WATER WITHDRAWAL AND USE IN MARYLAND, 1986

By Judith C. Wheeler

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CONVERSION FACTORS AND ABBREVIATIONS

For those readers who prefer to use metric (International System) units rather than the inch-pound units used in this report, values may be converted by using the following factors:

Multiply inch-pound unit	by	To obtain metric unit
acre	4,047	square meter (m^2)
square mile (mi^2)	2.590	square kilometer (km^2)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
acre-foot per year (acre-ft/yr)	0.003377	cubic meter per day (m^3/d)
kilowatt hour (KWh)	3.6 X 10	joule (J)

SELECTED WATER RELATIONS (approximations)

1 gallon =	8.345	pounds
1 million gallons =	3.070	acre-foot
1 cubic foot of water =	62.40	pounds
1 cubic foot of water =	7.480	gallons
1 acre-foot =	325,851	gallons
(1 acre covered by 1 foot of water) =	43,560	cubic feet
1 inch of rain per acre =	27,200	gallons per acre
1 inch of rain per square mile =	17.40	million gallons per square mile

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ABSTRACT

During 1986, about 1,460 million gallons per day (Mgal/d) of freshwater was withdrawn from the surface-water and ground-water resources of Maryland. Of this amount, 1,198 Mgal/d (82 percent) was used in the State and 262 Mgal/d (18 percent) was transferred to surrounding States and the District of Columbia, for water supply. About 8 Mgal/d of freshwater was imported from bordering States for use in Maryland. In addition, about 6,240 Mgal/d of saline surface water was withdrawn and used in Maryland, primarily, for cooling purposes in the generation of electricity.

The majority of freshwater withdrawals (84 percent) were from surface-water sources. Most fresh surface water was withdrawn and used in the Potomac drainage basin (about 870 Mgal/d), whereas most ground water (about 180 Mgal/d) was withdrawn and used in the Upper Chesapeake drainage basin. The Potomac Group aquifers provided the most ground water (56 Mgal/d).

Ten water-use categories comprise the major demands on the surface-water and ground-water resources of the State in 1986:

- Public supply--801 Mgal/d was withdrawn and delivered to residents (for domestic use), commercial establishments, and industries. Public suppliers delivered water to 80 percent of the total population. Baltimore City received the largest public-supply deliveries (151 Mgal/d) in 1986.

- Domestic--482 Mgal/d (418 Mgal/d was received from public suppliers and about 64 Mgal/d was self-supplied).

- Commercial--92.8 Mgal/d (about 66 Mgal/d was received from public suppliers and 26.6 Mgal/d was self-supplied).

- Industrial--142 Mgal/d (63.4 Mgal/d was received from public suppliers and 78.5 Mgal/d was self-supplied). Industries also used 352 Mgal/d of brackish or saline surface water and about 80.7 Mgal/d of reclaimed sewage water.

- Mining--26.7 Mgal/d (26.1 Mgal/d freshwater and about 0.6 Mgal/d saline water) was withdrawn.

- Thermoelectric power generation--393 Mgal/d of freshwater was withdrawn. In addition, 5,890 Mgal/d of saline surface water was used primarily for cooling condensers.

- o Hydroelectric power generation (instream water use)--20,400 Mgal/d of freshwater was used for the production of electricity. Although the amount of water diverted by some plants was considerable, the amount consumed was negligible (probably less than 5 percent).

- o Agricultural (nonirrigation)--11.3 Mgal/d of freshwater was used primarily for livestock watering, feedlots, and dairy operations.

- o Irrigation (including irrigating farm crops, golf courses, parks, and nursery plants)--55.7 Mgal/d was used. Of this amount, 52 Mgal/d was used for irrigating farm crops.

- o Aquaculture--6.88 Mgal/d of freshwater was used primarily for raising fish; 4.56 Mgal/d of saline water was used primarily for raising crabs and oysters.

INTRODUCTION

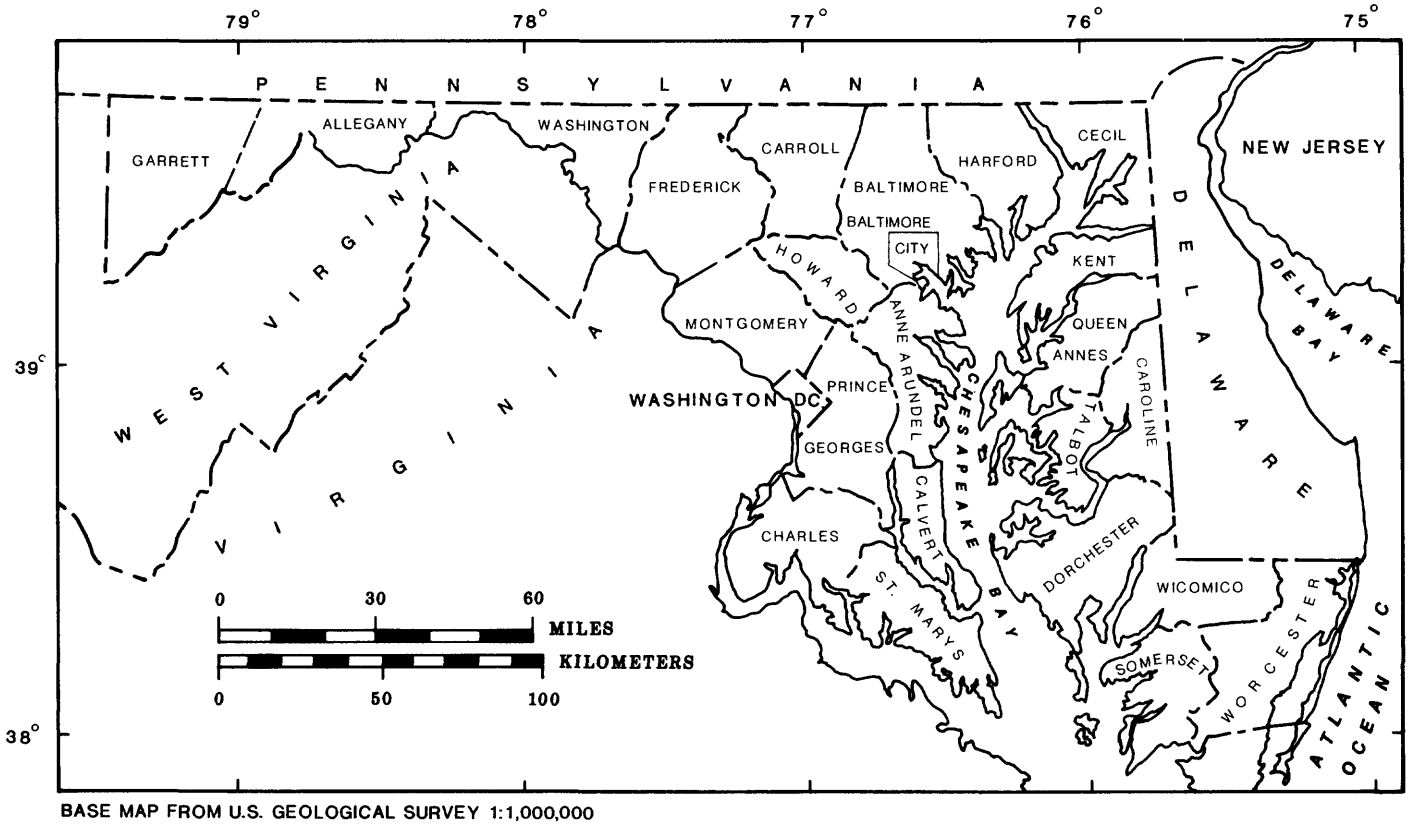
Maryland has a total land and water area of 12,303 mi^2 (square miles) and is divided into 23 counties and Baltimore City (fig. 1). The State has abundant surface-water and ground-water resources. As the demand for water increases, however, stress is placed on these resources. Efficient water-resource management depends, in part, on the collection of water-withdrawal and use data. Once compiled, these data are valuable in determining the effects of present withdrawals on the State's water resources and on current water-use patterns, as well as in anticipating the effects of future water demands.

Purpose and Scope

This report, prepared in cooperation with the Maryland Geological Survey and the Maryland Water Resources Administration (WRA), summarizes the amounts of fresh and saline water withdrawn and used in Maryland in 1986. The data are discussed briefly and presented in graphs, tables, and maps, by counties, drainage basins, and aquifers.

The amount of water withdrawn from water sources within each county has been distinguished from the amount of water used in each county. Water withdrawal in each county includes all water withdrawn or transferred to another county or State. Water use is defined as the amount of water actually used in each county including (1) water withdrawn for use within the county and (2) water transferred in from another county or State. Self-supplied water and water delivered from public-supply systems are combined for each category.

The water-use categories discussed in this report are public supply, domestic, commercial, industrial, mining, thermoelectric power generation, hydroelectric power generation, agricultural (nonirrigation), irrigation, and aquaculture. Water withdrawn by a public or private water utility and delivered to a variety of users is designated as a "public supply." If a public supply is not available or is not used, the water is classified "self-supplied." Homes and small communities relying on individual wells are



BASE MAP FROM U.S. GEOLOGICAL SURVEY 1:1,000,000

Figure 1.--Counties of Maryland.

classified as domestic self-supplied water use. Thermoelectric power generation is defined as electric energy generated in steam-electric plants including those that use nuclear fuel. Water used for the generation of electricity by hydroelectric power plants is discussed here but the quantities of water used are not included in the freshwater totals because this use is considered "instream" water use--that is, water use takes place within the stream channel.

