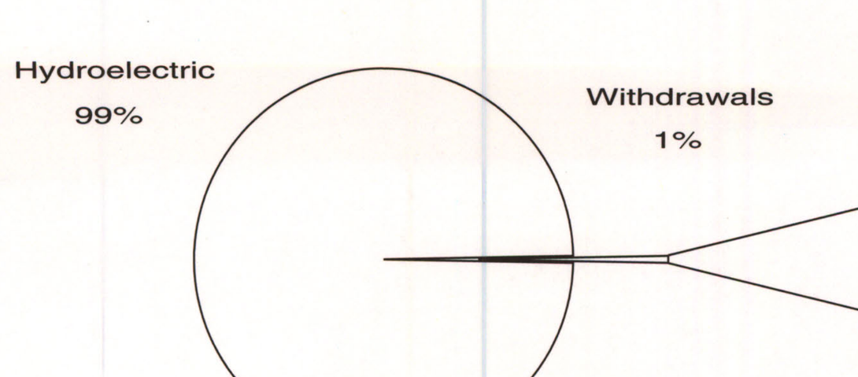
Table 1.--Area, population, and estimated withdrawals and hydroelectric instream use of water for river basins in Maine, 1990.

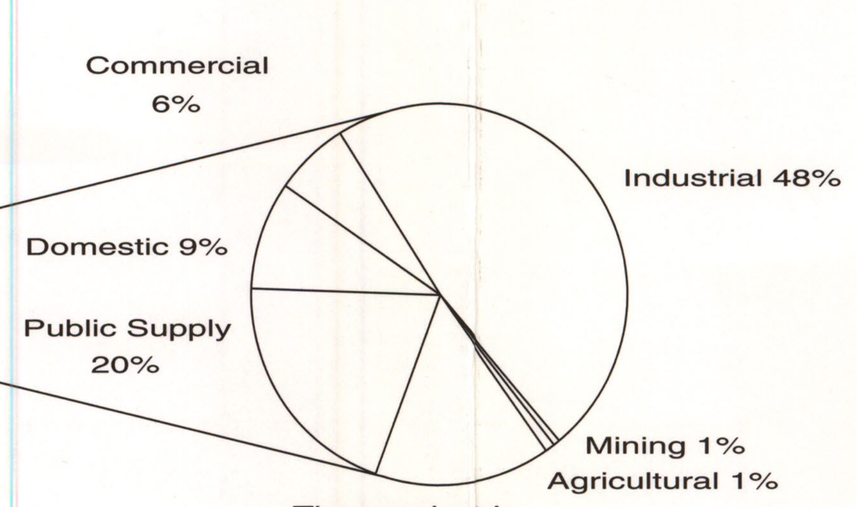
[Units are in million gallons per day (Mgal/d), except where noted; population numbers are rounded to the nearest hundred people; other numbers are rounded to nearest 0.1 Mgal/d or to three significant figures; values may not add to totals because of independent rounding; mi², square miles]

					Estimated withdrawals								
						Self-supplied							
Map code	River Basin	Hydrologic cataloging unit	Area[1] (mi²)	Population (thousands)	Public supply	Domestic	Commercial	Industrial	Mining	Agriculture	Thermoelectric	Total withdrawals	Hydroelectric instream use
1	Upper St. John	01010001	2,120	15.9	1.1	0.7	0.2	1.2	0.1	0.1	0.0	3.4	0.0
2	Allagash	01010002	1,250	0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3	Fish	01010003	908	5.7	.1	.4	.1	.7	.0	.1	.0	1.4	.0
4	Aroostook	01010004	2,420	44.7	3.1	2.4	.4	3.9	.1	.3	10.7	20.9	364
5	Meduxnekeag	01010005	634	18.3	1.2	1.0	.2	1.6	.0	.1	.0	4.1	.0
6	West Branch Penobscot	01020001	2,150	9.2	.7	.0	.1	2.9	.0	.0	.1	3.8	6,060
7	East Branch Penobscot	01020002	1,130	.7	.7	.0	.0	.1	.1	.0	.0	.9	1,390
8	Mattawamkeag	01020003	1,510	9.8	.2	.7	.1	2.1	.0	.1	.0	3.2	.0
9	Piscataquis	01020004	1,460	16.7	1.1	.7	.1	1.1	.0	.1	.0	3.1	958
10	Lower Penobscot	01020005	2,360	131.3	3.0	7.5	2.5	39.4	.2	.4	53.7	107	10,300
11	Upper Kennebec	01030001	1,570	3.6	.3	.2	.0	.6	.0	.0	.1	1.2	28.3
12	Dead	01030002	878	1.0	.1	.1	.0	.6	.0	.0	.7	1.5	1,600
13	Lower Kennebec	01030003	3,450	207.2	17.4	9.9	9.3	114	.2	.7	1.7	153	20,800
14	Upper Androscoggin	01040001	852	1.3	.3	.0	.0	.8	.0	.0	.0	1.1	24.2
15	Lower Androscoggin	01040002	1,940	176.2	15.6	5.3	2.2	30.7	.6	.5	12.7	67.6	27,600
16	St. Croix	01050001	999	7.7	.4	.5	1.7	1.3	.0	.0	.0	3.9	2,100
17	Maine Coastal	01050002	4,880	98.6	10.6	6.1	1.3	18.6	.4	.2	.3	37.5	644
18	St. George-Sheepscot	01050003	1,250	67.9	7.0	2.0	1.9	3.3	.6	.1	.2	15.1	.0
19	Presumpscot	01060001	2,240	245.4	25.6	8.0	11.2	24.5	.8	.4	1.9	72.4	3,490
20	Saco	01060002	843	67.8	7.0	1.7	1.1	4.3	.1	.1	.1	14.4	5,940
21	Piscataqua-Salmon Falls	01060003	560	99.0	10.7	1.3	1.6	1.7	.5	.2	.0	16.0	1,410
TOTAL			35,404	1,228	106	48.5	34.0	254	3.7	3.4	82.2	532	82,700

[1] Areas given for the Upper Androscoggin, Lower Androscoggin, Saco, and Piscataqua-Salmon Falls are calculated because river basin boundaries extend beyond State boundaries; areas for other basins are from Seaber and others (1987).

