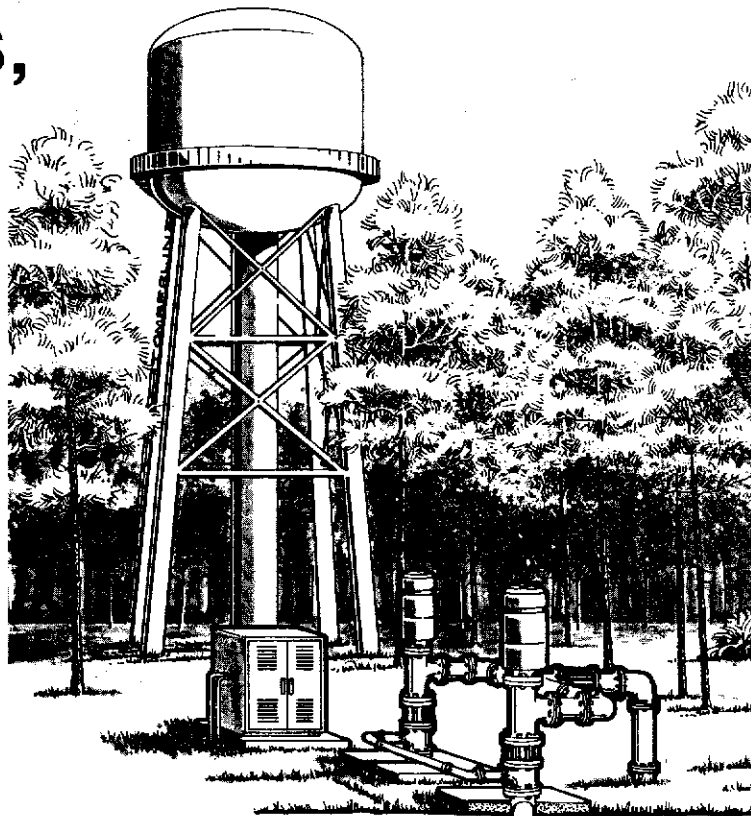


WATER WITHDRAWALS, USE, AND TRENDS IN FLORIDA, 1985

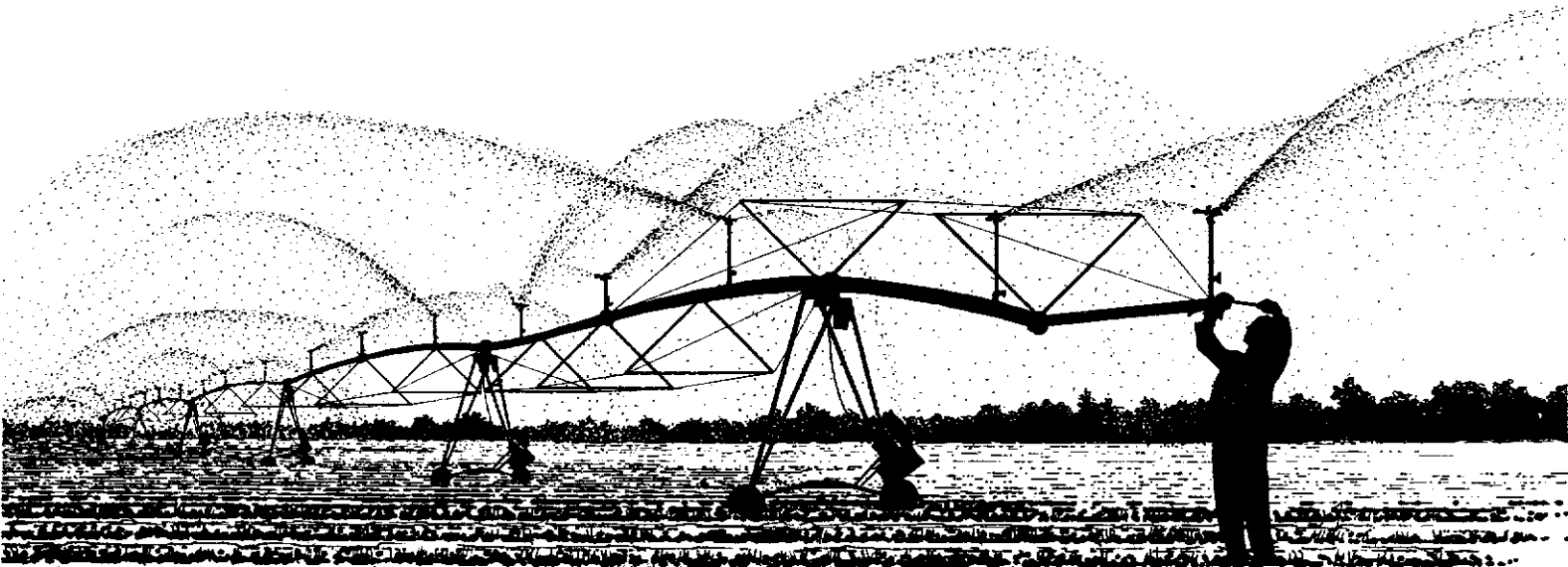
U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 88-4103



Prepared in cooperation with

FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
SOUTH FLORIDA WATER MANAGEMENT DISTRICT
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
SUWANNEE RIVER WATER MANAGEMENT DISTRICT



ABBREVIATIONS AND CONVERSION FACTORS

The inch-pound units used in this report may be converted to metric (International System) units by the following factors:

<u>Multiply inch-pound unit</u>	<u>By</u>	<u>To obtain metric unit</u>
gallons per day (gal/d)	0.003785	cubic meter per day (m^3/d)
million gallons per day (Mgal/d)	0.003785	cubic meters per second (m^3/s)
billion gallons per day (bgd)	3.785	cubic meters per second (m^3/s)

Additional Abbreviation

mg/L = milligrams per liter

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By Richard L. Marella

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Tallahassee, Florida

1988

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WATER WITHDRAWALS, USE, AND TRENDS IN FLORIDA, 1985

By Richard L. Marella

ABSTRACT

Total water withdrawn for use in Florida for 1985 was 17,057 million gallons per day of which 6,259 million gallons per day, or nearly 37 percent, was freshwater and 10,798 million gallons per day was saline. The majority of freshwater withdrawn was ground water (64 percent) and the majority of saline water withdrawn was surface water (99 percent). Thermo-electric power generation accounted for more than 99 percent of saline-water withdrawals. Agricultural irrigation accounted for the majority of freshwater withdrawals for both ground water (41 percent) and surface water (60 percent) in 1985.

Florida's population increased by nearly 3 million people between 1975-85, tourism increased by nearly 13 million visitors, and irrigated agricultural acreage increased by 70,000 during the same time. The use of freshwater to support those activities also has increased, by almost 388 million gallons per day (excluding freshwater withdrawals for thermoelectric power generation) between 1975-85. Additionally, fresh ground-water withdrawals increased 718 million gallons per day between 1975-85. Ground water accounted for 64 percent of Florida's total freshwater use, up from 51 percent in 1980 and 48 percent in 1975.

Florida ranked sixth in the Nation in ground-water withdrawals for 1985 with more than 4,000 million gallons per day withdrawn. Ground water is the primary source of freshwater in Florida because it is readily available and generally is suitable for most uses. The Floridan aquifer system, which underlies the entire State, supplied the majority (62 percent) of ground water in Florida for 1985. In contrast to ground water, withdrawals of surface water declined more than 1,373 million gallons per day between 1975-85. The majority of this decrease (1,002 million gallons per day) reflects less water withdrawn for thermoelectric power generation because of more efficient use of cooling water.

The largest amount of freshwater was withdrawn from Palm Beach County and the largest amount of saline water was withdrawn from Hillsborough County in 1985. The following counties withdrew the largest amount of freshwater for each category: Palm Beach (agricultural irrigation), Dade (public supply), Polk (domestic self supplied and commercial-industrial self supplied) and Escambia (thermoelectric power generation).

INTRODUCTION

Florida's population has recently become the fastest growing in the Nation and has nearly doubled between 1965 and 1985. Substantial increases also have occurred in tourism and agricultural production during this same time. All of these increases result in additional demands for water. However, Florida's water resources are finite and, consequently, it is vital that the quantity of water needed to support these increases be determined.

Purpose and Scope

The purpose of this report is to provide an assessment of water withdrawals and use for 1985. This assessment will not only show changes in quantities of water withdrawn but will also indicate trends in use and will provide the data required for establishing water budgets and projections.

This report presents withdrawal data in Florida for each of the following categories: public supply, domestic self supplied, commercial-industrial self supplied, agricultural irrigation and nonirrigation, self-supplied thermoelectric power generation, and miscellaneous water withdrawals and uses for Florida in 1985. Information concerning nonwithdrawal uses, which includes hydroelectric power generation, navigation, water-based recreation, propagation of fish and wildlife, and dilution and conveyance of liquid or solid wastes, was not collected.

Within each category, withdrawal data are presented by source (including aquifers), seasonality, uses and historical values, and by counties. Locations of counties and selected cities in Florida are shown in figure 1. Each use category is described in a separate section. The description includes information on how the data were collected and derived for each category.

Previous Investigations

This study is the sixth assessment of water-use data conducted for the State of Florida. Previous studies were done for 1965 and 1970 by Pride (1970, 1973); and for 1975, 1977, and 1980 by Leach (1978, 1980, 1983).

Terminology

The term "withdrawal" in this report means the amount of water withdrawn from a source (ground or surface, fresh or saline). This is equivalent to "intake," "water diversion," or "pumpage," terms commonly used by industry, and for irrigation, and public supply, respectively.

The term "water use" in this report describes how and where the water was used and in what amounts. This definition differs slightly from the one used in past years when water use described both withdrawal quantities and use.

The terms "water consumed" or "consumptive use," as used in this report, refer to that part of the water withdrawn that is no longer available because it has evaporated, been incorporated into products and crops, consumed by man or livestock, or otherwise removed from the water environment.