Methods of Data Collection and Estimation

Most of the water-use data on public suppliers, commercial and industrial facilities, mines, and thermoelectric power plants were obtained from pumpage reports submitted to WRA by users withdrawing 0.01 Mgal/d (million gallons per day) or more. Annual and monthly withdrawal data are stored in a computerized data base by WRA. The U.S. Geological Survey, in cooperation with WRA and the Maryland Department of the Environment (MDE), also maintains a site-specific water-use data base, the Maryland State Water-Use Data System (SWUDS) that is designed to store water-withdrawal data from the WRA data base and return-flow data from MDE for users that withdraw or return 0.01 Mgal/d or more. The Water Resources Administration's data base and SWUDS were used in the preparation of this report. Water-use data for users of less than 0.01 Mgal/d were obtained from the average daily permit allocations as stated in water appropriation and use permits issued by WRA.

Water-use data on domestic, agriculture, irrigation and hydroelectric power generation were estimated using the following methods:

Self-supplied domestic withdrawal was estimated by determining the number of people not served by public suppliers (based on the percentage of housing units, estimating three persons per unit) with drilled or dug wells (Booth, 1984) and subtracting that number from the total population for each county (compiled from Maryland Department of State Planning, 1987). Per capita water use in Maryland was estimated to be 75 gal/d (gallons per day) (U.S. Environmental Protection Agency, 1973, p. 15).

Agricultural (nonirrigation) water use was estimated based on the number of farm animals in each county (U.S. Department of Commerce, 1984, p. 157-170) and the amount of water used per animal category (U.S. Environmental Protection Agency, 1973). It was arbitrarily assumed that grazing animals such as cattle, horses, and sheep relied on surface water for supply and poultry, hogs, and dairy cows relied on ground water.

Irrigation water use was estimated from the number of acres irrigated, using a water application rate of 0.9 (acre-ft/acre)/yr (acre-foot per acre per year) or about 818 gal/d (Carr, L.E., Maryland Cooperative Extension Service, oral commun., 1987).

Hydroelectric power generation water use was estimated based on annual generation data (Energy Information Administration, 1986a, 1986b, 1987a, and 1987b) and a coefficient of water used per KWh (kilowatt hour) (Weisberg, S.B., Martin Marietta Environmental Systems, written commun., 1986).

Population and Water-Use Trends

The total population of Maryland based on 1985 U.S. Census data is approximately 4,440,000 (compiled from Maryland Department of State Planning data, 1987). Population and water-use facts for 1986 are presented in table 1. About 80 percent of the total population (3.56 million people) were served by public-supply systems in 1986. Surface water was used by 66 percent of the population; ground water was used by 34 percent of the population.

Table 1.--*Population and water use in Maryland, 1986*

[Population data rounded to three significant figures and may not add to totals because of independent rounding. Percentages rounded to two significant figures]

Total population:	4,440,000
Population served by public-supply systems	3,560,000
Population served by self-supplied systems	874,000
Surface-water supply:	
Percentage of total population served by surface water	66
Number served by public-supply systems	2,950,000
Percentage of total population	66
Number served by self-supplied systems	0
Percentage of total population	0
Ground-water supply:	
Percentage of total population served by ground water	34
Number served by public-supply systems	619,000
Percentage of total population	14
Number served by self-supplied systems	874,000
Percentage of total population	20

Population and water-use trends for Maryland from 1950 through 1986 are shown in figure 2. In 1950, 2.34 million people used about 400 Mgal/d of freshwater. Both population and water use increased steadily through the 1950's and 1960's. From 1970-86, however, the rate of population growth slowed, only increasing from 3.92 million people in 1970 to 4.44 million in 1986. Water use, during the same period, leveled off in the early 1970's at about 1,500 Mgal/d, then decreased over the rest of the decade. In 1980, water use was about 1,400 Mgal/d. Possible explanations for the decrease in water use include changing economic trends, particularly declining water use among certain industries; increased use of conservation techniques and fixtures; and different methods of collecting water-use data. However, water use increased from 1985-86, from about 1,400 Mgal/d to about 1,460 Mgal/d, primarily, due to increases in withdrawals for irrigation and for public-supply distribution.

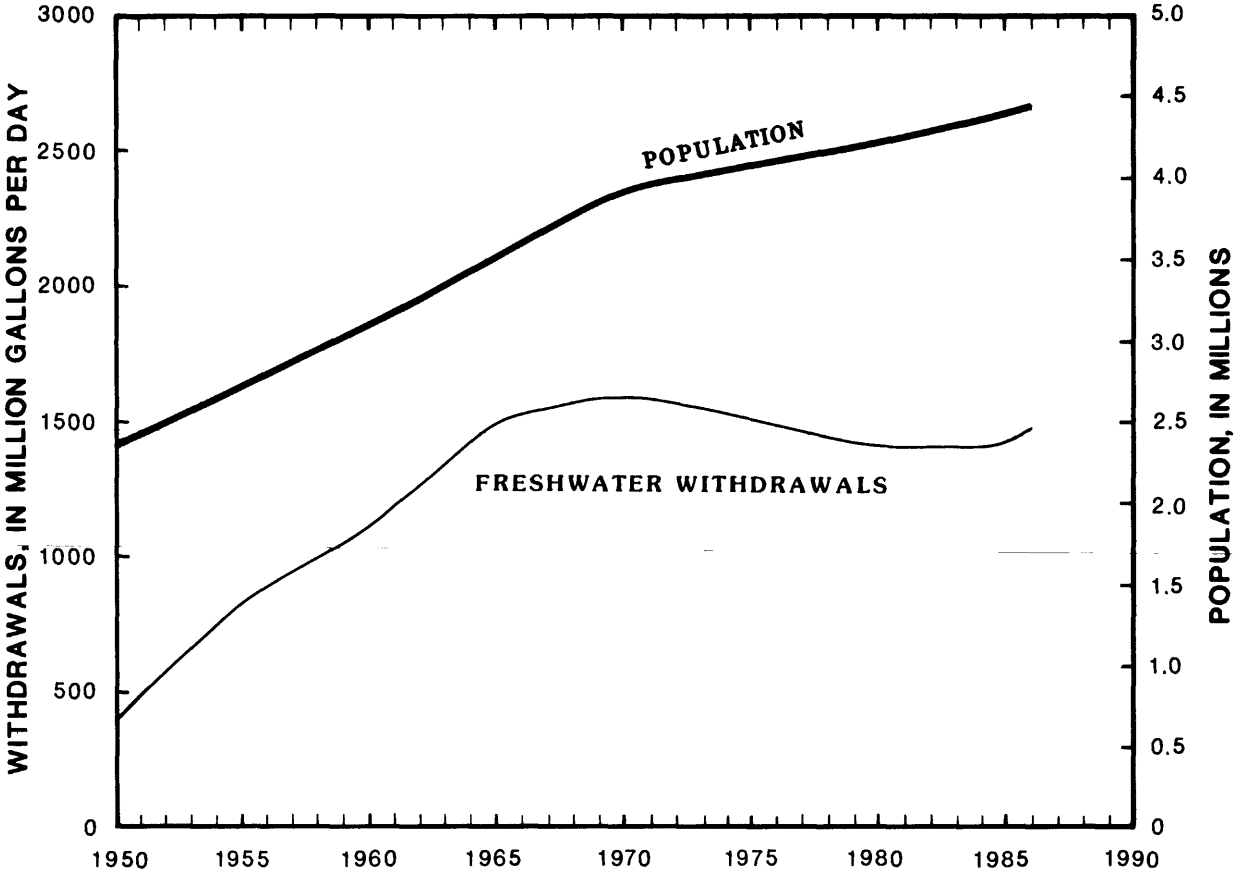


Figure 2.--Population and water-use trends in Maryland, 1950-1986.

WATER WITHDRAWAL AND USE

During 1986, approximately 1,460 Mgal/d of freshwater was withdrawn from Maryland's surface- and ground-water sources. Of this amount, 1,198 Mgal/d (82 percent) was used in the State and 262 Mgal/d (18 percent) was transferred to surrounding States and the District of Columbia, for water supply. Conversely, about 8 Mgal/d of freshwater was imported from bordering States for use in Maryland.

Freshwater withdrawals by county are shown in figure 3. The largest water withdrawals (greater than 100 Mgal/d) were in Montgomery and Baltimore Counties. These Counties provide the water sources for the public suppliers that serve the Baltimore City and District of Columbia metropolitan areas. The smallest water withdrawals were in Baltimore City and Howard County because the main public-supply sources for Baltimore City are located in Baltimore County, and because Howard County is served primarily by the Baltimore City public-supply system and the Washington Suburban Sanitary Commission (WSSC) system (water sources are in Montgomery and Prince Georges Counties).