A water withdrawal generally refers to water removed for use from streams, reservoirs, or the ground. However, water can also be used without being moved from the stream channel--this is called instream use. The major instream use in Maine is for hydroelectric-power generation. Hydroelectric instream use is discussed separately from withdrawals in this report for two reasons. First, unlike withdrawals, virtually no change in the quantity of the water takes place during hydroelectric instream use. Second, the volume of water used for hydroelectric-power generation is so large that it overshadows the combined withdrawals for all other uses. In Maine, hydroelectric instream use is more than 150 times the total withdrawals. Other important instream uses include navigation, wastewater assimilation, recreation, and aquatic habitat.

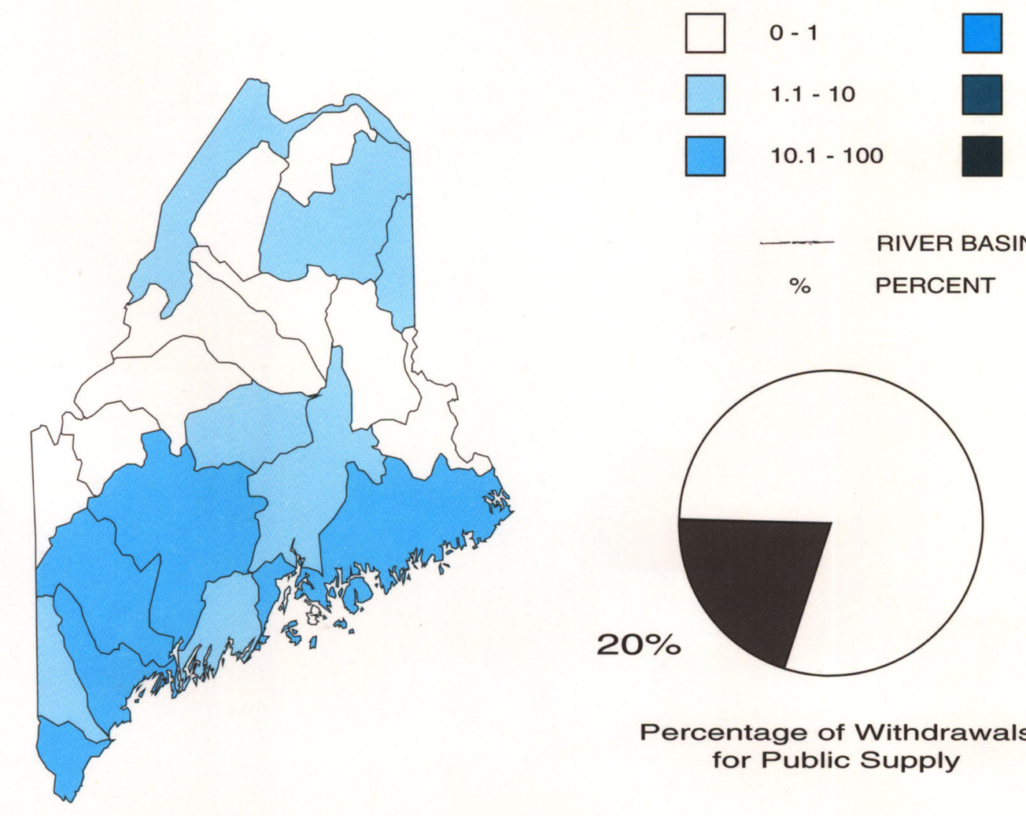




Hydroelectric instream use and total withdrawals in Maine, 1990

WITHDRAWALS BY WATER-USE CATEGORY AND RIVER BASIN

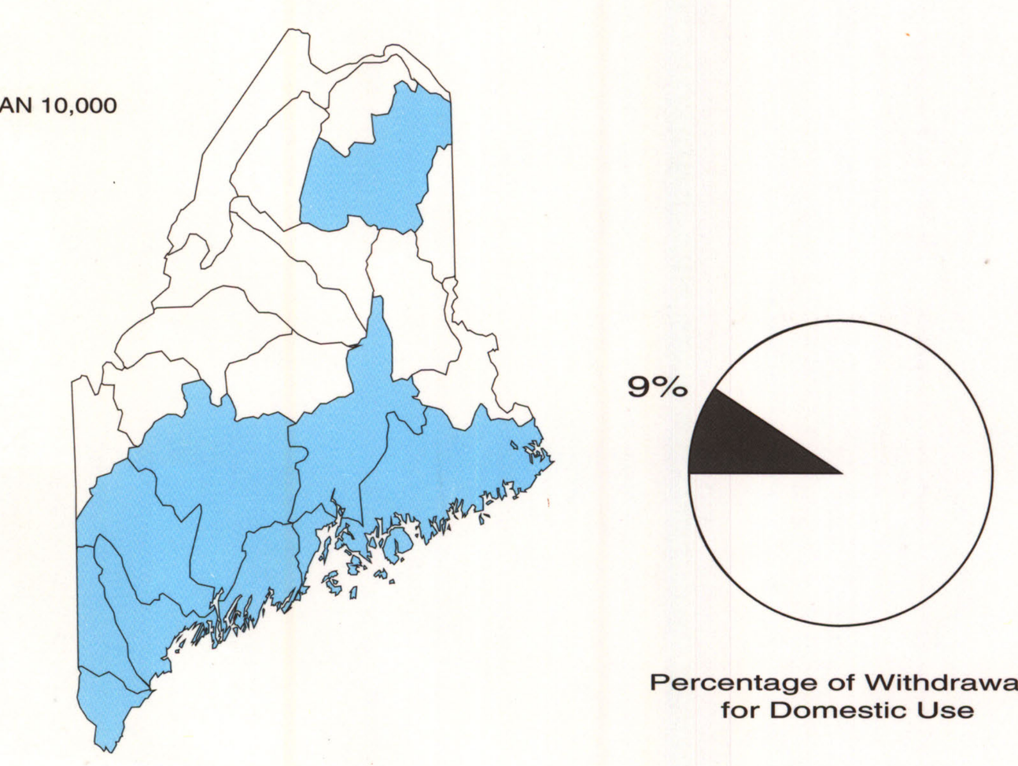
EXPLANATION
WATER WITHDRAWALS IN MILLION GALLONS PER DAY
0 - 1
1.1 - 10
10.1 - 100
101 - 1,000
1,001 - 10,000
GREATER THAN 10,000
RIVER BASIN BOUNDARY
% PERCENT