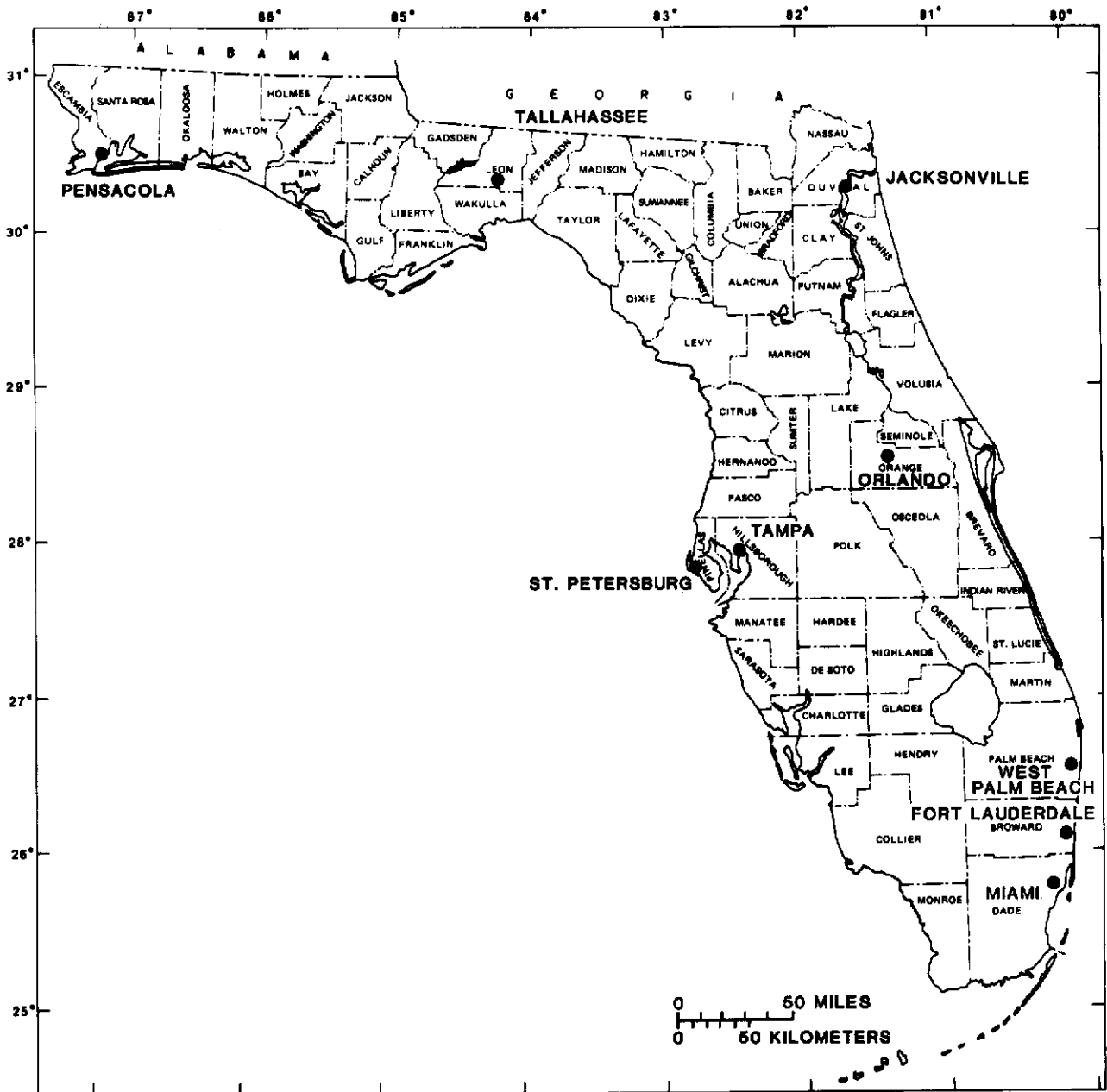


Figure 1.—Counties and selected cities in Florida.

The term "saline water" refers to water containing more than 1,000 mg/L (milligrams per liter) of dissolved solids; anything less is considered "freshwater."

The term "reverse osmosis" refers to a process of desalination of saline water which removes chlorides or other dissolved solids from saline water to make it potable. Potable water, according to the Florida Department of Environmental Regulation (Florida Department of State, 1982), must have less than 250 mg/L of chlorides and 500 mg/L of dissolved solids.

The term "irrigation" refers to the process of supplementing rainfall with water that is needed to produce a crop. This supplemental irrigation value (calculated in inches) includes water required to compensate for irrigation system inefficiencies.

The term "aquifer" is defined as a formation, group of formations, or a part of a formation that contains sufficient saturated, permeable material to yield significant quantities of water to wells and springs. The five major aquifers referred to in this report are shown in figure 2.

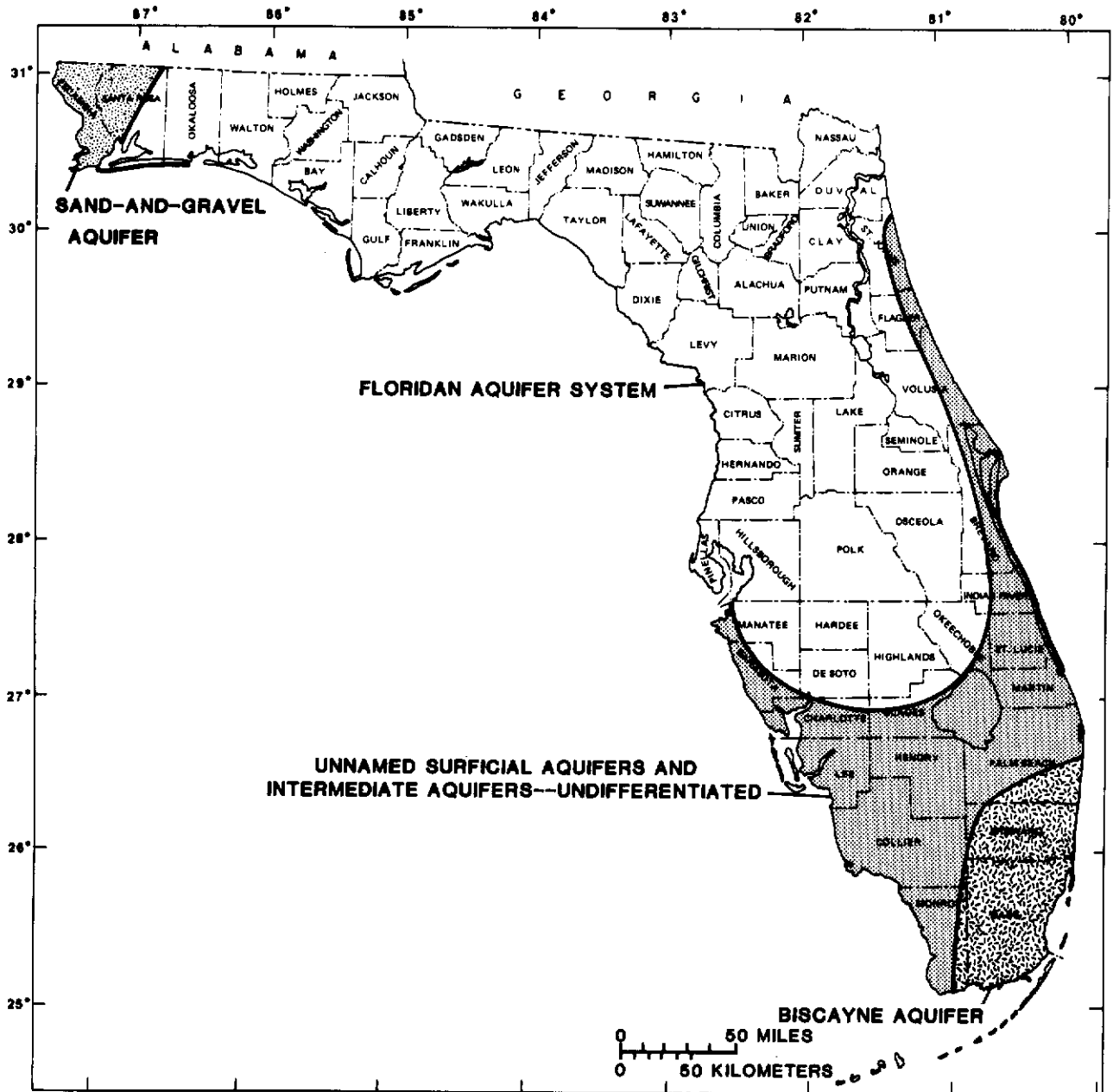


Figure 2.—Principal aquifers in Florida.
(Modified from Franks, 1982.)

Water withdrawals and water-use data are expressed in million gallons per day. Withdrawal and use values are the average daily quantities used, as derived from annual-use data, and are rounded to whole numbers in the text. The tables in this report show values in million gallons per day and are reported to two places to the right of the decimal or to 10,000 gal/d (gallons per day). The reader is cautioned that the accuracy of these values vary from category to category; public-supply values are more accurate than agricultural irrigation or domestic self supplied.

Acknowledgments

Grateful acknowledgments are extended to utility operators, the managers of industrial and thermoelectric powerplants and to other county, State, and Federal agencies who furnished data pertinent to this report. Thanks also are extended to county agricultural agents for supplying records on types of crops, acreage, and irrigation methods, and to the Florida Department of Environmental Regulation for supplying records of pumpage for utilities and discharge records for wastewater plants.

Special thanks are extended to the Executive Directors of the five water management districts for their district's participation and staff cooperation in providing valuable data for Florida. The participation of the following individuals at the water management districts is acknowledged for their data collection and tabulation efforts: Chris Howell and Camille Bielby at the Northwest Florida Water Management District; John Dennard and Vincent Singleton at the St. Johns River Water Management District; Carl Woehlcke, Steve Opalot, Anita Carey, and Raymond Burgess at the South Florida Water Management District; Elizabeth Stieglitz and Richard Owen at the Southwest Florida Water Management District; and Donald Monroe and David Fiske at Suwannee River Water Management District. In addition, appreciation is expressed to the St. Johns River Water Management District for making the author, while an employee of the Management District, available to the U.S. Geological Survey under grant No. 14-08-001-A0467.

TOTAL WATER WITHDRAWALS, USE, AND TRENDS IN FLORIDA

Florida's population in 1985 was 11.3 million and is projected to surpass 15 million people (fig. 3) by the year 2000 (Smith and Sincich, 1987). In addition to population, an estimated 30 million visitors came to Florida in 1985, an increase of nearly 13 million since 1975 (Florida Division of Tourism, 1987). Many studies have been conducted to determine what effect this growth will have on Florida resources. The State is underlain virtually everywhere by aquifers capable of yielding significant quantities of freshwater to wells. Surface-water resources also are ample and include 1,700 streams or rivers and 7,800 freshwater lakes (Bridges and Foose, 1986). Increases in population, tourism, and agricultural acreage have increased withdrawals of both ground water and surface water.

In 1985, the total amount of water withdrawn in Florida was 17,057 Mgal/d (million gallons per day), of which 6,259 Mgal/d, or nearly 37 percent, was freshwater (fig. 4) and 10,798 Mgal/d was saline. Ground water accounted for more than 64 percent of freshwater withdrawals and surface water accounted for more than 99 percent of saline withdrawals.

Agricultural irrigation accounted for the majority of fresh ground-water and fresh surface-water withdrawals (fig. 5) for 1985. Thermoelectric power generation accounted for more than 99 percent of saline-water withdrawals.