Withdrawal-data category by use are summarized in figure 4. Tables 2 to 12 (located in the appendix at the end of the report) present withdrawal and use data, by county, for the 10 major categories of use. Table 2 is a summary of withdrawals by county.

A comparison of total fresh surface- and ground-water withdrawals by county is shown in figure 5. Approximately 84 percent (1,220 Mgal/d) of the freshwater withdrawn in Maryland in 1986 came from surface-water sources compared to 16 percent (242 Mgal/d) from ground-water sources. Most fresh surface-water withdrawals (more than 25 Mgal/d) occurred in Montgomery, Baltimore, Allegany, Washington, and Prince Georges Counties (table 2), whereas most ground-water withdrawals (more than 25 Mgal/d) occurred in Anne Arundel County.

The largest drainage basins in Maryland are the Potomac and the Upper Chesapeake (fig. 6). About 74 percent of total fresh surface-water withdrawals occurred in the Potomac basin. During 1986, 870 Mgal/d was withdrawn and used in this basin compared to 314 Mgal/d (nearly 26 percent) withdrawn and used in the Upper Chesapeake basin. In addition, about 16.3 Mgal/d of fresh surface water was withdrawn in the Potomac basin and transferred to the Upper Chesapeake basin for use; conversely, 36 Mgal/d of fresh surface water was withdrawn in the Upper Chesapeake basin, then transferred to the Potomac basin for use. Less than 1 percent of fresh surface water was withdrawn in the remaining two basins.

About 74 percent (180 Mgal/d in 1986) of total ground-water withdrawals occurred in the Upper Chesapeake basin compared to about 23 percent (56 Mgal/d in 1986) withdrawn in the Potomac basin. Only about 1 percent of total ground-water withdrawals occurred in the remaining two basins.

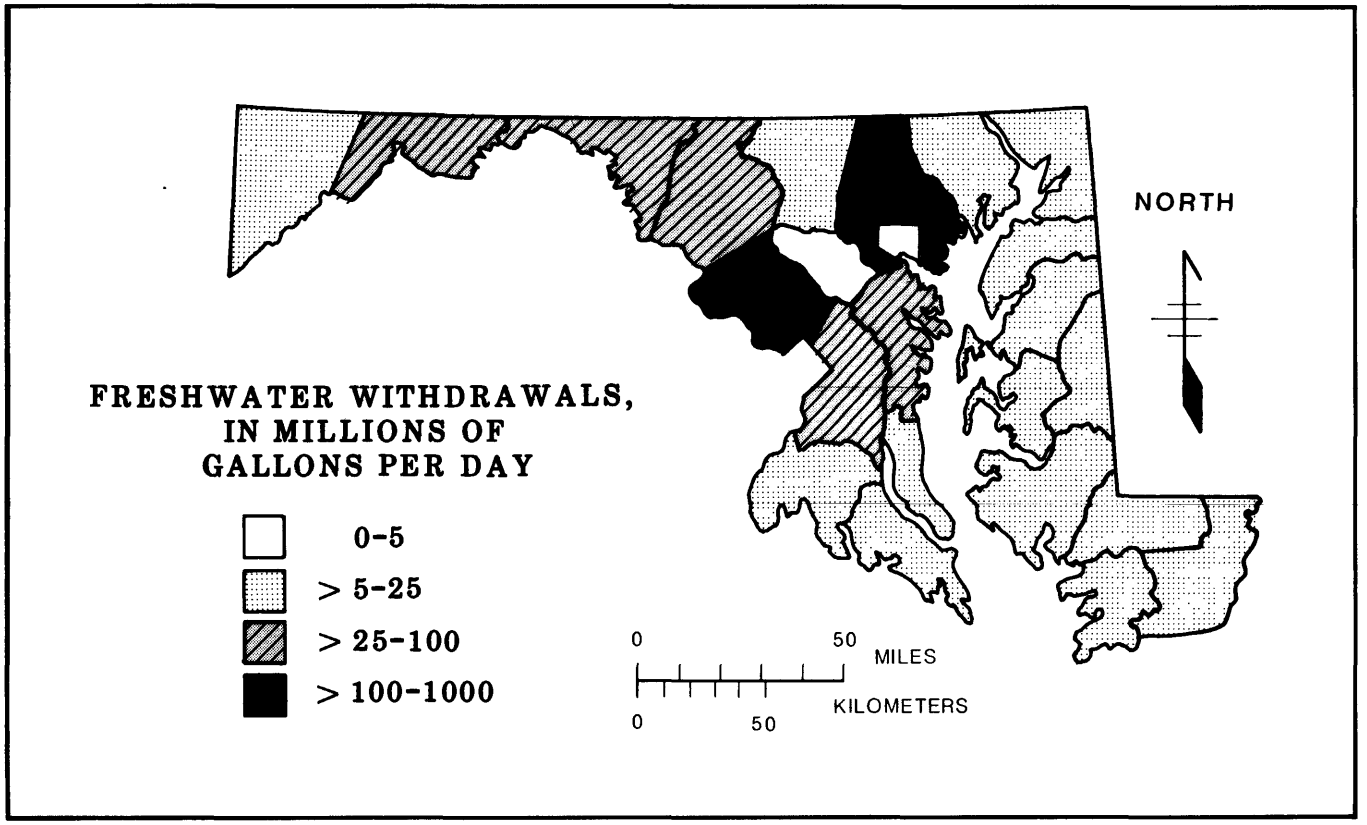


Figure 3.--Freshwater withdrawals in Maryland, by county, 1986.

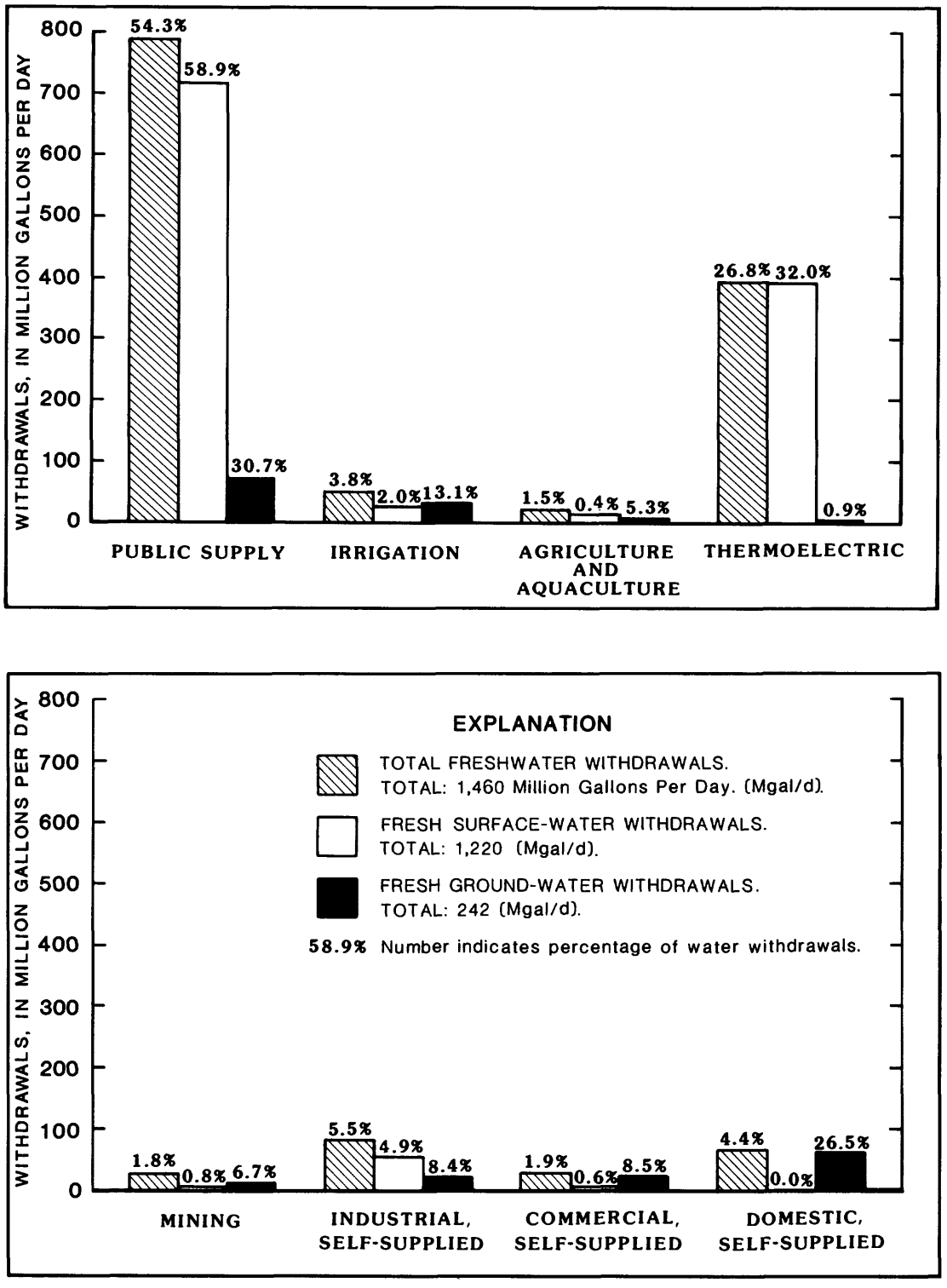


Figure 4.--Freshwater withdrawals and percentage for each type of use in Maryland, 1986.