Percentage of Withdrawals for Public Supply

Public-Supply Withdrawals

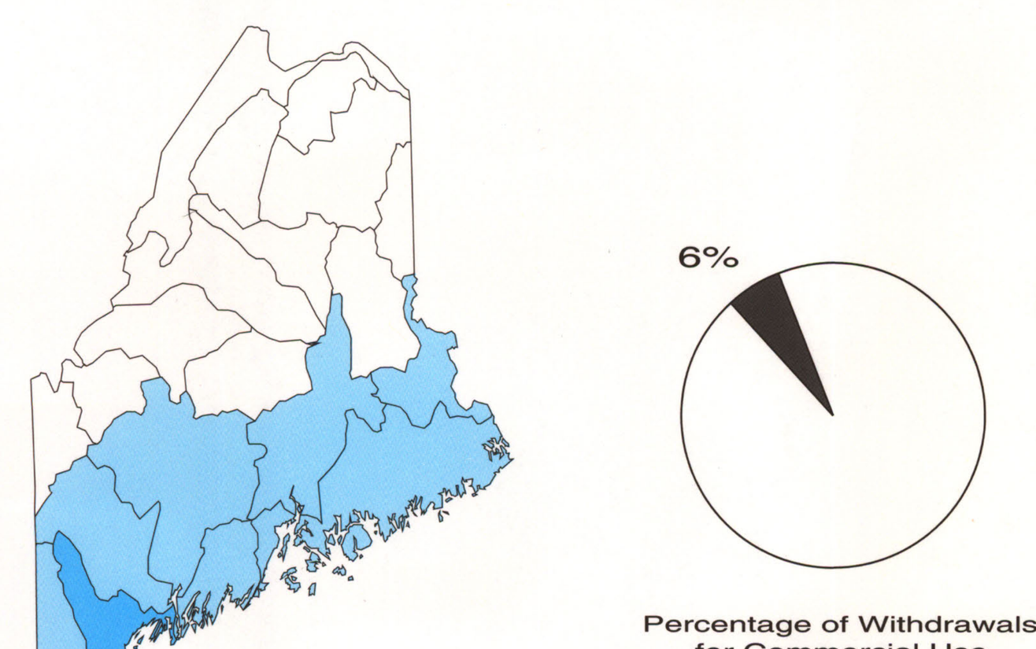
Public-supply withdrawals: Water withdrawn by public and private water suppliers who provide water to various users, such as domestic, commercial, and industrial users, and thermoelectric powerplants. Public supply also includes public use, losses, and transfers to other public suppliers or basins.
* Public-supply withdrawals, 106 million gallons per day, accounted for 20 percent of total withdrawals.
* Public suppliers served approximately 689,000 people or about 56 percent of the State's population.
* The largest withdrawals for public supply were in the Presumpscot, Lower Kennebec, Lower Androscoggin, Piscataqua-Salmon Falls, and Maine Coastal Basins. These basins contain more than 67 percent of the State's population, including the major population centers of Portland, Lewiston-Auburn, and the Capital district.



Percentage of Withdrawals for Domestic Use

Domestic Withdrawals

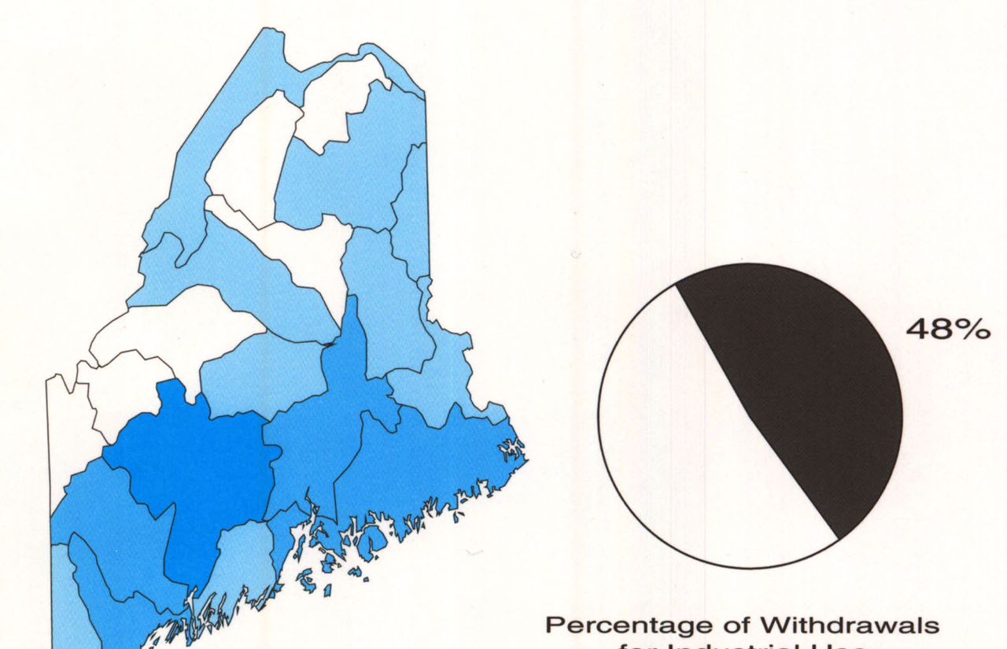
Domestic withdrawals: Water withdrawn for normal household purposes in homes, apartments, or in any place where people are included in a census survey. Domestic withdrawals include water used for drinking, preparing food, bathing, washing clothes or dishes, flushing toilets, and watering lawns and gardens.
* Domestic self-supplied withdrawals, 48.5 million gallons per day, accounted for 9 percent of total withdrawals.
* Approximately 539,000 people or about 44 percent of the State's population were self-supplied.
* The largest withdrawals for domestic self-supply were in the Lower Kennebec, Presumpscot, Lower Penobscot, Maine Coastal, and Lower Androscoggin River Basins, which contain about 70 percent of the State's population.