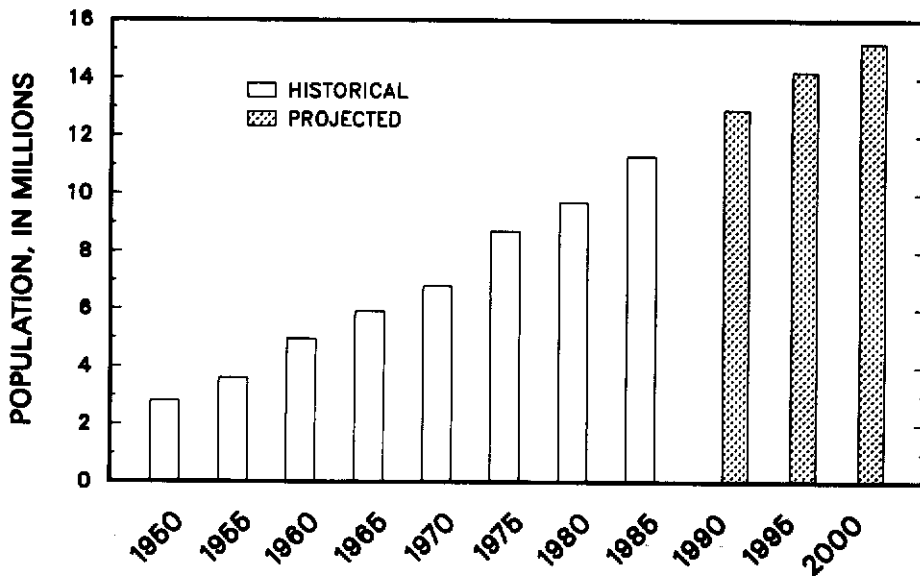
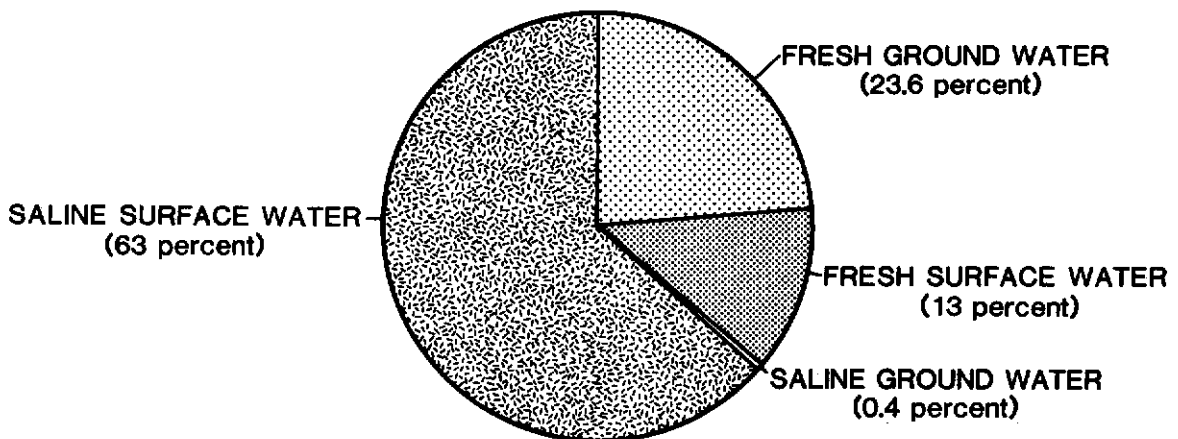
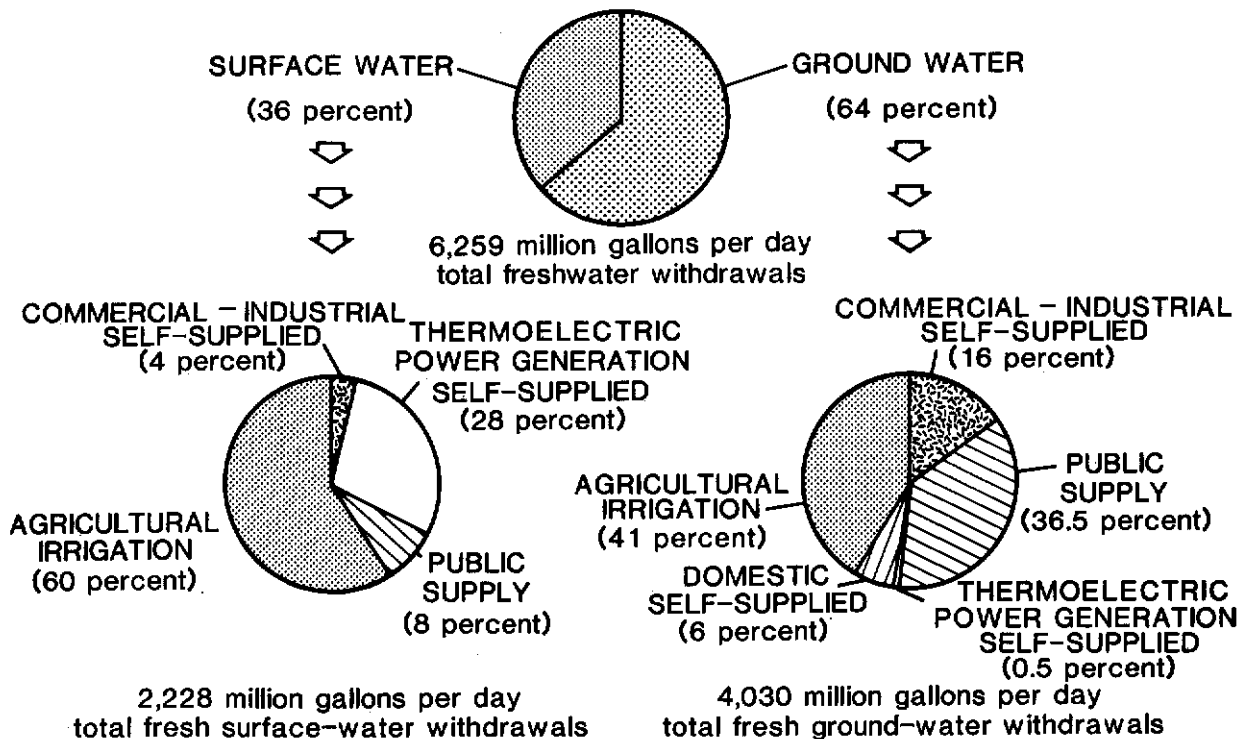


Figure 3.—Historical and projected population in Florida, in 5-year intervals, 1950-2000. (From Smith and Sincich, 1987.)



17,057 million gallons per day total withdrawals

Figure 4.—Total water withdrawals in Florida by source, 1985.



Figures may not add to totals because of independent rounding

Figure 5.—Freshwater withdrawals in Florida by category, 1985.

The largest amount of freshwater was withdrawn in Palm Beach County, and the largest amount of saline water was withdrawn in Hillsborough County in 1985 (table 1). Four counties withdrew more than 200 Mgal/d of fresh ground water with Dade County withdrawing the largest amount, followed by Polk, Hillsborough, and Broward Counties. Two counties withdrew more than 200 Mgal/d of fresh surface water with Palm Beach County accounting for the largest withdrawal, followed by Escambia County.

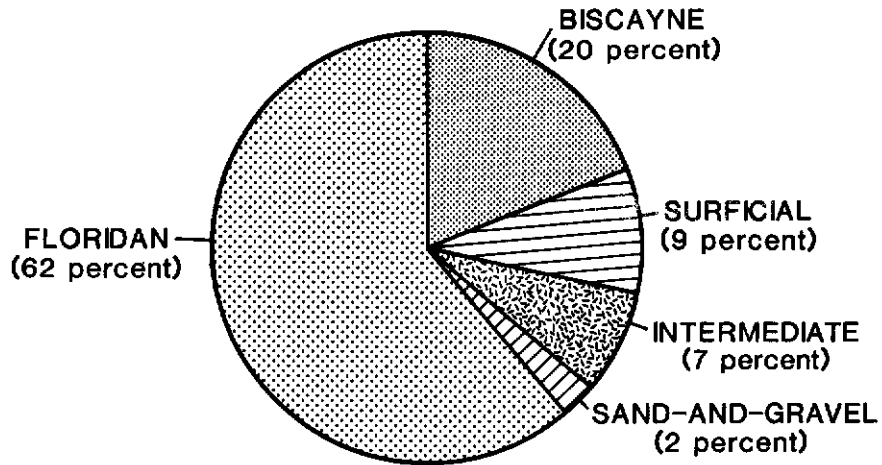
With more than 4,000 Mgal/d of ground water withdrawn (table 1), Florida ranked sixth in the Nation in ground-water withdrawals for 1985, and the largest user of ground water east of the Mississippi River (Solley and others, 1988). The Floridan aquifer system supplied 62 percent of the total ground water withdrawn in 1985 (fig. 6). Agricultural irrigation accounted for the largest withdrawal of water from the Floridan aquifer system followed by public supply. These two categories accounted for 73 percent of withdrawals from the Floridan aquifer system. Polk, Hillsborough, Orange, and Duval Counties were the largest users of water from the Floridan aquifer system in 1985. The Biscayne aquifer, which underlies southeast Florida (fig. 2), accounted for 20 percent of Florida's ground-water withdrawals. Dade and Broward Counties withdrew all of their ground water from the Biscayne aquifer.

Seasonal fluctuations of water withdrawals for each category vary dramatically. The seasonal fluctuation of total freshwater withdrawals for 1985 is shown in figure 7. More than 40 percent of the year's freshwater withdrawals occurred from March through June.