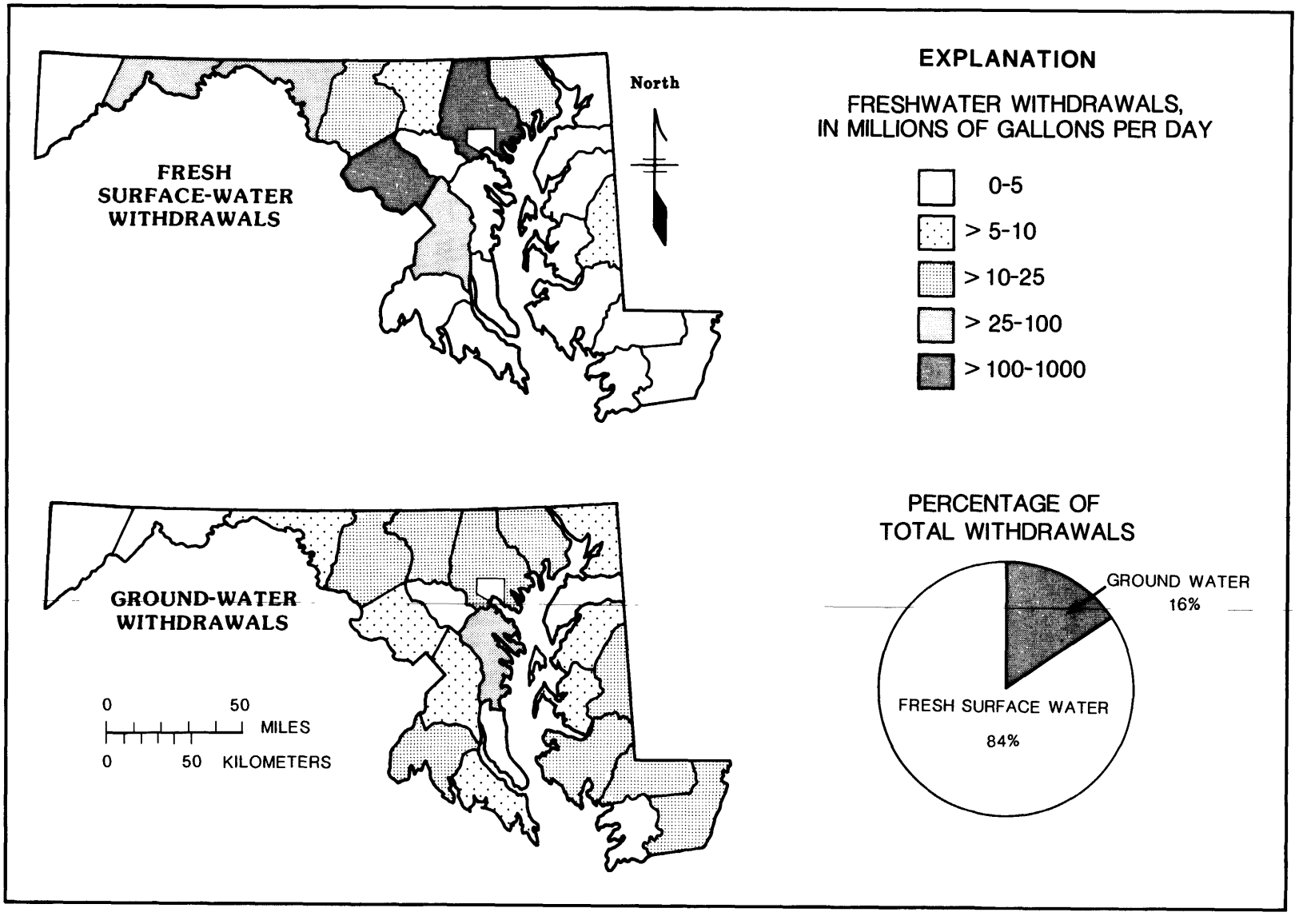
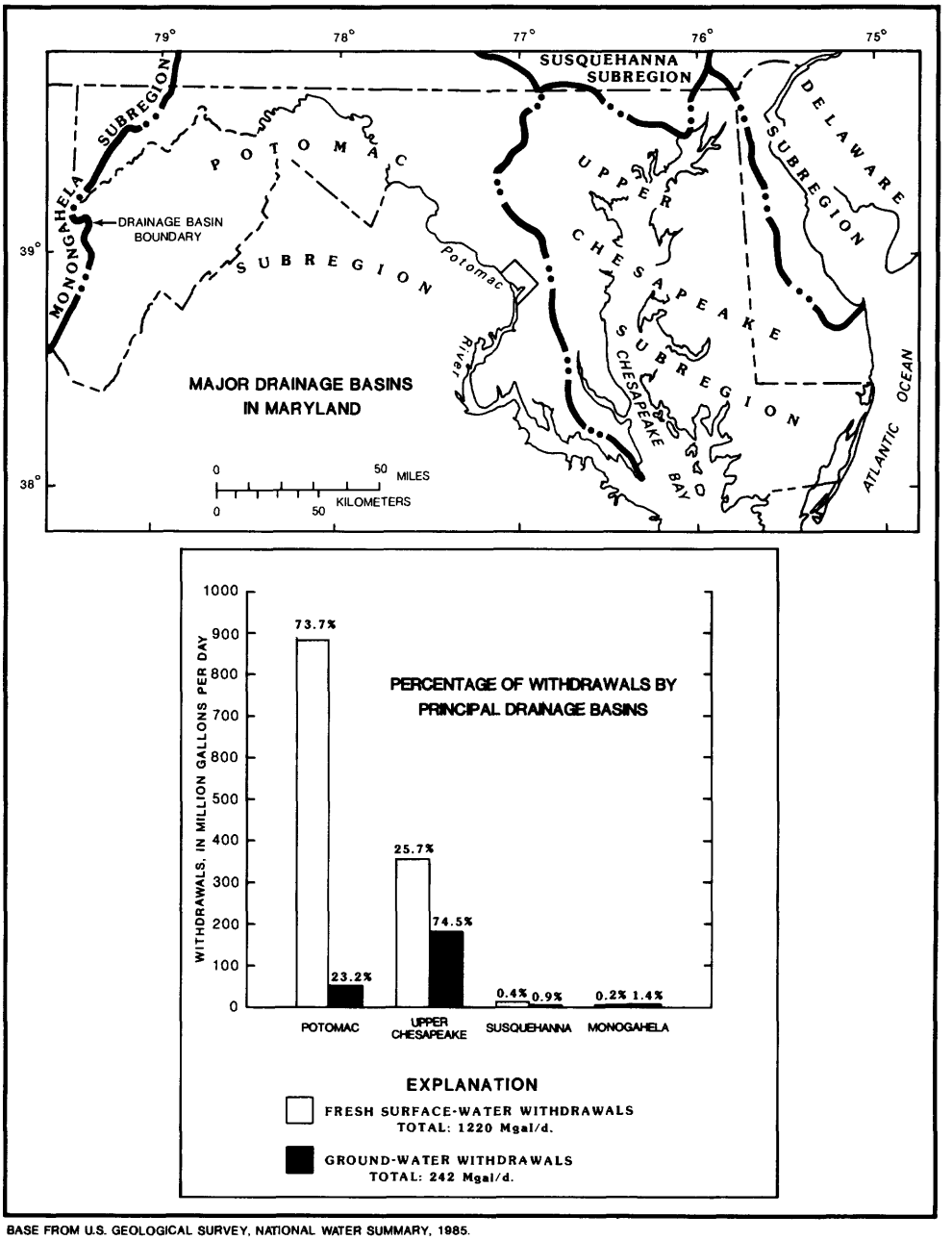


Figure 5.--Fresh surface-water and ground-water withdrawals in Maryland, by county, 1986.



BASE FROM U.S. GEOLOGICAL SURVEY, NATIONAL WATER SUMMARY, 1985.

Figure 6.--Fresh surface-water and ground-water withdrawals by principal drainage basin in Maryland, 1986.

Estimated percentages of ground-water withdrawals by aquifers for 1986 are shown in figure 7. The map in the figure shows the geographic distribution of the principal aquifers in Maryland (U.S. Geological Survey, 1985, p. 245) with a generalized hydrogeologic section (A-A') of the aquifers most utilized in the State. The Potomac Group aquifers provided the most ground water, 56 Mgal/d (about 23 percent), followed by the Columbia aquifer with 50 Mgal/d (about 21 percent). The least amount of water came from the Newark Group aquifers with about 4 Mgal/d (less than 2 percent).

Public Supply

The largest amount of water withdrawn, 801 Mgal/d (54 percent of total withdrawals; fig. 4), was by public-supply systems (municipalities, county and town systems, and private utilities). Water was delivered to a variety of users including residents (domestic use), commercial establishments, and industries (table 3). Most public suppliers in central and western Maryland rely on surface-water sources. The largest user of surface water for public supply in the State is Baltimore City. In 1986, 151 Mgal/d were withdrawn for use by the city. In addition, the city supplied about 113 Mgal/d to parts of Baltimore, Howard, Anne Arundel, and Carroll Counties. Another large user of surface water for public supply in Maryland is WSSC, which withdrew 164 Mgal/d in 1986 and delivered water to most of Montgomery and Prince Georges Counties and to part of Howard County.