Percentage of Withdrawals for Commercial Use

Commercial Withdrawals

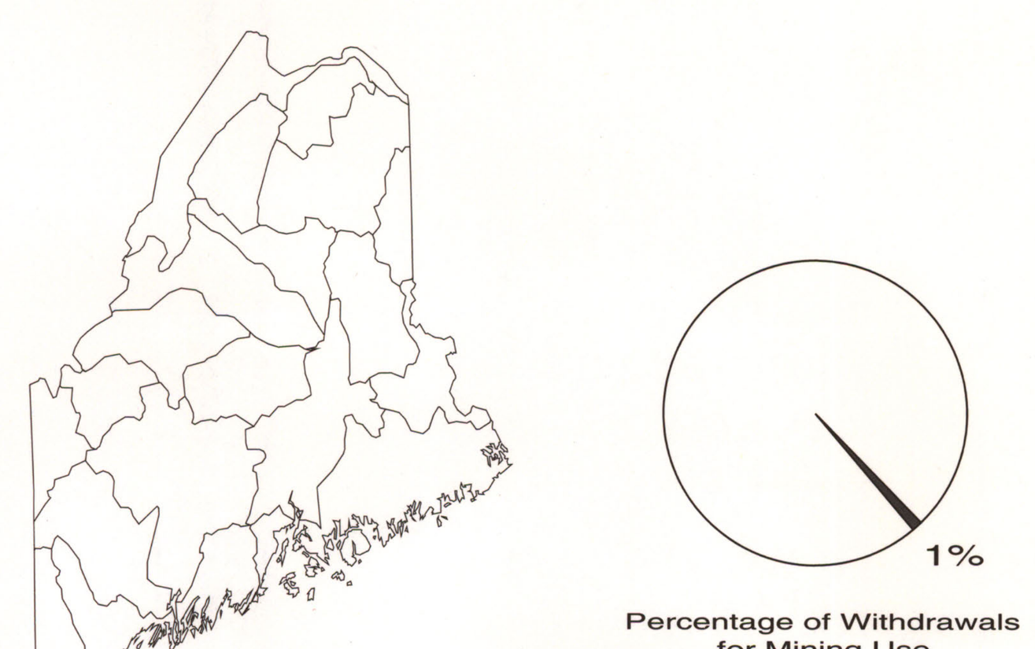
Commercial withdrawals: Water withdrawn for use in motels, hotels, restaurants, office buildings, and other commercial facilities, plus institutions, such as hospitals or schools. Water withdrawn for air conditioning and fish hatcheries also is included.
* Commercial self-supplied withdrawals, 34.0 million gallons per day, accounted for about 6.4 percent of total withdrawals.
* The largest withdrawals for commercial self-supply (11.2 million gallons per day; more than 30 percent of the total commercial withdrawals) were in the Presumpscot River Basin, which contains the greater Portland area.



Percentage of Withdrawals for Industrial Use

Industrial Withdrawals

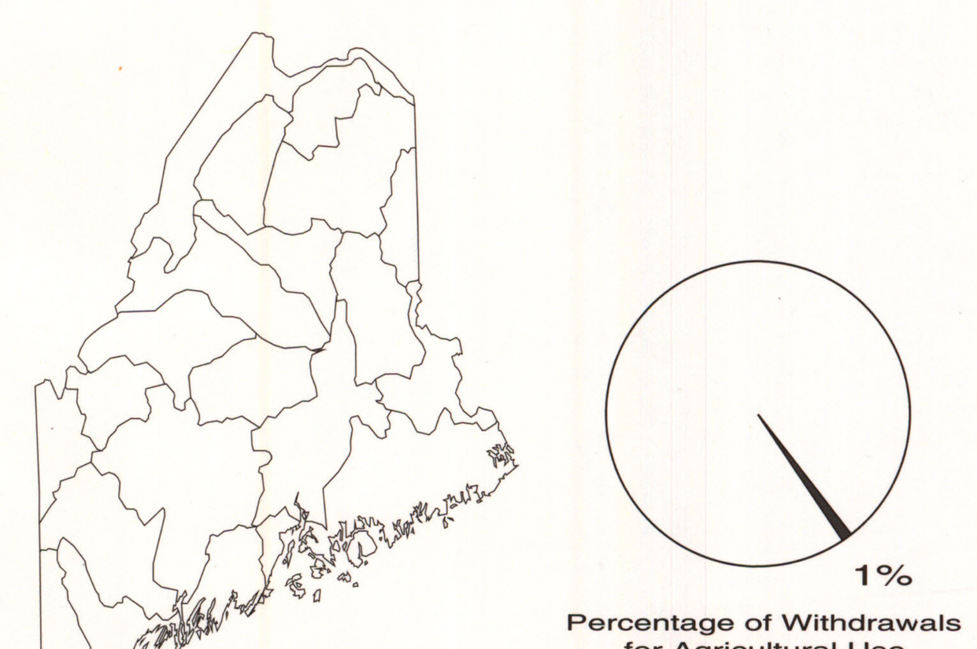
Industrial withdrawals: Water withdrawn for use in fabricating, processing, washing, and cooling industrial materials.
* Industrial self-supplied withdrawals, 254 million gallons per day, accounted for more than 48 percent of withdrawals.
* The largest industrial water withdrawals are for the lumber-and-wood-product and the paper-and-allied-product industries.
* The largest withdrawals by industries (114 million gallons per day--about 45 percent of total industrial withdrawals) were in the Lower Kennebec River Basin. Four other basins, the Lower Penobscot, Lower Androscoggin, Presumpscot, and Maine Coastal Basins, accounted for an additional 45 percent of the industrial withdrawals.