Table 1.—Total water withdrawals in Florida by county, 1985

[In million gallons per day]

County	Ground water			Surface water			Totals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	51.42	0.00	51.42	0.04	0.00	0.04	51.46	0.00	51.46
Baker	6.07	.00	6.07	2.19	.00	2.19	8.26	.00	8.26
Bay	12.04	.00	12.04	29.88	264.60	294.48	41.92	264.60	306.52
Bradford	9.25	.00	9.25	.00	.00	.00	9.25	.00	9.25
Brevard	115.68	.02	115.70	39.79	1,157.88	1,197.67	155.47	1,157.90	1,313.37
Broward	230.18	.00	230.18	5.10	694.14	699.24	235.28	694.14	929.42
Calhoun	1.65	.00	1.65	.03	.00	.03	1.68	.00	1.68
Charlotte	46.69	.98	47.67	6.49	.00	6.49	53.18	.98	54.16
Citrus	25.20	.00	25.20	.70	2,277.00	2,277.70	25.90	2,277.00	2,302.90
Clay	21.26	.00	21.26	5.31	.00	5.31	26.57	.00	26.57
Collier	118.22	.00	118.22	5.47	.00	5.47	123.69	.00	123.69
Columbia	9.81	.00	9.81	.05	.00	.05	9.86	.00	9.86
Dade	486.05	.00	486.05	4.50	.99	5.49	490.55	.99	491.54
De Soto	74.93	.00	74.93	8.85	.00	8.85	83.78	.00	83.78
Dixie	4.06	.00	4.06	.15	.00	.15	4.21	.00	4.21
Duval	159.30	.00	159.30	1.37	479.42	480.79	160.67	479.42	640.09
Escambia	84.29	.00	84.29	258.77	.00	258.77	343.06	.00	343.06
Flagler	8.94	.00	8.94	.93	.00	.93	9.87	.00	9.87
Franklin	2.98	.00	2.98	.00	.00	.00	2.98	.00	2.98
Gadsden	8.45	.00	8.45	7.67	.00	7.67	16.12	.00	16.12
Gilchrist	5.41	.00	5.41	.00	.00	.00	5.41	.00	5.41
Glades	15.96	.00	15.96	66.12	.00	66.12	82.08	.00	82.08
Gulf	4.03	.00	4.03	33.85	.00	33.85	37.88	.00	37.88
Hamilton	43.38	.00	43.38	.00	.00	.00	43.38	.00	43.38
Hardee	94.18	.00	94.18	.00	.00	.00	94.18	.00	94.18
Hendry	33.94	.00	33.94	158.06	.00	158.06	192.00	.00	192.00
Hernando	40.86	.00	40.86	.00	.00	.00	40.86	.00	40.86
Highlands	100.40	.00	100.40	23.27	.00	23.27	123.67	.00	123.67
Hillsborough	249.30	.00	249.30	67.91	2,327.86	2,395.77	317.21	2,327.86	2,645.07
Holmes	5.04	.00	5.04	.43	.00	.43	5.47	.00	5.47
Indian River	44.02	.97	44.99	107.18	18.44	125.62	151.20	19.41	170.61
Jackson	18.44	.00	18.44	110.89	.00	110.89	129.33	.00	129.33
Jefferson	8.20	.00	8.20	1.36	.00	1.36	9.56	.00	9.56
Lafayette	7.31	.00	7.31	.26	.00	.26	7.57	.00	7.57
Lake	64.88	.00	64.88	8.30	.00	8.30	73.18	.00	73.18
Lee	60.17	8.12	68.29	11.35	248.92	260.27	71.52	257.04	328.56
Leon	34.44	.00	34.44	2.17	.00	2.17	36.61	.00	36.61
Levy	14.14	.00	14.14	4.45	.00	4.45	18.59	.00	18.59
Liberty	1.09	.00	1.09	.00	.00	.00	1.09	.00	1.09
Madison	6.00	.00	6.00	.00	.00	.00	6.00	.00	6.00
Manatee	93.18	.00	93.18	34.31	.00	34.31	127.49	.00	127.49
Marion	49.14	.00	49.14	3.89	.00	3.89	53.03	.00	53.03
Martin	45.99	.30	46.29	142.93	.00	142.93	188.92	.30	189.22
Monroe	1.60	59.11	60.71	.00	.00	.00	1.60	59.11	60.71
Nassau	46.14	.00	46.14	.93	1.58	2.51	47.07	1.58	48.65
Okaloosa	27.67	.00	27.67	.00	.00	.00	27.67	.00	27.67
Okeechobee	24.44	.00	24.44	5.27	.00	5.27	29.71	.00	29.71
Orange	191.82	.00	191.82	53.92	.00	53.92	245.74	.00	245.74
Osceola	53.69	.00	53.69	5.58	.00	5.58	59.27	.00	59.27
Palm Beach	153.93	.00	153.93	554.28	325.25	879.53	708.21	325.25	1,033.46
Pasco	126.02	.00	126.02	.87	1,131.40	1,132.27	126.89	1,131.40	1,258.29
Pinellas	23.47	.00	23.47	.55	495.80	496.35	24.02	495.80	519.82
Polk	320.36	.00	320.36	78.44	.00	78.44	398.80	.00	398.80
Putnam	70.27	.00	70.27	20.07	.00	20.07	90.34	.00	90.34
St. Johns	50.22	.00	50.22	1.07	.00	1.07	51.29	.00	51.29
St. Lucie	68.28	.00	68.28	163.62	1,254.28	1,417.90	231.90	1,254.28	1,486.18
Santa Rosa	16.68	.00	16.68	.15	.00	.15	18.83	.00	18.83
Sarasota	33.48	6.88	40.36	.47	.00	.47	33.95	6.88	40.83
Seminole	66.66	.00	66.66	2.06	.00	2.06	68.72	.00	68.72
Sumter	78.27	.00	78.27	.35	.00	.35	78.62	.00	78.62
Suwannee	21.30	.00	21.30	66.60	.00	66.60	87.90	.00	87.90
Taylor	48.53	.00	48.53	1.63	.00	1.63	50.16	.00	50.16
Union	2.11	.00	2.11	.00	.00	.00	2.11	.00	2.11
Volusia	79.07	.01	79.08	117.73	15.25	133.00	196.82	15.26	212.08
Wakulla	1.29	.00	1.29	.00	28.05	28.05	1.29	28.05	30.34
Walton	6.05	.00	6.05	.52	.00	.52	6.57	.00	6.57
Washington	3.07	.00	3.07	.14	.00	.14	3.21	.00	3.21
Totals:	4,030.39	76.39	4,106.78	2,228.29	10,721.86	12,950.15	6,258.68	10,798.25	17,056.93



4,107 million gallons per day total ground water withdrawals includes 76 million gallons per day of saline ground water

Figure 6.—Ground-water withdrawals in Florida by aquifer, 1985.

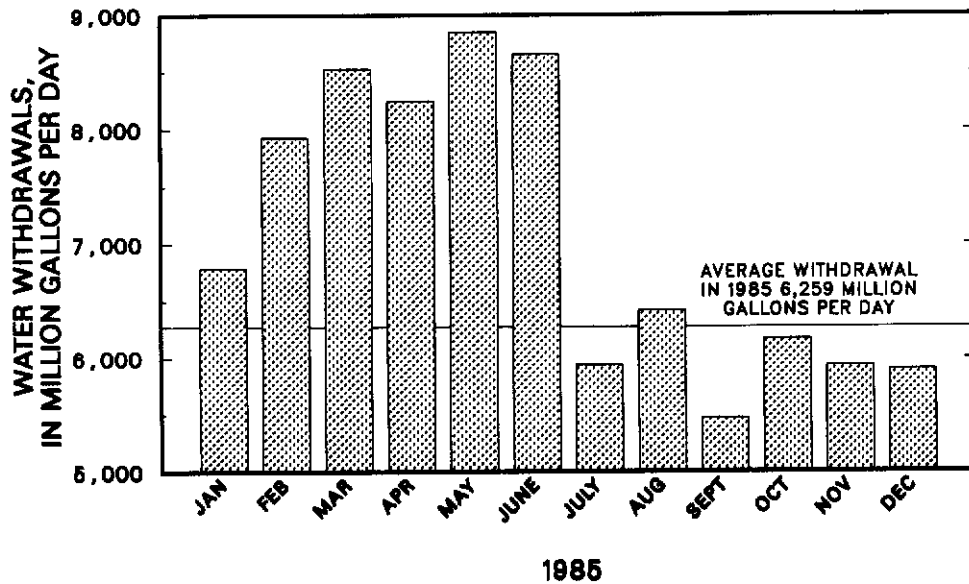


Figure 7.—Monthly freshwater withdrawals in Florida, 1985.

The source, use, and disposition of freshwater for 1985 are shown in figure 8. This figure portrays withdrawals, use, and consumptive use of freshwater for 1985. An estimated 43 percent or 2,730 Mgal/d of freshwater withdrawals was consumptive use in 1985.

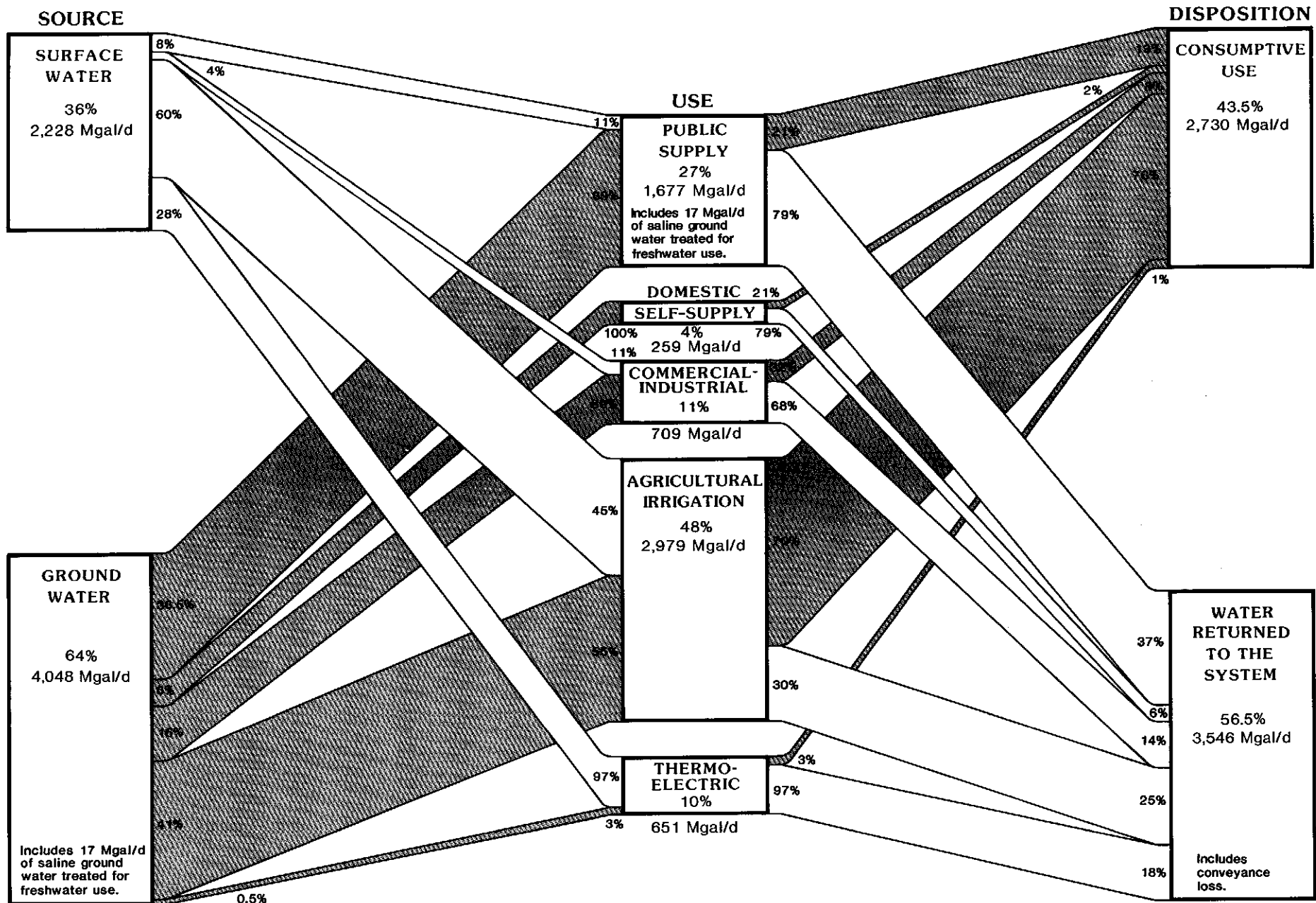
Wastewater discharge from public-supply and commercial-industrial self-supplied systems were tabulated for 1985. Wastewater discharge data were collected by the Florida Department of Environmental Regulation (FDER) for 774 public or private wastewater-treatment facilities and 125 commercial-industrial facilities. Total wastewater discharge in 1985 equaled 1,392 Mgal/d of which 1,122 Mgal/d was from public and private wastewater facilities. Dade, Broward, Palm Beach, and Pinellas Counties treated and discharged more than 100 Mgal/d of total wastewater in 1985 (table 2).