The Potomac River in Maryland is used as a source of water by several public suppliers in Virginia and West Virginia, as well as by the Washington Aqueduct, which delivers water to the District of Columbia. In 1986, about 50 Mgal/d of fresh surface water was withdrawn from the river and transferred to these States for use, and nearly 212 Mgal/d was withdrawn for public-supply deliveries in the District.

Some municipalities in Maryland obtained all or part of their water supply from bordering States, including Cumberland in Allegany County, which received 8 Mgal/d of water from Pennsylvania in 1986; Brunswick in Frederick County, which received about 0.075 Mgal/d from springs located in Virginia; and Delmar in Wicomico County, which received 0.3 Mgal/d from wells located in Delaware.

Most public suppliers that rely on ground-water sources are located in the eastern and southern part of Maryland. The largest ground-water withdrawals for public-supply deliveries are in Anne Arundel County (about 30 Mgal/d in 1986). In the counties east of Chesapeake Bay, all public suppliers rely on ground water.

Domestic

Domestic water users in Maryland receive water from public-supply systems and from self-supplied sources (table 4). During 1986, total use (withdrawals and deliveries) was 482 Mgal/d, of which 418 Mgal/d was delivered by public suppliers to 80 percent of the total population. The remaining 20 percent of the population withdrew about 64 Mgal/d from privately owned wells. The amount of surface water used for domestic purposes is negligible; all self-supplied water withdrawn for domestic use was from ground-water sources.

Commercial

Commercial water users, including educational institutions and military installations, receive water from public-supply systems and from privately owned wells. Total commercial use during 1986 was 92.8 Mgal/d (table 5), of which about 66 Mgal/d (71 percent) was provided by public suppliers and about 26.6 Mgal/d (29 percent) was self-supplied.

Industrial

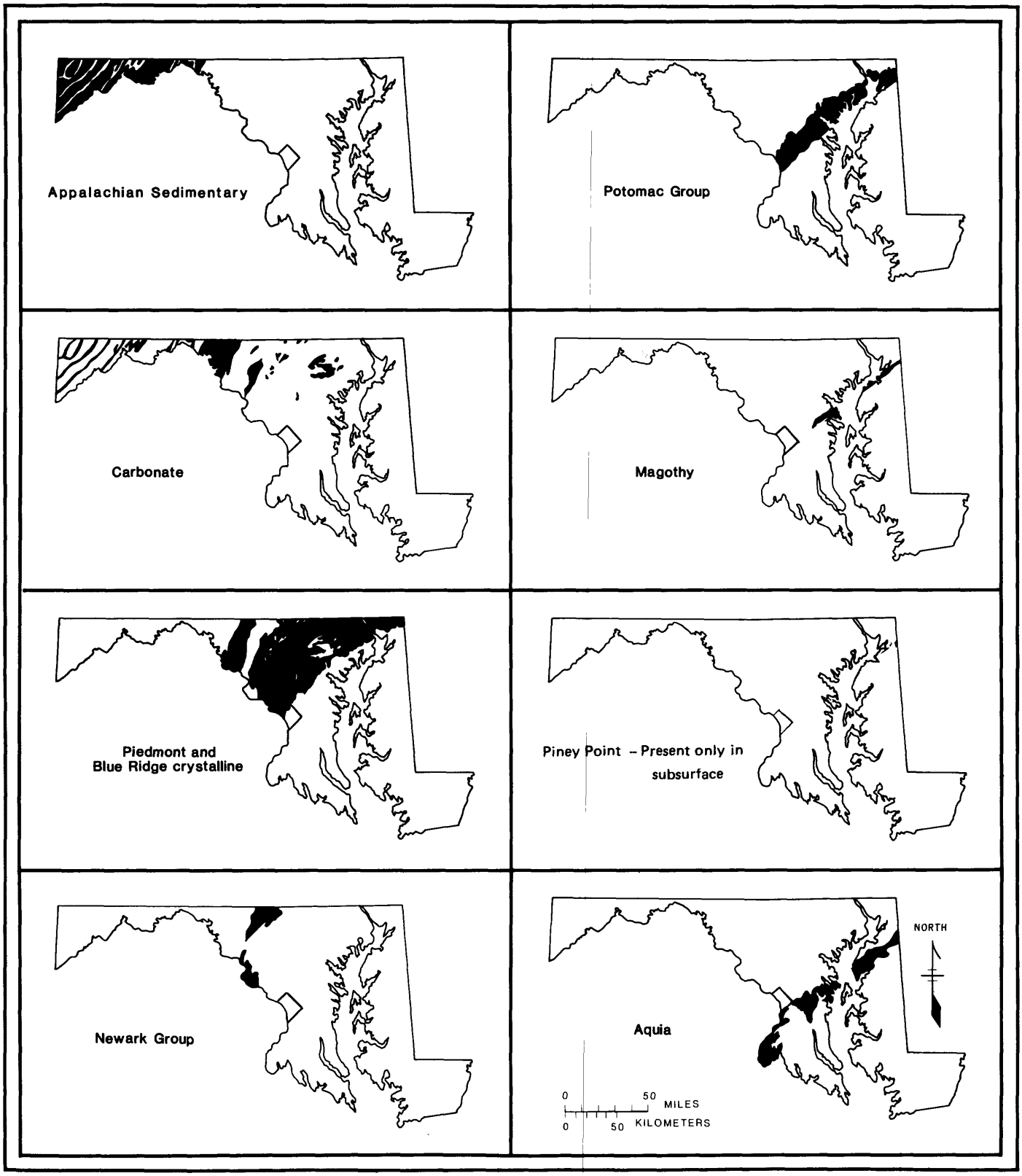
Maryland is located within a regional manufacturing belt which extends along the eastern seaboard of the United States. Both heavy and light industries are important in the State's economy. Heavy industries include steel mills, shipyards, petroleum refineries, chemical plants, and truck assembly lines. Some of the prominent light industries include food processing, printing, publishing, and clothing manufacturing. Water used by industries is both self-supplied and received from public-supply systems. Major water uses include washing and separation processes, cooling (industrial machinery and refrigeration), boiler make-up, product manufacturing, and dust control. During 1986, 142 Mgal/d of freshwater was used by industries in Maryland (table 6). Of that amount, 78.5 Mgal/d or 55 percent was self-supplied and 63.4 Mgal/d (45 percent) was provided by public suppliers. Industries also used 352 Mgal/d of brackish or saline surface water (containing more than 1,000 milligrams per liter of dissolved solids (Hem, 1970, p. 219) and about 80.7 Mgal/d of reclaimed sewage water.

Mining

Mining is a significant economic activity in Maryland. The commercially important mineral resources extracted are those used for building materials and fuels. The leading commodities are bituminous coal, stone, sand, and gravel. Water withdrawn in mining operations is primarily for dewatering and mineral washing. During 1986, 26.7 Mgal/d (26.1 Mgal/d of freshwater and about 0.6 Mgal/d of brackish or saline water) was withdrawn for mining purposes (table 7). Of that amount, 10.4 Mgal/d was from surface-water sources and 16.3 Mgal/d was from ground-water sources.

Thermoelectric Power Generation

Fourteen thermoelectric power plants operate in Maryland; 13 are fossil-fueled and 1 is nuclear powered. Freshwater use by the plants in 1986 was 393 Mgal/d, of which 391 Mgal/d was from surface water and about 2 Mgal/d from ground water (table 8). In addition, 5,890 Mgal/d of saline surface water was used by the plants. Most of the surface water (more than 95 percent) was used for cooling condensers, of which 92 percent was returned to the water source.



BASE FROM U.S. GEOLOGICAL SURVEY, NATIONAL WATER SUMMARY, 1985.

Figure 7.--Ground-water withdrawals by principal aquifers in Maryland, 1986.