Percentage of Withdrawals for Mining Use

Mining Withdrawals

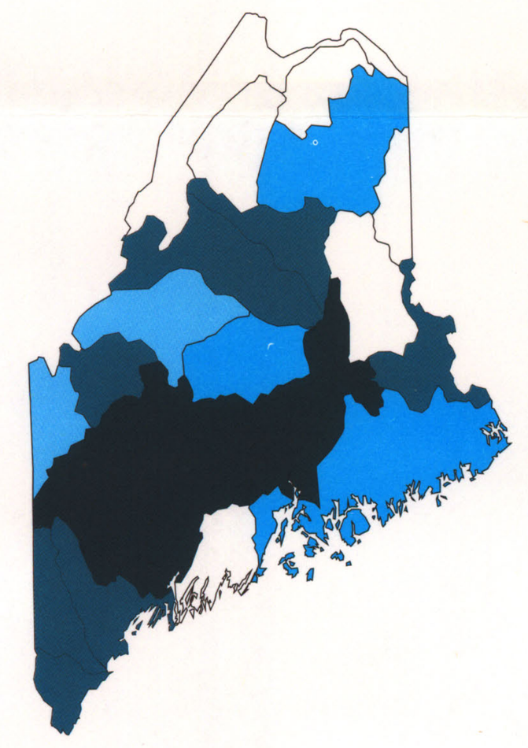
Mining withdrawals: Water withdrawn for use in the extraction of minerals, which includes withdrawals associated with quarrying, dewatering, milling (crushing, screening, washing, flotation), and other preparations customarily done at the mine site or as part of a mining activity.
* Mining withdrawals, 3.7 million gallons per day, accounted for less than 1 percent of total withdrawals. All mining operations in Maine were assumed to be self-supplied.
* Sand and gravel was the major mineral commodity in Maine.
* Water withdrawals for mining were concentrated in the more heavily populated southern River Basins (Presumpscot, St. George-Sheepscot, and Lower Androscoggin).



Percentage of Withdrawals for Agricultural Use

Agricultural Withdrawals

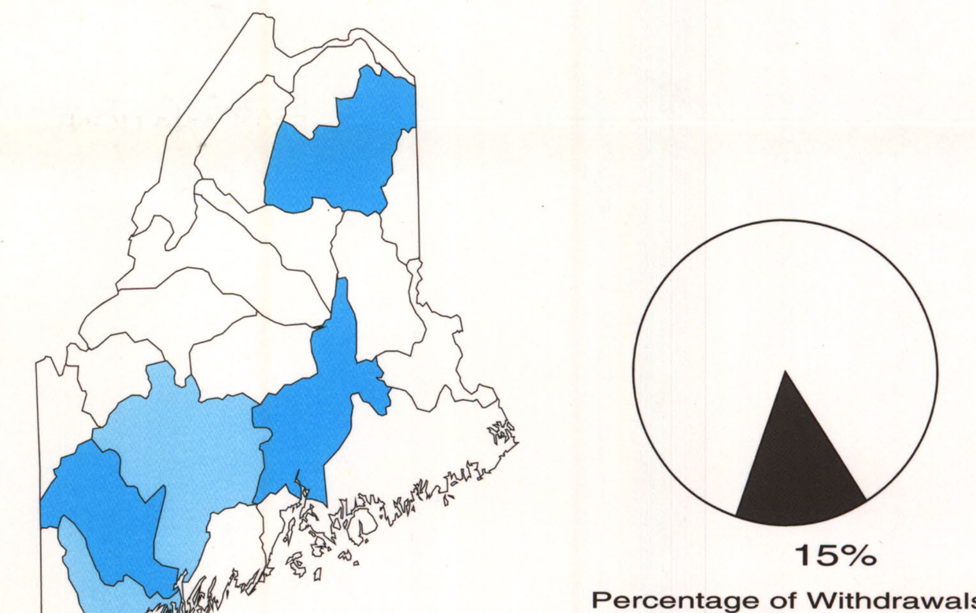
Agricultural withdrawals: Water withdrawn for use in irrigation and livestock watering.
* Agriculture withdrawals, 3.4 million gallons per day, accounted for less than 1 percent of total withdrawals.
* Agricultural withdrawals were evenly divided between livestock watering and irrigation.
* The largest withdrawals for agriculture were in the Lower Kennebec and Lower Androscoggin River Basins where dairy farms are common.



EXPLANATION
WATER USE IN MILLION GALLONS PER DAY
0 - 1
1.1 - 10
10.1 - 100
101 - 1,000
1,001 - 10,000
GREATER THAN 10,000
RIVER BASIN BOUNDARY

Hydroelectric Instream Use

Hydroelectric instream use: Water used in the generation of electricity at plants where the turbine generators are driven by moving water.
* Hydroelectric instream use, 82,700 million gallons per day from both large and small plants, was more than 150 times the total volume of water withdrawn for all other uses.
* The largest utilization of water for hydroelectric-power generation was in the Lower Androscoggin and the Lower Kennebec Basins.
* Hydroelectric powerplants generated approximately 30 percent of all electric power in Maine in 1990.



Percentage of Withdrawals for Thermoelectric Use

Thermoelectric Withdrawals

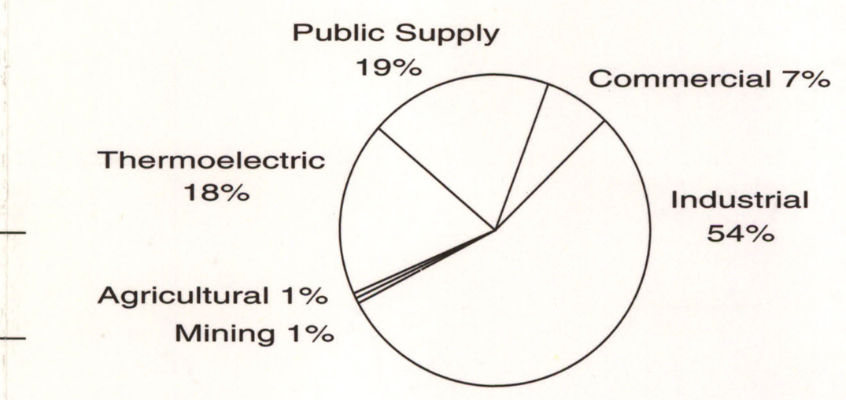
Thermoelectric withdrawals: Water withdrawn for use in the process of generating thermoelectric power. The water is primarily used for cooling.
* Self-supplied withdrawals for thermoelectric-power generation, 82.2 million gallons per day, accounted for about 15 percent of total withdrawals.
* About 94 percent of withdrawals for thermoelectric-power generation were in the Lower Penobscot, the Lower Androscoggin, and the Aroostook Basins.
* Other fossil-fuel and nuclear powerplants in Maine used saline water, so their use of water is not included in this report.