Variations in historical water use are difficult to assess primarily because of differences in data-collection techniques and sources over the years. Since 1970, water-use data on a State level have been collected four times (table 3) and by eight different agencies (five water management districts, the Florida Bureau of Geology, the Florida Department of Environmental Regulation, and the U.S. Geological Survey).

Since 1975 (Leach, 1978), freshwater withdrawals have increased 48 percent in the 10 years between 1975 and 1985 (excluding thermoelectric power generation withdrawals). Specifically, fresh ground water which accounted for 64 percent of the total use in Florida during 1985, increased 51 percent from 1980 and 48 percent from 1975. This increase of more than 718 Mgal/d from 1975 (fig. 9) shows the growing importance of ground water in Florida. The steady increase in ground-water withdrawals from 1975-85 is a result of the ability to drill and pump water more economically from large, deep wells and the reliability of both quality and quantity of water from these wells.

In contrast to ground water, withdrawals of surface water have declined between 1975-85. Fresh surface water used for irrigation declined by more than 300 Mgal/d between 1975-85. Overall, fresh surface-water withdrawals decreased by 1,373 Mgal/d during this period. More than 1,000 Mgal/d of the decrease reflects less water withdrawn for thermoelectric power generation because of more efficient use of cooling water.

From 1975 to 1985, freshwater withdrawals for public supply increased 514 Mgal/d, domestic self supplied increased 58 Mgal/d, and agricultural irrigation increased 49 Mgal/d, whereas commercial-industrial self-supplied withdrawals decreased 231 Mgal/d and thermoelectric power generation decreased 1,044 Mgal/d (fig. 10). An extremely high withdrawal for agricultural irrigation and totals for 1965 are reflected in figures 9, 10, and 27. This can be attributed to 1965 estimates of the number of acres irrigated and withdrawal amounts that were considered to have been too high (Leach, 1983, p. 11) and not a true representation of withdrawals for agricultural irrigation and total water withdrawals for that year.



FIGURES MAY NOT ADD TO TOTALS BECAUSE OF INDEPENDENT ROUNDING.

Figure 8.--Source, use, and disposition of freshwater in Florida, 1985.

Table 2.—Treated wastewater discharge in Florida by county, 1985

[In million gallons per day; Source: Florida Department of Environmental Regulation]

County	Type of treatment facility		Total
	Municipal	Industrial	
Alachua	11.80	3.21	15.01
Baker	.48	.12	.60
Bay	29.79	.00	29.79
Bradford	.97	5.28	6.25
Brevard	26.18	.33	26.51
Broward	146.62	.02	146.64
Calhoun	.37	.00	.37
Charlotte	4.39	.00	4.39
Citrus	4.39	.00	4.39
Clay	4.61	.00	4.61
Collier	11.03	.00	11.03
Columbia	1.10	.00	1.10
Dade	249.67	.49	250.16
De Soto	.72	.08	.80
Dixie	.46	.00	.46
Duval	68.66	30.25	98.91
Escambia	17.38	47.58	64.96
Flagler	1.53	.00	1.53
Franklin	1.01	.00	1.01
Gadsden	1.69	.61	2.30
Gilchrist	.21	.00	.21
Glades	.07	.00	.07
Gulf	.68	32.54	33.22
Hamilton	.40	.00	.40
Hardee	.89	.00	.89
Hendry	1.03	.20	1.23
Hernando	3.66	.00	3.66
Highlands	2.71	.33	3.04
Hillsborough	67.56	12.72	80.28
Holmes	.41	.00	.41
Indian River	3.30	.00	3.30
Jackson	1.73	.09	1.82
Jefferson	.31	.00	.31
Lafayette	.09	.00	.09
Lake	4.83	.00	4.83
Lee	21.91	.00	21.91
Leon	14.79	.00	14.79
Levy	.40	.00	.40
Liberty	.11	.00	.11
Madison	.72	.00	.72
Manatee	17.08	.00	17.08
Marion	5.63	.08	5.71
Martin	3.76	.11	3.87
Monroe	7.75	.00	7.75
Nassau	1.85	35.22	37.07
Okaloosa	10.62	.46	11.08
Okeechobee	.32	.09	.41
Orange	29.08	1.59	30.67
Osceola	7.53	3.91	11.44
Palm Beach	94.95	9.31	104.26
Pasco	11.34	.00	11.34
Pinellas	101.46	.00	101.46
Polk	18.59	31.63	50.22
Putnam	1.74	18.97	20.71
St. Johns	4.70	.00	4.70
St. Lucie	6.12	.60	6.72
Santa Rosa	1.73	5.14	6.87
Sarasota	17.06	.00	17.06
Seminole	39.25	4.20	43.45
Sumter	.68	.24	.92
Suwannee	.50	.00	.50
Taylor	.88	25.00	25.88
Union	.30	.00	.30
Volusia	28.45	.00	28.45
Wakulla	.01	.00	.01
Walton	1.01	.54	1.55
Washington	.52	.00	.52
Totals:	1,121.57	270.94	1,392.51

Table 3.—Historical water-use withdrawals in Florida by category

[In million gallons per day; modified from Pride (1973) and Leach (1978, 1980, and 1983); note: For 1970, 1975, 1977, and 1980, livestock withdrawals are reported under agricultural irrigation, 1970, and not as reported in rural domestic]

Withdrawal use	Ground water			Surface water			Total fresh-water	Total saline water	Total water used
	Fresh	Saline	Total	Fresh	Saline	Total			
• 1985 •									
Public supply	1,474.52	17.28	1,491.80	185.31	0.00	185.31	1,659.83	17.28	1,677.11
Domestic self supplied	259.29	.00	259.29	.00	.00	.00	259.29	.00	259.29
Commercial-industrial	631.53	.00	631.53	77.28	26.87	104.15	708.81	26.87	735.68
Agricultural	1,646.31	.00	1,646.31	1,332.99	.00	1,332.99	2,979.30	.00	2,979.30
Thermoelectric power generation	18.74	59.11	77.85	632.71	10,649.99	11,327.70	651.45	10,754.10	11,405.55
Total:	4,030.39	76.39	4,106.78	2,228.29	10,721.86	12,950.15	6,258.68	10,798.25	17,056.93
• 1980 •									
Public supply	1,184.35	0.00	1,184.35	176.93	0.00	176.93	1,361.28	0.00	1,361.28
Domestic self supplied	250.78	.00	250.78	.10	.00	.10	250.88	.00	250.88
Commercial-industrial	643.13	42.24	685.37	138.20	15.24	153.44	781.33	57.48	838.81
Agricultural	1,613.75	.00	1,613.75	1,443.15	.00	1,443.15	3,056.90	.00	3,056.90
Thermoelectric power generation	62.62	79.00	141.62	1,792.26	13,760.80	15,553.06	1,854.88	13,839.80	15,694.68
Total:	3,754.63	121.24	3,875.87	3,550.64	13,776.04	17,326.68	7,305.27	13,897.28	21,202.55
• 1977 •									
Public supply	1,059.06	0.00	1,059.06	172.82	0.00	172.82	1,231.88	0.00	1,231.88
Domestic self supplied	191.81	.00	191.81	1.01	.00	1.01	192.82	.00	192.82
Commercial-industrial	733.06	58.25	791.31	189.23	15.24	204.47	922.29	73.49	995.78
Agricultural	1,467.25	.00	1,467.25	1,469.43	.00	1,469.43	2,936.68	.00	2,936.68
Thermoelectric power generation	55.22	49.30	104.52	1,312.05	14,688.90	16,000.95	1,367.27	14,738.20	16,105.47
Total:	3,508.40	107.55	3,613.95	3,144.54	14,704.14	17,848.68	6,650.94	14,811.69	21,462.63
• 1975 •									
Public supply	982.83	0.00	982.83	162.98	0.00	162.98	1,145.81	0.00	1,145.81
Domestic self supplied	200.93	.00	200.93	2.05	.00	2.05	202.98	.00	202.98
Commercial-industrial	778.91	47.80	826.71	160.70	15.24	175.94	939.61	63.04	1,002.65
Agricultural	1,289.93	.00	1,289.93	1,640.67	.00	1,640.67	2,930.50	.00	2,930.50
Thermoelectric power generation	60.15	47.50	107.65	1,635.39	11,391.50	13,026.89	1,695.54	11,439.00	13,134.54
Total:	3,312.65	95.30	3,407.95	3,601.79	11,406.74	15,008.53	6,914.44	11,502.04	18,416.48
• 1970 •									
Public supply	758.80	0.00	758.80	124.70	0.00	124.70	883.50	0.00	883.50
Domestic self supplied	165.00	.00	165.00	.00	.00	.00	165.00	.00	165.00
Commercial-industrial	736.20	86.90	823.10	190.60	45.60	236.20	926.80	132.50	1,059.30
Agricultural	1,190.24	.00	1,190.24	910.43	.00	910.43	2,100.67	.00	*2,100.67
Thermoelectric power generation	11.90	50.10	62.00	1,675.00	9,340.00	11,015.00	1,686.90	9,390.10	11,077.00
Total:	2,862.14	137.00	2,999.14	2,900.73	9,385.60	12,274.33	5,750.87	9,522.60	*15,273.47

*Does not include 28.11 Mgal/d of saline water used for mosquito control.