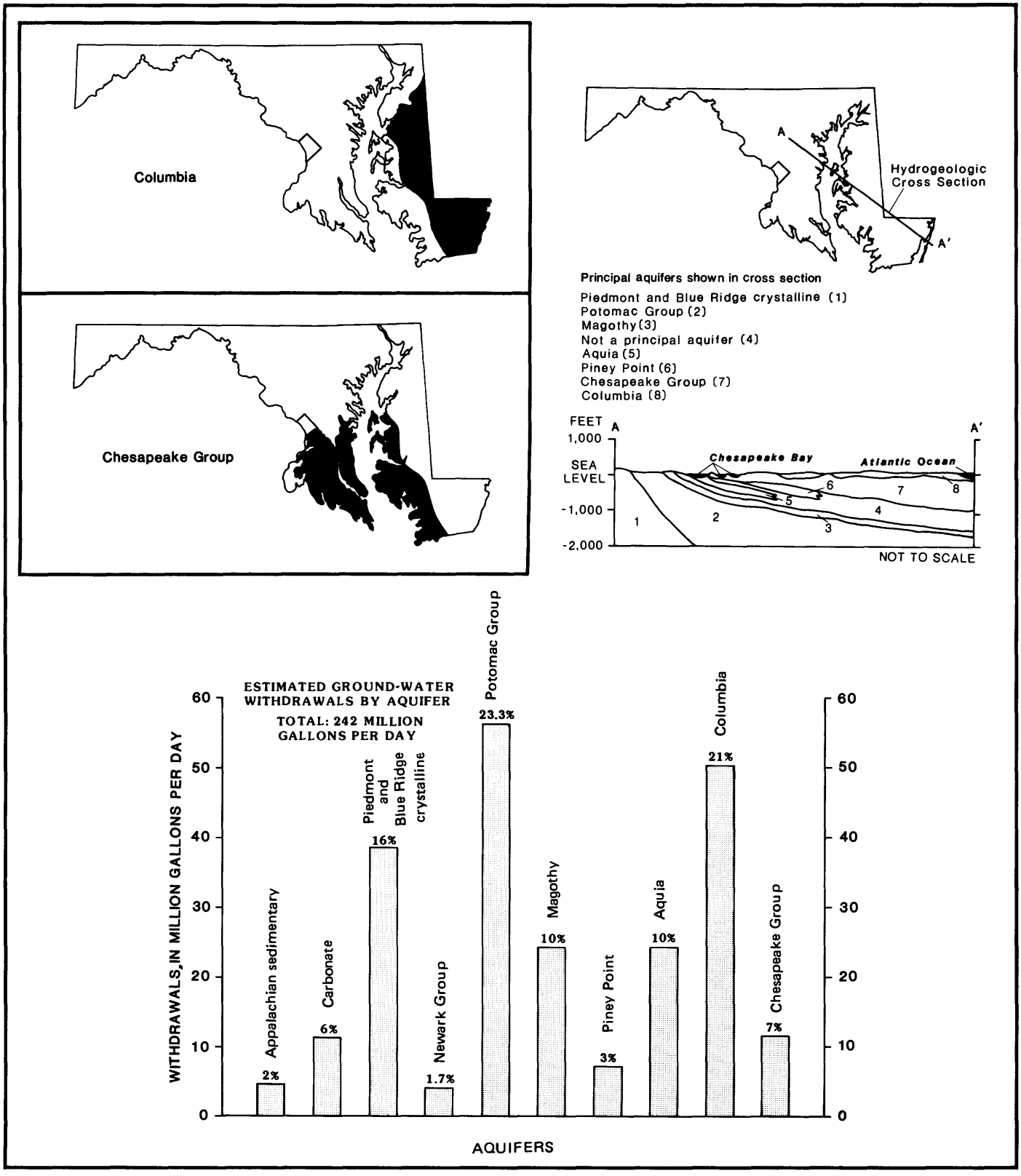


Figure 7.--Ground-water withdrawals by principal aquifers in Maryland --Continued.

Hydroelectric Power Generation

Water used for the generation of electricity by hydroelectric power plants is discussed here but the quantities of water used are not included in the freshwater totals because this use is considered "instream" water use--that is, water use takes place within the stream channel. Twelve dams are currently producing or are licensed to produce hydroelectric energy in Maryland (Weisberg and Rose, 1985, p. 1). During 1986, it was estimated that 20,400 Mgal/d of freshwater passed through these plants for the production of electricity (table 9). Although the amount of water diverted by some plants to produce electricity is enormous, the amount consumed is negligible--some water is evaporated during the generation process and from storage reservoirs.

Agricultural (nonirrigation)

During 1986, about 11.3 Mgal/d of freshwater was used for agricultural (nonirrigation) activities, mainly livestock watering, feedlots, and dairy operations; 2.96 Mgal/d was from surface-water sources and 8.3 Mgal/d from ground-water sources (table 10). The major types of livestock raised in Maryland are poultry, cattle, dairy cows, hogs, sheep, and horses. The four counties of the lower Eastern Shore account for about 34 percent of total agricultural receipts in the State, primarily because this area is one of the nation's leading producers of broiler chickens (Di Lisio, 1983, p. 80).

Irrigation

Water used for irrigating farm crops, commercial, municipal and institutional lawns and parks, golf courses, and nursery plants was estimated to be 55.7 Mgal/d in 1986 (table 11). Of this amount, 52 Mgal/d was used for irrigating farm crops including corn, soybeans, tobacco, grains, tomatoes, cantaloupes, and watermelons. A total of about 64,100 acres of cropland were irrigated in the State in 1986, of which 57,440 acres or about 90 percent were located in the eight counties east of the Chesapeake Bay. Surface water was used to irrigate 29,000 acres (24 Mgal/d) and ground water was used to irrigate 35,100 acres (32 Mgal/d). Caroline County had the largest percentage of irrigated acreage (29 percent) in the State, with about 15.3 Mgal/d withdrawn for irrigation; followed by Dorchester County with 24 percent and 12.4 Mgal/d.

Aquaculture

Aquaculture, also known as fish farming or fish culture, is the controlled production of finfish, shellfish, and aquatic plants in fresh and saline environments (Maryland Department of Agriculture, 1988). In Maryland, the aquaculture industry includes ornamental fish, oysters, soft shell crabs, crawfish, trout, and aquatic plants. During 1986, 6.88 Mgal/d of freshwater was withdrawn for aquacultural purposes in the State, of which 2.31 Mgal/d was from surface-water sources and 4.57 Mgal/d was from ground water (table 12). In addition, 4.56 Mgal/d of saline water was used.

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APPENDIX

Water-withdrawal and use data

Table 2.--Total water withdrawals (excluding hydroelectric power generation) in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Population, in thousands	Water withdrawals, in million gallons per day									
		Source									
		Surface water			Ground water			Re-claimed sewage	Total, excluding reclaimed sewage		
		Fresh	Saline	Total	Fresh	Saline	Total		Fresh	Saline	Total
Allegany	75.3	52.0	0.00	52.0	1.56	0.00	1.56	0.00	53.6	0.00	53.6
Anne Arundel	403	4.84	794	799	50.1	.00	50.1	.00	54.9	794	849
Baltimore	670	267	774	1,040	14.4	.00	14.4	80.7	281	774	1,060
Calvert	42.6	.47	3,050	3,050	4.33	.00	4.33	.00	4.8	3,050	3,060
Caroline	24.1	7.38	.00	7.38	11.3	.00	11.3	.00	18.7	.00	18.7
Carroll	110	6.47	.00	6.47	12.3	.00	12.3	.00	18.7	.00	18.7
Cecil	66.5	3.44	.00	3.44	5.60	.00	5.60	.00	9.04	.00	9.04
Charles	87.9	1.82	1,050	1,050	11.5	.00	11.5	.00	13.3	1,050	1,060
Dorchester	29.9	3.87	2.31	6.18	15.1	.00	15.1	.00	19.0	2.31	21.3
Frederick	131	12.2	.00	12.2	13.7	.00	13.7	.00	25.8	.00	25.8
Garrett	26.6	4.07	.00	4.07	4.51	.00	4.51	.00	8.58	.00	8.58
Harford	156	10.0	.00	10.0	10.2	.00	10.2	.00	20.2	.00	20.2
Howard	148	.62	.00	.62	2.62	.00	2.62	.00	3.24	.00	3.24
Kent	16.8	.34	.00	.34	4.96	.00	4.96	.00	5.30	.00	5.30
Montgomery	654	751	.00	751	5.77	.00	5.77	.00	756	.00	753
Prince Georges	682	43.4	460	503	7.15	.00	7.15	.00	50.6	460	510
Queen Annes	29.5	4.43	.00	4.43	6.90	.00	6.90	.00	11.3	.00	11.3
St Marys	66.6	1.11	1.60	2.71	7.66	.00	7.66	.00	8.7	1.60	10.3
Somerset	19.7	.28	.48	.28	3.95	.00	3.95	.00	4.23	.48	4.71
Talbot	27.3	.93	.00	.93	5.07	.00	5.07	.00	6.00	.00	6.00
Washington	114	43.8	.00	43.8	8.68	.00	8.68	.00	52.5	.00	52.5
Wicomico	68.9	1.50	.00	1.50	16.4	.00	16.4	.00	17.9	.00	17.9
Worcester	35.4	.24	.58	.82	13.5	.00	13.5	.00	13.7	.58	14.3
Baltimore City	754	.00	115	115	4.26	.00	4.26	.00	4.26	115	119
Total	4,440	1,220	6,240	7,470	242	0.00	242	80.7	1,460	6,240	7,710