SURFACE-WATER AND GROUND-WATER WITHDRAWALS

Table 2.--Withdrawals of water by category and source in Maine, 1990

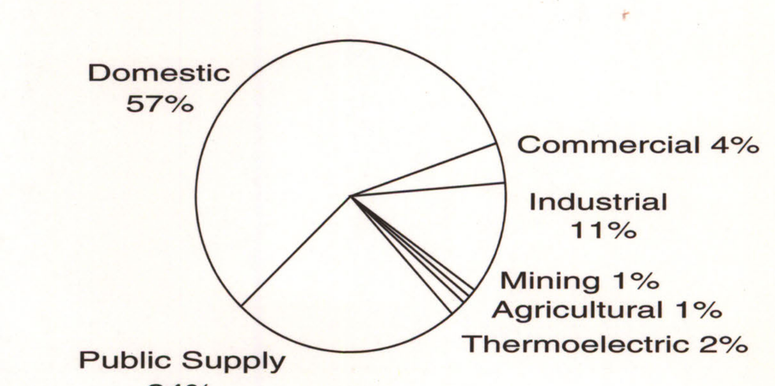
[Numbers are rounded to the nearest 0.1 Mgal/d or to three significant figures; values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

	Source		
Category	Ground water (Mgal/d)	Surface water (Mgal/d)	Total (Mgal/d)
Public supply	20.5	85.7	106
Domestic	48.5	.0	48.5
Commercial	3.5	30.5	34.0
Industrial	9.8	244	254
Mining	.8	2.9	3.7
Agriculture	.7	2.7	3.4
Thermoelectric	1.4	80.8	82.2
TOTAL	85.2	447	532



Surface-water withdrawals in Maine by category, 1990

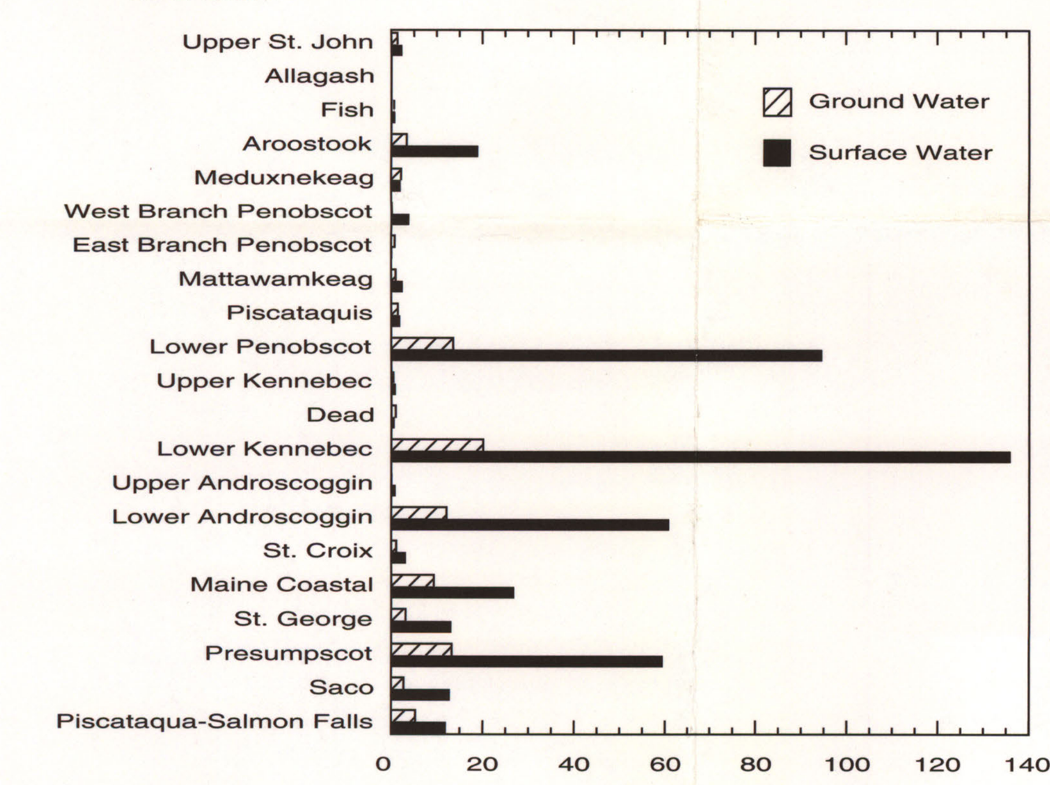
447 million gallons per day



Ground-water withdrawals in Maine by category, 1990

85.2 million gallons per day

EXPLANATION
% Percent



Withdrawals in Maine by river basin and source, 1990

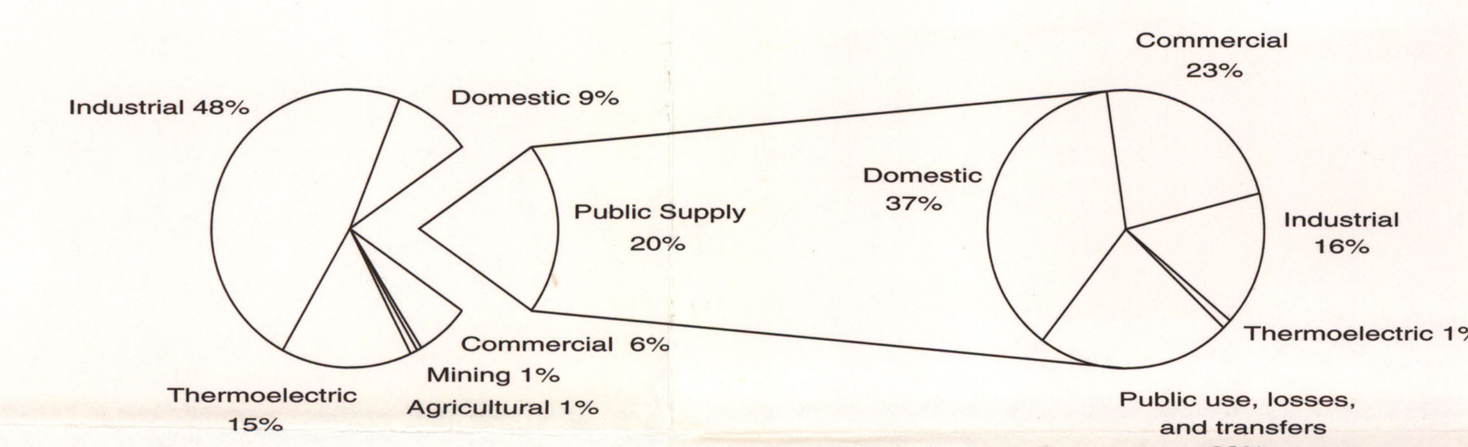
Surface water is water that is present at land surface, such as in streams, reservoirs, and lakes. The major surface-water bodies in Maine are the St. John and Aroostook Rivers in northern Maine; the Penobscot, Kennebec, and Androscoggin Rivers and Moosehead Lake in the central part of the State; and the Presumpscot and Saco Rivers in western and southern Maine.