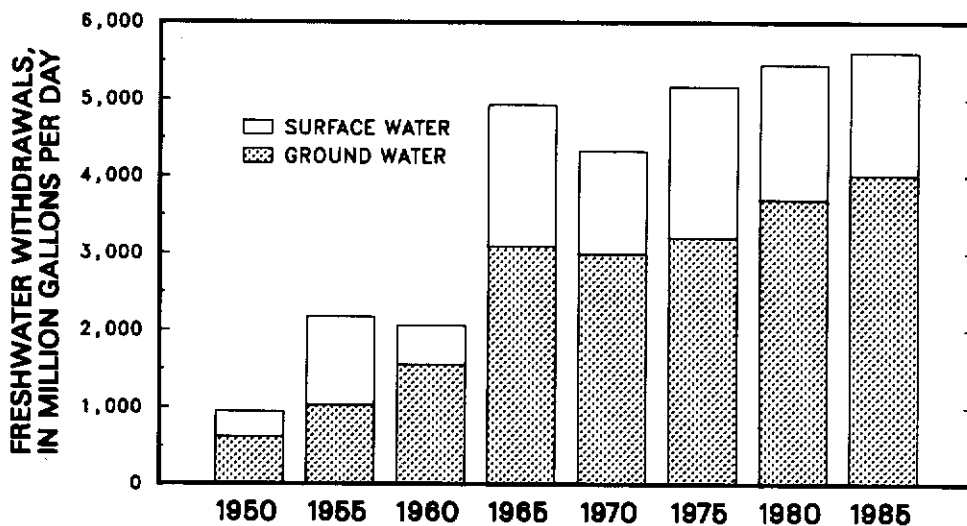


Figure 9.—Historical freshwater withdrawals in Florida by source, in 5-year intervals, 1950-85. (Does not include thermoelectric power generation withdrawals.) (Modified from Leach, 1983.)

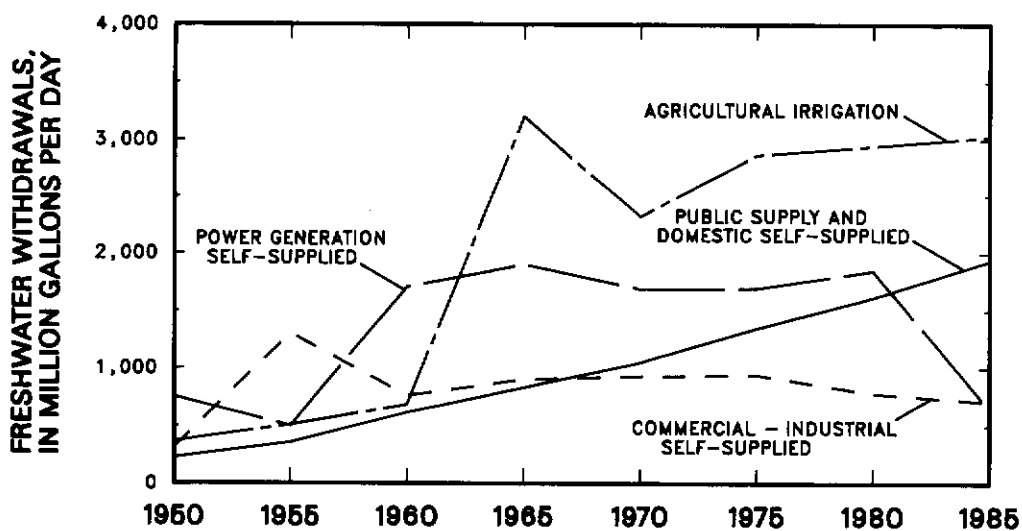


Figure 10.—Historical freshwater withdrawals in Florida by category, in 5-year intervals, 1950-85. (Modified from Leach, 1983.)

WATER WITHDRAWALS, USE, AND TRENDS BY CATEGORY

Public Supply

The public-supply category includes water withdrawn by both public and private water suppliers. According to the FDER, any system serving 25 people or more is considered to be a public or private water supplier. For this report, those utilities that served 400 people or more, or withdrew more than 0.01 Mgal/d were inventoried. Water withdrawn by smaller utilities was counted in another category. Data were collected by each of the five water management districts in Florida using information from their Consumptive Use Permit files or data supplied by the FDER monthly operating reports.

During 1985, 633 public and private utilities were inventoried in Florida. Total public-supplied water withdrawals amounted to 1,677 Mgal/d, of which 89 percent was ground water (fig. 11). Of that total, 17 Mgal/d was saline water withdrawn for treatment by reverse osmosis or diluted for potable use. Only 16 utilities within the State withdrew surface water during 1985.

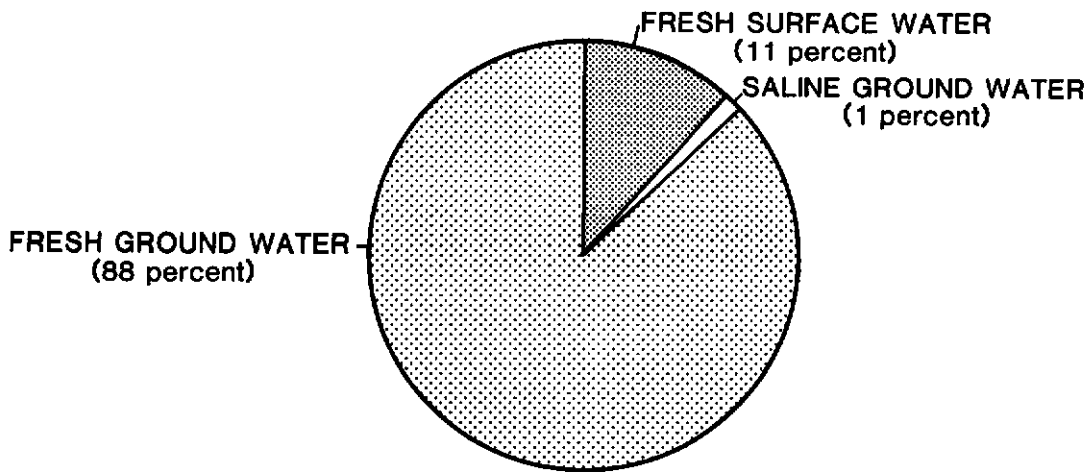
In 1985, Florida ranked second in the Nation behind California (Solley and others, 1988) in ground-water withdrawals for public supply (1,492 Mgal/d). The Floridan aquifer system, which contains potable water underlying most of the State, supplied 693 Mgal/d for public supply. The Biscayne aquifer, which is present only in southeastern Florida, supplied 569 Mgal/d for public supply. These two aquifers accounted for nearly 85 percent of ground-water withdrawals for this category in 1985 (fig. 12). The remainder of public ground water supplies was withdrawn from the sand-and-gravel, surficial, and intermediate aquifers.

Water withdrawals for public supply in Florida often display seasonal fluctuations because of variations in temperature and precipitation that affect demand. Public-supplied withdrawals fluctuated from a peak in May to a low in September in 1985 (fig. 13). This fluctuation of almost 400 Mgal/d relates to seasonal differences in residential demand, primarily for lawn irrigation, and seasonal tourism.

Public-supplied water was used for all of the major use categories in Florida during 1985. These categories include: domestic (residential), commercial, industrial, irrigation, and thermoelectric power generation. In addition to these five categories, water use is also reported for utility use which includes firefighting, water lost to leakage, and system maintenance. Domestic uses, which include indoor and outdoor residential uses, accounted for 71 percent of the use of public-supplied withdrawals (fig. 14).

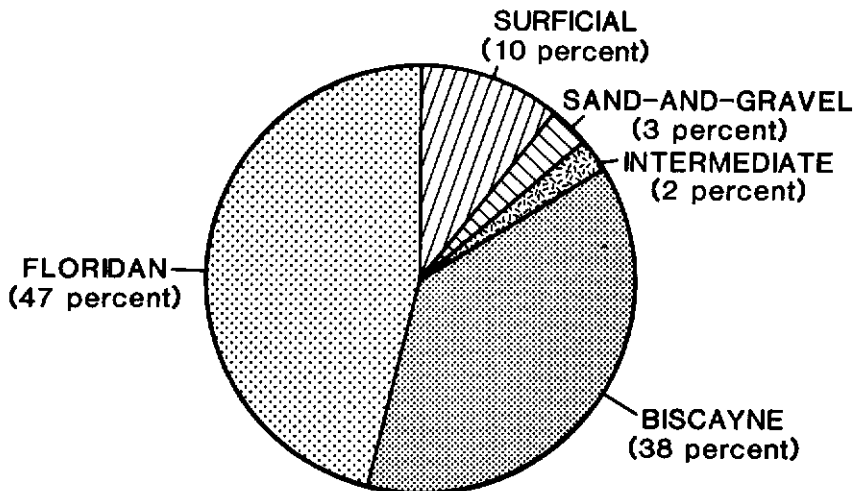
Returns from public-supply systems to wastewater-treatment plants in 1985 totaled 1,122 Mgal/d. Approximately 67 percent of water withdrawn for public supply is returned to wastewater-treatment plants, and 33 percent of public-supplied withdrawals is consumptive use. The residential component of public supply consumptive use is estimated to be 21 percent (Solley and others, 1986).

Dade County withdrew 340 Mgal/d of ground water and served 1.69 million people in 1985. Within Dade County is the single largest water supplier in the State, Miami-Dade Water and Sewer Authority, which withdrew



1,677 million gallons per day
total public-supplied withdrawals

Figure 11.—Public-supplied water withdrawals in Florida by source, 1985.



1,492 million gallons per day
total public-supplied ground-water withdrawals

Figure 12.—Public-supplied ground-water withdrawals in Florida by aquifer, 1985.