Table 3.--Public-supply withdrawals and deliveries in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Population served, in thousands			Water withdrawals, in million gallons per day			Water deliveries, by type of use, in million gallons per day			Water transfer into or out (-) of county
	Source			Source						
	Surface water	Ground water	Total	Surface water	Ground water	Total	Domestic	Commercial	Industrial	Total, in million gallons per day
Allegany	53.5	8.62	62.2	0.45	0.29	0.74	6.34	1.07	2.72	9.33
Anne Arundel	32.6	249	281	2.09	30.2	32.3	27.0	5.10	3.34	3.16
Baltimore	609	1.00	610	265	.02	265	68.6	14.7	14.7	-167
Calvert	.00	8.17	8.17	.00	1.09	1.09	.98	.11	.00	.00
Caroline	.00	8.41	8.41	.00	1.26	1.26	1.13	.06	.06	.00
Carroll	20.0	20.2	40.2	2.95	1.18	4.13	4.21	1.52	.52	1.13
Cecil	16.7	10.9	27.6	1.57	1.29	2.86	2.37	.18	.31	.00
Charles	.00	37.3	37.3	.00	5.33	5.33	4.80	.53	.00	.00
Dorchester	.00	17.4	17.4	.00	3.56	3.56	1.78	.36	1.42	.00
Frederick	39.2	21.4	60.6	9.24	1.65	10.9	8.94	1.09	1.09	.23
Garrett	3.85	3.86	7.71	1.98	.61	2.59	.86	.11	.10	-1.52
Harford	25.4	62.3	87.7	4.47	3.86	8.33	7.08	.83	.42	.00
Howard	114	.00	114	.00	.00	.00	10.5	1.31	1.31	13.1
Kent	.00	7.14	7.14	.00	.89	.89	.71	.09	.09	.00
Montgomery	579	8.00	587	392	.34	392	71.5	8.52	5.11	-306
Prince Georges	621	36.2	657	39.1	2.91	42.1	69.3	8.66	8.66	44.6
Queen Annes	.00	4.43	4.43	.00	.54	.54	.43	.05	.05	.00
St Marys	.00	18.0	18.0	.00	2.46	2.46	1.97	.37	.12	.00
Somerset	.00	11.5	11.5	.00	1.44	1.44	1.15	.14	.15	.00
Talbot	.00	12.1	12.1	.00	1.89	1.89	1.51	.28	.09	.00
Washington	77.4	7.40	84.8	8.89	.72	9.61	4.25	.96	3.84	-.56
Wicomico	.00	42.5	42.5	.00	6.01	6.01	4.80	.60	.91	.30
	.00	23.8	23.8	.00	6.20	6.20	4.96	.93	.31	.00
Baltimore City	754	.00	754	.00	.00	.00	113	19.6	18.1	151
Total	2,950	619	3,560	727	74.0	801	416	66.0	63.4	

Table 4.--Domestic water withdrawals (self-supplied) and deliveries from public suppliers in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Self-supplied				Public-supplied		Total
	Population (self-supplied), in thousands	Water withdrawals, in million gallons per day			Population served, in thousands	Water deliveries, in million gallons per day	Withdrawals and deliveries, in million gallons per day
		Source		Total			
		Surface water	Ground water				
Allegany	13.1	0.00	1.05	1.05	62.2	6.34	7.82
Anne Arundel	122	.00	9.24	9.24	281	27.0	36.3
Baltimore	59.5	.00	4.90	4.90	610	68.6	73.5
Calvert	34.5	.00	2.47	2.47	8.17	.98	3.42
Caroline	15.6	.00	1.11	1.11	8.41	1.13	2.24
Carroll	69.8	.00	5.06	5.06	40.2	4.21	9.27
Cecil	38.9	.00	3.09	3.09	27.6	2.38	5.47
Charles	50.6	.00	3.54	3.54	37.3	4.80	8.34
Dorchester	12.6	.00	.96	.96	17.4	1.78	2.74
Frederick	70.2	.00	4.97	4.97	60.6	8.94	13.9
Garrett	18.9	.00	1.43	1.43	7.71	.86	2.29
Harford	68.0	.00	4.89	4.89	87.7	7.08	12.0
Howard	34.1	.00	2.02	2.02	114	10.5	12.5
Kent	9.70	.00	.72	.72	7.14	.71	1.43
Montgomery	67.0	.00	4.48	4.48	587	71.5	76.0
Prince Georges	25.3	.00	1.60	1.60	657	69.3	70.9
Queen Annes	25.0	.00	1.96	1.96	4.43	.43	2.39
St Marys	48.6	.00	3.57	3.57	18	1.97	5.54
Somerset	8.13	.00	.57	.57	11.5	1.15	1.71
Talbot	15.2	.00	1.20	1.20	12.1	1.51	2.71
Washington	29.6	.00	2.12	2.12	84.8	4.25	6.37
Wicomico	26.4	.00	2.24	2.24	42.5	4.80	7.04
Worcester	11.7	.00	.95	.95	23.8	4.96	5.91
Baltimore City	.00	.00	.00	.00	754	113	113
Total	874	0.00	64.1	64.1	3,560	418	482

Table 5.--Commercial freshwater withdrawals (self-supplied) and deliveries from public suppliers in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Self-supplied			Public-supplied	Total
	Water withdrawals, in million gallons per day				
	Source		Total	Water deliveries, in million gallons per day	Withdrawals and deliveries, in million gallons per day
	Surface water	Ground water			
Allegany	0.02	0.16	0.18	1.01	1.25
Anne Arundel	.36	7.59	7.95	5.10	13.10
Baltimore	.07	.63	.70	14.70	15.40
Calvert	.04	.40	.44	.11	.55
Caroline	.00	.24	.24	.06	.29
Carroll	.33	.45	.78	.52	1.30
Cecil	.20	.49	.69	.18	.87
Charles	.03	1.93	1.96	.53	2.49
Dorchester	.03	.29	.32	.36	.68
Frederick	.04	1.26	1.30	1.09	2.39
Garrett	.07	.37	.44	.11	.55
Harford	4.79	.61	5.40	.83	6.23
Howard	.10	.41	.51	1.31	1.82
Kent	.00	.13	.13	.09	.22
Montgomery	.00	.39	.39	8.52	8.91
Prince Georges	.00	1.11	1.11	8.66	9.77
Queen Annes	.01	.36	.37	.05	.42
St Marys	.00	1.49	1.49	.37	1.86
Somerset	.00	.11	.11	.15	.26
Talbot	.00	.30	.30	.28	.58
Washington	.03	.35	.38	.96	1.34
Wicomico	.00	.47	.47	.60	1.07
Worcester	.00	.81	.81	.93	1.74
Baltimore City	.00	.00	.00	19.6	19.6
Total	6.25	20.4	26.6	66.1	92.8

Table 6.--Industrial water withdrawals (self-supplied) and deliveries from public suppliers in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Self-supplied withdrawals, in million gallons per day								Public-supplied deliveries of freshwater, in million gallons per day	Total withdrawals and deliveries of freshwater, in million gallons per day
	Source					Total, excluding reclaimed sewage				
	Surface water		Ground water		Reclaimed sewage					
	Fresh	Saline	Fresh	Saline		Fresh	Saline	Total		
Allegany	51.1	0.00	0.02	0.00	0.00	51.2	0.00	51.2	2.72	53.9
Anne Arundel	.01	.00	2.78	.00	.00	2.79	.00	2.79	3.34	6.13
Baltimore	.23	340	4.13	.00	80.7	4.36	340	344	14.7	19.1
Calvert	.00	.00	.02	.00	.00	.02	.00	.02	.00	.02
Caroline	.00	.00	.50	.00	.00	.50	.00	.50	.06	.56
Carroll	2.44	.00	.06	.00	.00	2.50	.00	2.50	.52	3.02
Cecil	.78	.00	.04	.00	.00	.82	.00	.82	.31	1.13
Charles	.01	.00	.01	.00	.00	.02	.00	.02	.00	.02
Dorchester	.00	.88	.64	.00	.00	.64	.88	1.52	1.42	2.06
Frederick	.09	.00	.24	.00	.00	.33	.00	.33	1.09	1.42
Garrett	.33	.00	.03	.00	.00	.36	.00	.36	.10	.46
Harford	.04	.00	.12	.00	.00	.16	.00	.16	.42	.58
Howard	.29	.00	.04	.00	.00	.33	.00	.33	1.31	1.64
Kent	.00	.00	.54	.00	.00	.54	.00	.54	.09	.63
Montgomery	.02	.00	.03	.00	.00	.05	.00	.05	5.11	5.16
Prince Georges	.00	.00	.03	.00	.00	.03	.00	.03	8.66	8.69
Queen Annes	.00	.00	.28	.00	.00	.28	.00	.28	.05	.33
St Marys	.01	.00	.04	.00	.00	.05	.00	.05	.12	.17
Somerset	.00	.00	.15	.00	.00	.15	.00	.15	.14	.29
Talbot	.00	.00	.61	.00	.00	.61	.00	.61	.09	.70
Washington	2.77	.00	.02	.00	.00	2.79	.00	2.79	3.84	6.63
Wicomico	.00	.00	3.76	.00	.00	3.76	.00	3.76	.91	4.67
Worcester	.00	.00	1.95	.00	.00	1.95	.00	1.95	.31	2.26
Baltimore City	.00	11.3	4.26	.00	.00	4.26	11.3	15.5	18.1	22.4
Total	58.2	352	20.3	0.00	80.7	78.5	352	430	63.4	142