During 1990, surface-water withdrawals were 447 million gallons per day and accounted for 84 percent of total withdrawals in Maine. The largest surface-water withdrawals were in the Lower Kennebec, Lower Penobscot, Presumpscot, and Lower Androscoggin River Basins. Withdrawals for industrial purposes accounted for more than 54 percent of all surface-water withdrawals.

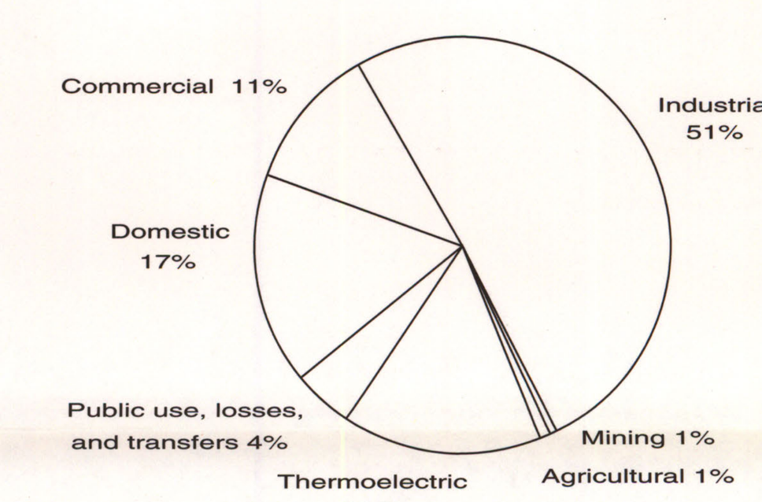
Ground water is the subsurface water that is present beneath the water table in soils and geologic formations that are fully saturated. When geologic formations yield significant quantities of water, they can be referred to as "aquifers." Maine has three main types of aquifers--those in glacial deposits (such as stratified drift or till), in crystalline bedrock (such as granite), and in carbonate rocks (limestone, which is found only in parts of northern Maine).

During 1990, ground-water withdrawals were 85.2 million gallons per day and accounted for 16 percent of total withdrawals in Maine. The largest ground-water withdrawals were in the Lower Kennebec, Lower Penobscot, Presumpscot, and Lower Androscoggin River Basins. Domestic and public-supply withdrawals accounted for 81 percent of ground-water withdrawals. Withdrawals for domestic use, 48.5 million gallons per day, were primarily from small-diameter wells (less than or equal to 4 inches) in crystalline-bedrock aquifers. Withdrawals for public-water suppliers, 20.5 million gallons per day, were primarily from large-diameter wells (greater than or equal to 8 inches) in stratified-drift aquifers.

SELF-SUPPLY WITHDRAWALS AND PUBLIC-SUPPLY DELIVERIES



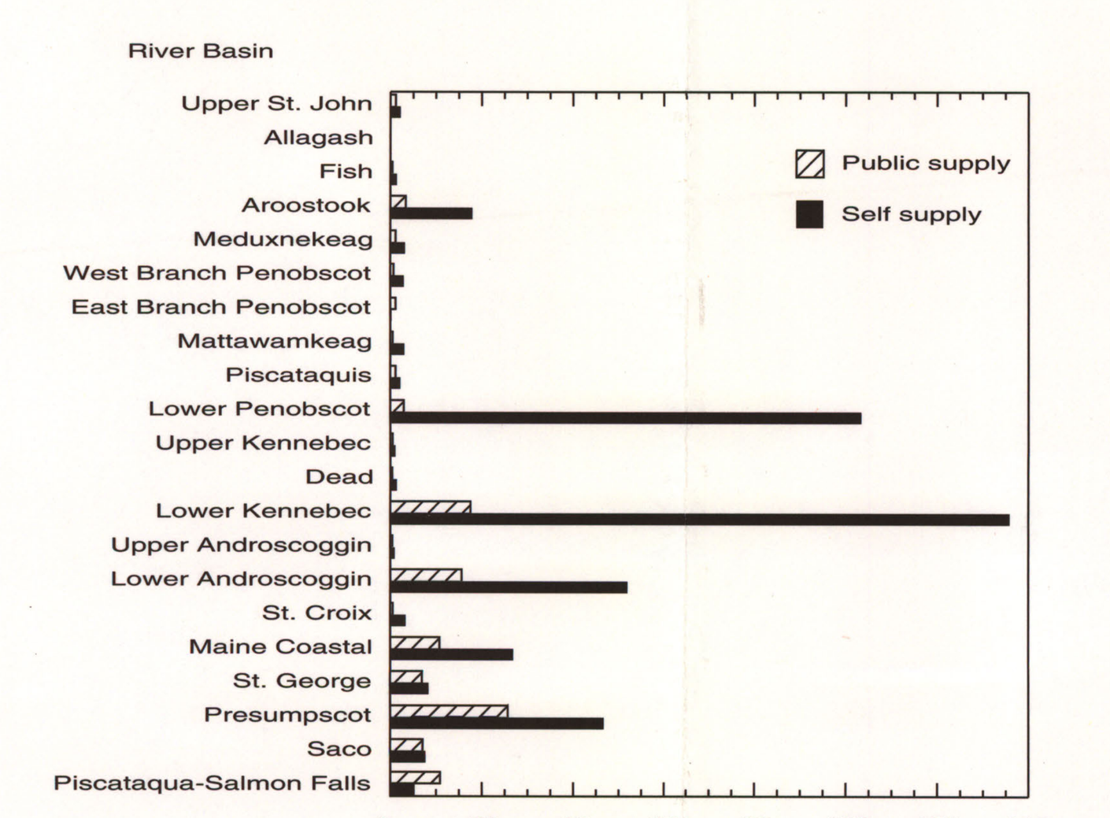
Total withdrawals and distribution of public-supply deliveries in Maine, 1990