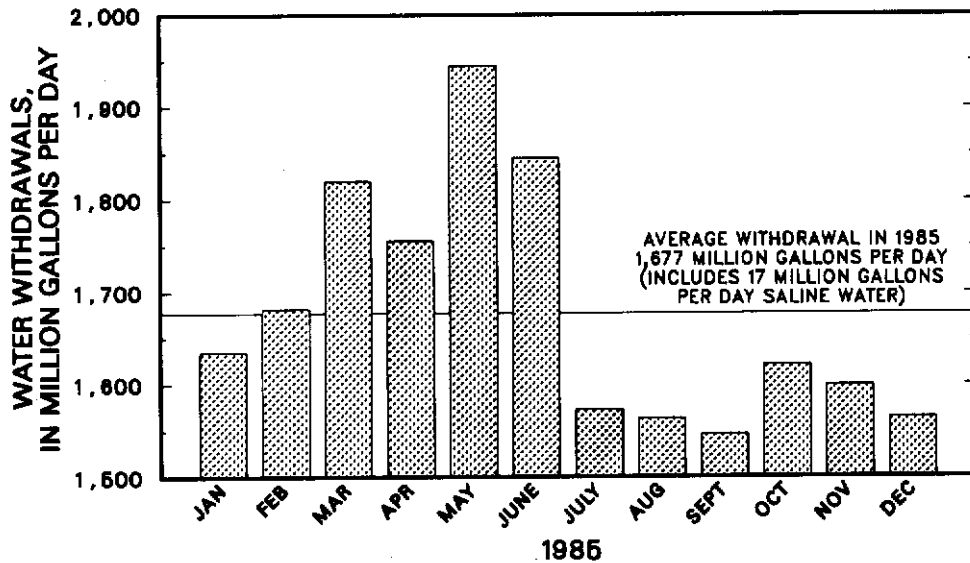
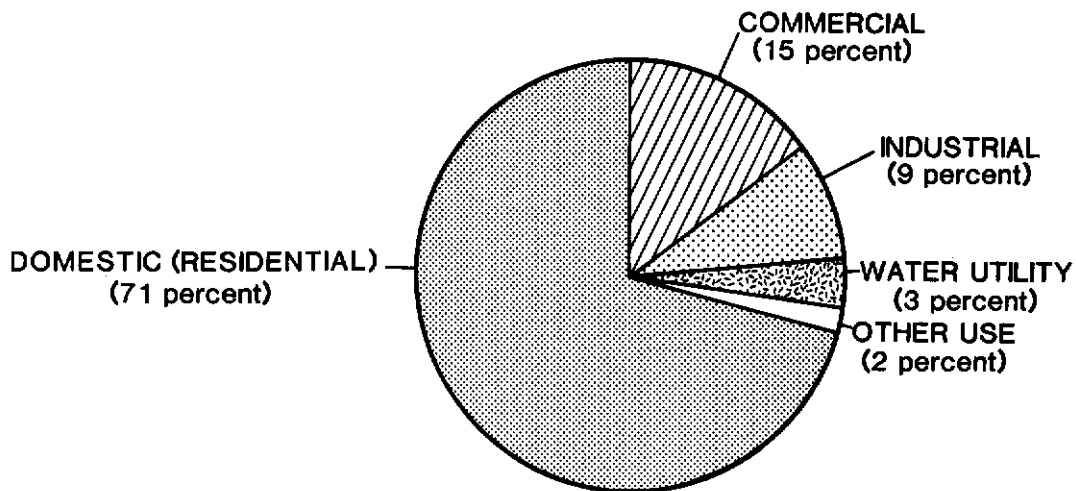


Figure 13.—Monthly public-supplied water withdrawals in Florida, 1985.

more than 292 Mgal/d of ground water in 1985. Dade County's total also includes water supplied to neighboring Monroe County (11 Mgal/d) for public supply throughout the Keys. Other counties with public-supplied withdrawals greater than 100 Mgal/d were Broward, Hillsborough, Palm Beach, and Orange (table 4). These four counties, combined with Dade County, account for more than 57 percent of public-supplied withdrawals in 1985.

In 1985, 162 Mgal/d of public-supplied water was withdrawn from one county for use in another county. The largest importer of public-supplied water is Pinellas County (table 5) which is supplied with more than 100 Mgal/d from adjacent Hillsborough and Pasco Counties. Table 5 also shows the total public-supplied water use, per capita, and population for each county in 1985.

Withdrawals for public supply have increased by 46 percent from 1975 to 1985 while the population in Florida has increased about 32 percent (3 million people). Most of the 531 Mgal/d (96 percent) increase in withdrawals for public supply over the past 10 years was from ground water (fig. 15). In 1985, 633 public and private utilities supplied water to 9.7 million residents or 86 percent of the State's population, slightly higher than the 79 percent served by systems in 1975. If Florida's population reaches 15 million by the year 2000 as projected (Smith and Sincich, 1987), and public-supply systems continue to supply approximately 86 percent of the population, withdrawals will probably increase by an additional 500 Mgal/d. An alternative source for public supply is obtaining potable water through the treatment of saline ground water by reverse osmosis or by dilution with freshwater. Use of this alternative source increased from less than 1 Mgal/d in 1980 to more than 17 Mgal/d in 1985.



1,677 million gallons per day
total public-supplied withdrawals

Figure 14.—Public-supplied water use in Florida by category, 1985.

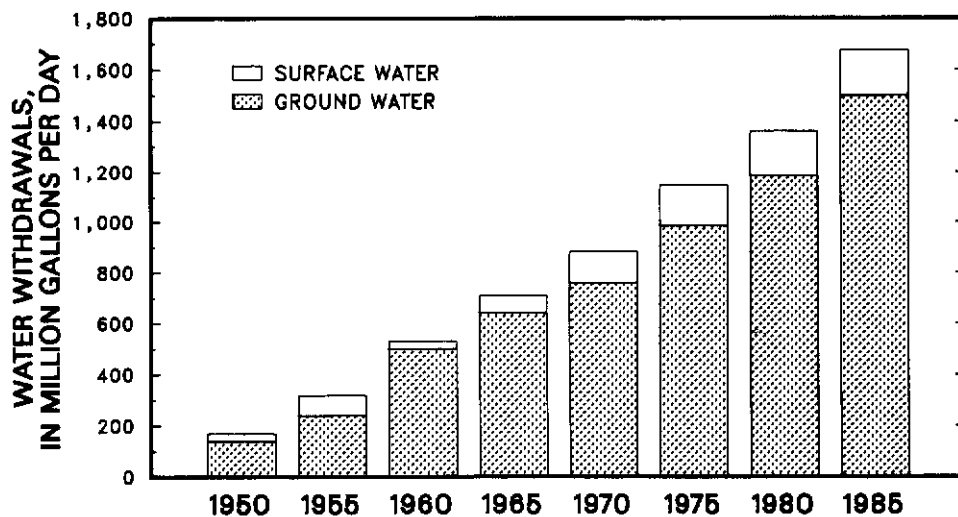


Figure 15.—Historical public-supplied freshwater withdrawals in Florida by source, in 5-year intervals, 1950–85. (Modified from Leach, 1983.)

Table 4.—Public-supplied water withdrawals in Florida by county, 1985

[In million gallons per day]

County	Ground water			Surface water			Totals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	21.25	0.00	21.25	0.00	0.00	0.00	21.25	0.00	21.25
Baker	.60	.00	.60	.00	.00	.00	.60	.00	.60
Bay	3.85	.00	3.85	28.07	.00	28.07	31.92	.00	31.92
Bradford	1.34	.00	1.34	.00	.00	.00	1.34	.00	1.34
Brevard	9.19	.02	9.21	14.09	.00	14.09	23.28	.02	23.30
Broward	187.95	.00	187.95	.00	.00	.00	187.95	.00	187.95
Calhoun	.39	.00	.39	.00	.00	.00	.39	.00	.39
Charlotte	.59	.98	1.57	2.72	.00	2.72	3.31	.98	4.29
Citrus	6.55	.00	6.55	.00	.00	.00	6.55	.00	6.55
Clay	8.40	.00	8.40	.00	.00	.00	8.40	.00	8.40
Collier	25.38	.00	25.38	.00	.00	.00	25.38	.00	25.38
Columbia	1.99	.00	1.99	.00	.00	.00	1.99	.00	1.99
Dade	339.77	.00	339.77	.00	.00	.00	339.77	.00	339.77
De Soto	.68	.00	.68	6.58	.00	6.58	7.26	.00	7.26
Dixie	.64	.00	.64	.00	.00	.00	.64	.00	.64
Duval	84.86	.00	84.86	.00	.00	.00	84.86	.00	84.86
Escambia	37.62	.00	37.62	.00	.00	.00	37.62	.00	37.62
Flagler	2.22	.00	2.22	.00	.00	.00	2.22	.00	2.22
Franklin	1.20	.00	1.20	.00	.00	.00	1.20	.00	1.20
Gadsden	1.60	.00	1.60	1.13	.00	1.13	2.73	.00	2.73
Gilchrist	.34	.00	.34	.00	.00	.00	.34	.00	.34
Glades	.25	.00	.25	.00	.00	.00	.25	.00	.25
Gulf	.98	.00	.98	.00	.00	.00	.98	.00	.98
Hamilton	.73	.00	.73	.00	.00	.00	.73	.00	.73
Hardee	1.32	.00	1.32	.00	.00	.00	1.32	.00	1.32
Hendry	2.89	.00	2.89	.00	.00	.00	2.89	.00	2.89
Hernando	7.88	.00	7.88	.00	.00	.00	7.88	.00	7.88
Highlands	7.88	.00	7.88	.00	.00	.00	7.88	.00	7.88
Hillsborough	100.94	.00	100.94	64.46	.00	64.46	165.40	.00	165.40
Holmes	.82	.00	.82	.00	.00	.00	.82	.00	.82
Indian River	7.87	.97	8.84	.00	.00	.00	7.87	.97	8.84
Jackson	2.44	.00	2.44	.00	.00	.00	2.44	.00	2.44
Jefferson	.60	.00	.60	.00	.00	.00	.60	.00	.60
Lafayette	.15	.00	.15	.00	.00	.00	.15	.00	.15
Lake	15.34	.00	15.34	.00	.00	.00	15.34	.00	15.34
Lee	17.33	8.12	25.45	6.28	.00	6.28	23.61	8.12	31.73
Leon	22.06	.00	22.06	.00	.00	.00	22.06	.00	22.06
Levy	1.19	.00	1.19	.00	.00	.00	1.19	.00	1.19
Liberty	.25	.00	.25	.00	.00	.00	.25	.00	.25
Madison	1.18	.00	1.18	.00	.00	.00	1.18	.00	1.18
Manatee	.00	.00	.00	30.89	.00	30.89	30.89	.00	30.89
Marion	11.89	.00	11.89	.00	.00	.00	11.89	.00	11.89
Martin	9.03	.30	9.33	.00	.00	.00	9.03	.30	9.33
Monroe	.00	.00	.00	.00	.00	.00	.00	.00	.00
Nassau	3.04	.00	3.04	.00	.00	.00	3.04	.00	3.04
Okaloosa	17.36	.00	17.36	.00	.00	.00	17.36	.00	17.36
Okeechobee	.00	.00	.00	1.93	.00	1.93	1.93	.00	1.93
Orange	122.60	.00	122.60	.00	.00	.00	122.60	.00	122.60
Osceola	5.69	.00	5.69	.00	.00	.00	5.69	.00	5.69
Palm Beach	117.39	.00	117.39	29.16	.00	29.16	146.55	.00	146.55
Pasco	75.44	.00	75.44	.00	.00	.00	75.44	.00	75.44
Pinellas	9.45	.00	9.45	.00	.00	.00	9.45	.00	9.45
Polk	54.90	.00	54.90	.00	.00	.00	54.90	.00	54.90
Putnam	2.97	.00	2.97	.00	.00	.00	2.97	.00	2.97
St. Johns	7.01	.00	7.01	.00	.00	.00	7.01	.00	7.01
St. Lucie	10.83	.00	10.83	.00	.00	.00	10.83	.00	10.83
Santa Rosa	7.60	.00	7.60	.00	.00	.00	7.60	.00	7.60
Sarasota	10.21	6.88	17.09	.00	.00	.00	10.21	6.88	17.09
Seminole	34.86	.00	34.86	.00	.00	.00	34.86	.00	34.86
Sumter	1.31	.00	1.31	.00	.00	.00	1.31	.00	1.31
Suwannee	1.33	.00	1.33	.00	.00	.00	1.33	.00	1.33
Taylor	1.58	.00	1.58	.00	.00	.00	1.58	.00	1.58
Union	.52	.00	.52	.00	.00	.00	.52	.00	.52
Volusia	36.39	.01	36.40	.00	.00	.00	36.39	.01	36.40
Wakulla	.59	.00	.59	.00	.00	.00	.59	.00	.59
Walton	2.99	.00	2.99	.00	.00	.00	2.99	.00	2.99
Washington	1.03	.00	1.03	.00	.00	.00	1.03	.00	1.03
Totals:	1,474.52	17.28	1,491.80	185.31	.00	185.31	1,659.83	17.28	1,677.11