Table 7.--Mining water withdrawals in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Water withdrawals, in million gallons per day								
	Source						Total		
	Surface water			Ground water					
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Allegany	0.02	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.02
Anne Arundel	1.85	.00	1.85	.14	.00	.14	1.99	.00	1.99
Baltimore	.55	.00	.55	4.36	.00	4.36	4.91	.00	4.91
Calvert	.00	.00	.00	.00	.00	.00	.00	.00	.00
Caroline	.00	.00	.00	.00	.00	.00	.00	.00	.00
Carroll	.00	.00	.00	4.87	.00	4.87	4.87	.00	4.87
Cecil	.63	.00	.63	.37	.00	.37	1.00	.00	1.00
Charles	.94	.00	.94	.01	.00	.01	.95	.00	.95
Dorchester	.89	.00	.89	.00	.00	.00	.89	.00	.89
Frederick	.43	.00	.43	3.95	.00	3.95	4.38	.00	4.38
Garrett	.45	.00	.45	1.83	.00	1.83	2.28	.00	2.28
Harford	.04	.00	.04	.18	.00	.18	.22	.00	.22
Howard	.00	.00	.00	.00	.00	.00	.00	.00	.00
Kent	.00	.00	.00	.00	.00	.00	.00	.00	.00
Montgomery	.08	.00	.08	.16	.00	.16	.24	.00	.24
Prince Georges	3.63	.00	3.63	.06	.00	.06	3.69	.00	3.69
Queen Annes	.00	.00	.00	.00	.00	.00	.00	.00	.00
St Marys	.30	.00	.30	.02	.00	.02	.32	.00	.32
Somerset	.00	.00	.00	.00	.00	.00	.00	.00	.00
Talbot	.00	.00	.00	.00	.00	.00	.00	.00	.00
Washington	.00	.00	.00	.24	.00	.24	.24	.00	.24
Wicomico	.01	.00	.01	.05	.00	.05	.06	.00	.06
Worcester	.00	.58	.58	.01	.00	.01	.01	.58	.59
Baltimore City	.00	.01	.01	.00	.00	.00	.00	.01	.01
Total	9.82	0.59	10.4	16.3	0.00	16.3	26.1	0.59	26.7

Table 8.--Thermoelectric power generation water withdrawals in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Water withdrawals, in million gallons per day				
	Source				
	Surface Water			Fresh ground water	Total freshwater withdrawals
	Fresh	Saline	Total		
Allegany	0.00	0.00	0.00	0.00	0.00
Anne Arundel	.00	794	794	.00	.00
Baltimore	.00	433	433	.00	.00
Calvert	.00	3,050	3,050	.26	.26
Caroline	.00	.00	.00	.00	.00
Carroll	.00	.00	.00	.00	.00
Cecil	.00	.00	.00	.00	.00
Charles	.00	1,050	1,050	.62	.62
Dorchester	.00	1.43	1.43	.03	.03
Frederick	.00	.00	.00	.00	.00
Garrett	.00	.00	.00	.00	.00
Harford	.00	.00	.00	.00	.00
Howard	.00	.00	.00	.00	.00
Kent	.00	.00	.00	.00	.00
Montgomery	359	.00	359	.00	359
Prince Georges	.00	460	460	1.25	1.25
Queen Annes	.00	.00	.00	.00	.00
St Marys	.00	.00	.00	.00	.00
Somerset	.00	.00	.00	.00	.00
Talbot	.00	.00	.00	.00	.00
Washington	31.7	.00	31.7	.00	31.7
Wicomico	.00	.00	.00	.00	.00
Worcester	.00	.00	.00	.00	.00
Baltimore City	.00	103	103	.00	.00
Total	391	5,890	6,280	2.16	393

Table 9.--Hydroelectric power generation water use in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Water use	
	Million gallons per day	Thousand acre-feet per year
Allegany	0.00	0.00
Anne Arundel	.00	.00
Baltimore	.00	.00
Calvert	.00	.00
Caroline	.00	.00
Carroll	.00	.00
Cecil	6.30	7.06
Charles	.00	.00
Dorchester	.00	.00
Frederick	.00	.00
Garrett	78.73	78.73
Harford	19,100	21,400
Howard	.00	.00
Kent	.00	.00
Montgomery	.00	.00
Prince Georges	.00	.00
Queen Annes	.00	.00
St Marys	.00	.00
Somerset	.00	.00
Talbot	.00	.00
Washington	1,230	1,380
Wicomico	.00	.00
Worcester	.00	.00
Baltimore City	.00	.00
Total	20,400	22,900

Table 10.--Agricultural (nonirrigation) water withdrawals in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Water withdrawals, in million gallons per day		
	Source		Total
	Surface water	Ground water	
Allegany	0.07	0.03	0.10
Anne Arundel	.06	.02	.08
Baltimore	.19	.18	.37
Calvert	.02	.01	.03
Caroline	.04	.28	.32
Carroll	.38	.58	.96
Cecil	.04	.24	.28
Charles	.06	.02	.08
Dorchester	.01	.20	.21
Frederick	.55	1.57	2.12
Garrett	.23	.24	.47
Harford	.24	.32	.56
Howard	.13	.12	.25
Kent	.09	.23	.32
Montgomery	.18	.20	.38
Prince Georges	.05	.03	.08
Queen Annes	.07	.24	.31
St Marys	.06	.06	.12
Somerset	.03	.69	.72
Talbot	.05	.20	.25
Washington	.34	.64	.98
Wicomico	.00	1.12	1.12
Worcester	.07	1.08	1.15
Baltimore City	.00	.00	.00
Total	2.96	8.3	11.3

Table 11.--Irrigation water withdrawals in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Irrigated land by type, in thousand acres		Water withdrawals					
			Thousand acre-feet per year			Million gallons per day		
			Source		Total	Source		Total
	Spray	Flood	Surface	Ground		Surface	Ground	
Allegany	0.12	0.00	0.40	0.00	0.40	0.36	0.00	0.36
Anne Arundel	.15	.00	.53	.10	.63	.47	.09	.56
Baltimore	.93	.00	.93	.20	1.13	.83	.18	1.01
Calvert	.56	.00	.46	.09	.55	.41	.08	.49
Caroline	18.6	.00	8.23	8.87	17.1	7.34	7.91	15.3
Carroll	.51	.00	.41	.07	.48	.37	.06	.43
Cecil	.32	.00	.25	.09	.34	.22	.08	.30
Charles	.98	.00	.87	.07	.94	.78	.06	.84
Dorchester	15.6	.00	3.28	1.6	13.9	2.93	9.44	12.4
Frederick	.28	.00	.31	.02	.34	.28	.02	.30
Garrett	.27	.00	.28	.00	.28	.25	.00	.25
Harford	.75	.00	.49	.20	.70	.44	.18	.62
Howard	.16	.00	.11	.03	.15	.10	.03	.13
Kent	2.50	.00	.28	2.75	3.03	.25	2.45	2.70
Montgomery	.39	.00	.76	.19	.95	.68	.17	.85
Prince Georges	.32	.00	.55	.18	.73	.49	.16	.65
Queen Annes	9.62	.00	4.88	3.95	8.82	4.35	3.52	7.87
St Marys	.84	.00	.77	.02	.80	.69	.02	.71
Somerset	1.58	.00	.28	1.12	1.40	.25	1.00	1.25
Talbot	1.86	.00	.99	.98	1.96	.88	.87	1.75
Washington	.07	.00	.07	.02	.09	.06	.02	.08
Wicomico	5.21	.00	1.67	3.11	4.78	1.49	2.77	4.26
Worcester	2.47	.00	.19	2.77	2.96	.17	2.47	2.64
Baltimore City	.00	.00	.00	.00	.00	.00	.00	.00
Total	64.1	0.00	27.0	35.4	62.4	24.1	31.6	55.7

Table 12.--Aquaculture water withdrawals in Maryland, by county, 1986

[Amounts rounded to three significant figures and may not add to totals because of independent rounding]

County or City	Water withdrawals, in million gallons per day				
	Source				
	Surface water			Fresh ground water	Total freshwater withdrawals
	Fresh	Saline	Total		
Allegany	0.01	0.00	0.01	0.00	0.01
Anne Arundel	.00	.00	.00	.01	.01
Baltimore	.00	2.48	2.48	.00	.00
Calvert	.00	.002	.002	.00	.00
Caroline	.00	.00	.00	.00	.00
Carroll	.00	.00	.00	.00	.00
Cecil	.00	.00	.00	.00	.00
Charles	.00	.00	.00	.00	.00
Dorchester	.01	.00	.01	.00	.01
Frederick	1.53	.00	1.53	.00	1.53
Garrett	.76	.00	.76	.00	.76
Harford	.00	.00	.00	.00	.00
Howard	.00	.00	.00	.00	.00
Kent	.00	.00	.00	.00	.00
Montgomery	.00	.00	.00	.00	.00
Prince Georges	.00	.00	.00	.00	.00
Queen Annes	.00	.00	.00	.00	.00
St Marys	.00	1.60	1.60	.00	.00
Somerset	.00	.48	.48	.00	.00
Talbot	.00	.00	.00	.00	.00
Washington	.00	.00	.00	4.56	4.56
Wicomico	.00	.00	.00	.00	.00
Worcester	.00	.00	.00	.00	.00
Baltimore City	.00	.00	.00	.00	.00
Total	2.31	4.56	6.87	4.57	6.88

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