EXPLANATION
% Percent

Total water use in Maine by category, 1990

532 million gallons per day



Self supply withdrawals and public-supply deliveries in Maine, 1990

Public supply is water withdrawn by public and private water suppliers who provide water to various users, such as domestic, commercial, and industrial users, and thermoelectric powerplants. It also includes public use, (water used for fire fighting, hydrant flushing, sanitation, and parks), losses that result from leaks in the distribution system, transfers to or from other river basins, and meter errors that may over-register or under-register the actual volume of water flowing through the meter. In the table below, large positive values in the column headed "Public use, losses, and transfers" reflect large exports of public-supply water to other river basins, whereas negative values indicate imports of water from other basins.

During 1990, withdrawals for public supply were 106 million gallons per day, which accounted for 20 percent of the water withdrawn in Maine. (Public use, losses, and transfers were included in this amount and accounted for 23 percent of public-supply withdrawals.) The largest public-supplied deliveries were in the Presumpscot, Lower Kennebec, Lower Androscoggin, Piscataqua-Salmon Falls, and Maine Coastal Basins. The largest category of public-supply water, 39.8 million gallons per day, was domestic, which accounted for about 37 percent of public-supply water. Commercial use (24.4 million gallons per day; about 23 percent) and industrial use (16.6 million gallons per day; about 16 percent) were the second and third largest users of public-supply water. Less than 1 percent of public-supply water was for thermoelectric use; other categories were assumed to have no public-supply deliveries.

Self-supply water is water that is withdrawn from a surface-water or ground-water source by a user rather than obtained from a public supplier. During 1990, self-supply withdrawals were 426 million gallons per day, which accounted for about 80 percent of water withdrawn in Maine. The Lower Kennebec and Lower Penobscot River Basins had the largest self-supply withdrawals. The largest use of self-supply water was by industrial users, 254 million gallons per day, which accounted for about 60 percent of all self-supply. Industrial use was about 94 percent self-supplied. The second largest use of self-supply water was for thermoelectric-power generation, 82.2 million gallons per day, about 19 percent of self supply. Thermoelectric users are more than 98 percent self-supplied. Domestic use was the only other category where self-supply withdrawals were more than 10 percent (48.5 million gallons per day; about 11 percent of self-supply); domestic users are about 55 percent self-supplied.

Total water use is the quantity of water use for a specific category and is the combination of self-supply withdrawals and public-supply deliveries. The domestic-use category, which only accounts for 9 percent of total withdrawals, is the second largest total water-use category (about 17 percent) in Maine.

Table 4.--Population with public- and self-supply water, and public supply deliveries of water in Maine, 1990

[Units are in million gallons per day (Mgal/d), except where noted; population numbers are rounded to the nearest hundred people; other numbers are rounded to the nearest 0.1 Mgal/d or to three significant figures; values may not add to totals because of independent rounding]

			Public-supply deliveries					
River Basin	Population with public supply (thousands)	Population with self supply (thousands)	Public use, losses, and transfers	Domestic	Commercial	Industrial	Thermoelectric	Total
Upper St. John	8.5	7.3	0.4	0.4	0.2	0.2	0.0	1.2
Allagash	.0	.0	.0	.0	.0	.0	.0	.0
Fish	.9	4.9	.0	.0	.0	.0	.0	.0
Aroostook	18.5	26.2	.9	.8	.6	.3	.4	3.0
Meduxnekeag	7.4	11.0	.4	.4	.2	.1	.0	1.1
West Branch Penobscot	9.0	.1	.2	.3	.2	.1	.0	.8
East Branch Penobscot	.6	.1	.2	.2	.1	.1	.0	.6
Mattawamkeag	2.0	7.8	.1	.1	.0	.0	.0	.2
Piscataquis	8.8	7.8	.3	.3	.2	.4	.0	1.2
Lower Penobscot	48.5	82.8	-3.5	3.0	2.4	1.1	.0	3.0
Upper Kennebec	1.9	1.7	.1	.1	.1	.1	.0	.4
Dead	.5	.5	.0	.0	.0	.0	.0	.0
Lower Kennebec	96.8	110.5	2.9	6.0	3.0	5.5	.0	17.4
Upper Androscoggin	.9	.4	.1	.1	.1	.0	.0	.3
Lower Androscoggin	116.7	59.5	3.1	6.9	3.7	1.8	.2	15.7
St. Croix	2.0	5.7	.1	.1	.1	.2	.0	.5
Maine Coastal	31.2	67.4	7.3	1.6	1.2	.5	.0	10.6
St. George-Sheepscot	45.6	22.3	1.5	2.3	1.4	1.7	.0	6.9
Presumpscot	156.2	89.2	6.6	9.3	5.6	3.5	.6	25.6
Saco	48.9	18.9	1.8	3.2	1.3	.7	.0	7.0
Piscataqua-Salmon Falls	84.3	14.7	1.8	4.7	4.0	.3	.0	10.8
TOTAL	689.2	538.8	24.3	39.8	24.4	16.6	1.2	106

Table 3.--Use of water by category and supply type in Maine, 1990

[Numbers exclude hydroelectric instream use; values are rounded to nearest 0.1 Mgal/d or to three significant figures; values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

	Supply type		
Category	Public supply (Mgal/d)	Self supply (Mgal/d)	Total (Mgal/d)
Domestic	39.8	48.5	88.3
Commercial	24.4	34.0	58.4
Industrial	16.6	254	270
Mining	.0	3.7	3.7
Agriculture	.0	3.4	3.4
Thermoelectric	1.2	82.2	83.4
Public use, losses, and transfers	24.3	.0	24.3
TOTAL	106	426	532

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M.C. Loiselle, M.A. Horn, and Laura Medalie
1994

For additional information write to:
District Chief
U.S. Geological Survey
26 Ganneston Drive
Augusta, Maine 04330

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