Table 5.—Public-supplied population and water use in Florida by county, 1985

[Population source: University of Florida, 1986]

County	Total population	Population	Public supply, in million gallons per day				Per capita
			Total use	Withdrawal	Imported	Exported	
Alachua	172,900	126,516	21.25	21.25	0.00	0.00	167
Baker	17,310	4,232	.60	.60	.00	.00	142
Bay	119,503	88,585	31.92	31.92	.00	.00	180
Bradford	23,400	7,875	1.34	1.34	.00	.00	170
Brevard	339,473	301,979	45.40	23.30	22.10	.00	150
Broward	1,124,136	1,106,725	187.95	187.95	.00	.00	170
Calhoun	9,506	2,816	.39	.39	.00	.00	138
Charlotte	78,475	51,126	10.64	4.29	6.35	.00	118
Citrus	72,278	32,932	6.55	6.55	.00	.00	199
Clay	85,358	64,559	8.40	8.40	.00	.00	130
Collier	115,221	86,804	25.38	25.38	.00	.00	117
Columbia	39,358	11,430	1.99	1.99	.00	.00	174
Dade	1,759,251	1,690,566	328.43	339.77	.00	11.34	194
De Soto	21,574	6,292	.68	7.26	.00	6.58	108
Dixie	9,206	4,502	.64	.64	.00	.00	141
Duval	624,084	527,827	84.86	84.86	.00	.00	161
Escambia	264,715	234,697	37.62	37.62	.00	.00	157
Flagler	16,046	14,089	2.22	2.22	.00	.00	157
Franklin	8,406	7,497	1.20	1.20	.00	.00	160
Gadsden	41,674	24,407	2.73	2.73	.00	.00	112
Gilchrist	7,008	1,600	.34	.34	.00	.00	215
Glades	6,921	2,120	.25	.25	.00	.00	117
Gulf	11,272	6,423	.98	.98	.00	.00	153
Hamilton	9,221	5,308	.73	.73	.00	.00	137
Hardee	21,146	8,879	1.32	1.32	.00	.00	148
Hendry	22,704	17,226	2.89	2.89	.00	.00	143
Hernando	71,320	63,593	7.88	7.88	.00	.00	124
Highlands	58,151	43,111	7.88	7.88	.00	.00	184
Hillsborough	748,974	711,154	114.09	165.40	.00	51.31	160
Holmes	15,552	4,488	.82	.82	.00	.00	183
Indian River	76,442	41,878	8.84	8.84	.00	.00	211
Jackson	40,902	15,243	2.44	2.44	.00	.00	160
Jefferson	11,543	2,875	.60	.60	.00	.00	149
Lafayette	4,499	933	.15	.15	.00	.00	162
Lake	124,278	79,934	15.34	15.34	.00	.00	192
Lee	254,367	206,809	31.73	31.73	.00	.00	153
Leon	168,531	140,407	22.06	22.06	.00	.00	157
Levy	22,460	7,567	1.19	1.19	.00	.00	145
Liberty	4,530	1,170	.25	.25	.00	.00	120
Madison	15,624	5,996	1.18	1.18	.00	.00	197
Manatee	178,820	175,334	21.49	30.89	.00	9.40	124
Marion	157,853	70,168	11.89	11.89	.00	.00	174
Martin	80,909	44,816	9.33	9.33	.00	.00	208
Monroe	70,729	70,729	11.34	.00	11.34	.00	160
Nassau	39,822	17,293	3.04	3.04	.00	.00	176
Okaloosa	136,366	121,084	17.36	17.36	.00	.00	143
Okeechobee	24,542	13,482	1.93	1.93	.00	.00	143
Orange	554,659	523,081	100.50	122.60	.00	22.10	192
Osceola	77,374	43,275	5.69	5.69	.00	.00	140
Palm Beach	713,253	687,128	146.55	146.55	.00	.00	213
Pasco	233,272	167,802	21.11	75.44	.00	54.33	130
Pinellas	831,151	805,133	115.08	9.45	105.63	.00	143
Polk	366,268	275,339	54.90	54.90	.00	.00	200
Putnam	56,823	18,105	2.97	2.97	.00	.00	164
St. Johns	68,822	52,809	7.01	7.01	.00	.00	133
St. Lucie	116,235	72,985	10.83	10.83	.00	.00	148
Santa Rosa	63,381	57,155	7.60	7.60	.00	.00	132
Sarasota	238,013	212,711	26.73	17.09	16.52	6.88	119
Seminole	229,937	208,210	34.86	34.86	.00	.00	167
Sumter	27,432	9,675	1.31	1.31	.00	.00	156
Suwannee	25,355	8,922	1.33	1.33	.00	.00	149
Taylor	17,864	10,405	1.58	1.58	.00	.00	152
Union	10,686	4,000	.52	.52	.00	.00	129
Volusia	307,042	267,898	36.40	36.40	.00	.00	136
Wakulla	13,159	6,259	.59	.59	.00	.00	94
Walton	25,656	22,071	2.99	2.99	.00	.00	135
Washington	14,992	7,135	1.03	1.03	.00	.00	146
Totals:	11,327,734	9,735,174	1,677.11	1,677.11	161.94	161.94	172

Domestic Self Supplied

Domestic self-supplied water is defined here as water provided by individual domestic wells or by small utility companies (serving fewer than 400 residents). The population figure was derived by subtracting the number of residents served by public-supplied systems from the total county populations. In 1985, an estimated 1.6 million people withdrew 259 Mgal/d of domestic self-supplied water, all of which was ground water. This withdrawal was calculated by multiplying the county per-capita use (in gallons per day) by the domestic self-supplied population for each county. The per-capita use figure was derived by taking the public-supplied withdrawal figure for each county and dividing it by the population served by the public supply.

The amount of water withdrawn within the domestic self-supplied category from each aquifer in 1985 is shown in figure 16. The majority of water (60 percent) is withdrawn from the shallow surficial aquifers throughout the State. These shallow aquifers can yield sufficient water for domestic uses, precluding the need to tap the deeper Floridan aquifer system, which increases in depth in the southern part of the State.

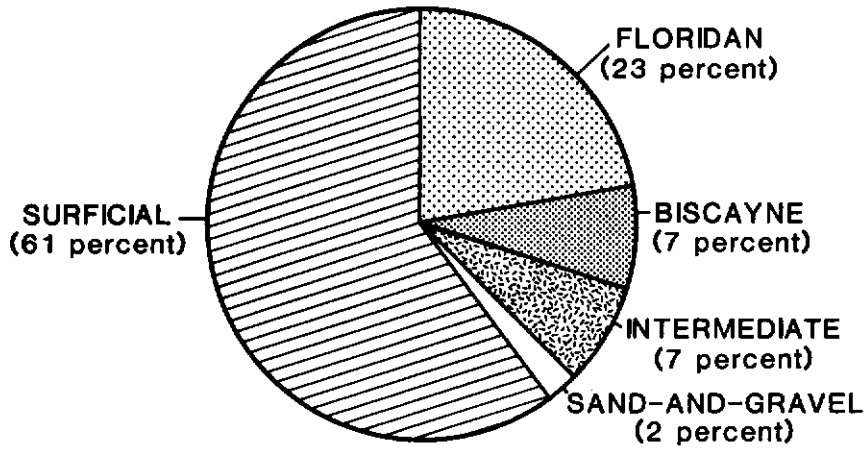
The overall public supply per-capita use for Florida in 1985 was 172 gal/d. This value includes public-supplied, commercial, and industrial water use as well as residential uses and water use for utilities (fig. 14). Water used solely for domestic purposes averaged 123 gal/d for 1985. This value is higher than the national average of 105 gal/d and ranks Florida 17th among the 50 States (Solley and others, 1988). The overall per capita use of public-supplied water increased slightly from 163 gal/d in 1970 to 172 gal/d in 1985 (fig. 17).

Duval County's self-supplied population, which exceeds 0.96 million, was the largest in the State for 1985. Other counties with large self-supplied populations were Polk (0.91 million) and Marion (0.87 million). These three counties also had the largest amount of water withdrawn for domestic self supplied (table 6). This table also shows the per capita use of public supply that was used to determine domestic self-supplied withdrawals.

Domestic self-supplied use increased from 165 Mgal/d in 1970 to 259.29 Mgal/d in 1985 despite only a slight increase in population between 1970 (1.4 million) and 1985 (1.6 million). Most of this increase in withdrawals results from a change in tabulation methods. In 1970, an estimated state-wide per capita figure was used (120 gal/d) versus that of the individual county per capita rates used in 1985. This individual county per capita figure accounts for small self-supplied commercial and industrial users that are not included under the commercial-industrial self-supplied category in the following section.

Commercial-Industrial Self Supplied

This category of use includes many types of self-supplied systems. Commercial self-supplied use includes the following facilities: government, military, schools, prisons, hospitals, recreational, and nonmanufacturing establishments. Industrial self-supplied use includes mining, processing, and manufacturing facilities. In 1985, there were 116 self-supplied commercial users inventoried and 223 self-supplied industrial users inventoried.



259 million gallons per day
total domestic self-supplied ground-water withdrawals

Figure 16.—Domestic self-supplied ground-water withdrawals in Florida by aquifer, 1985.

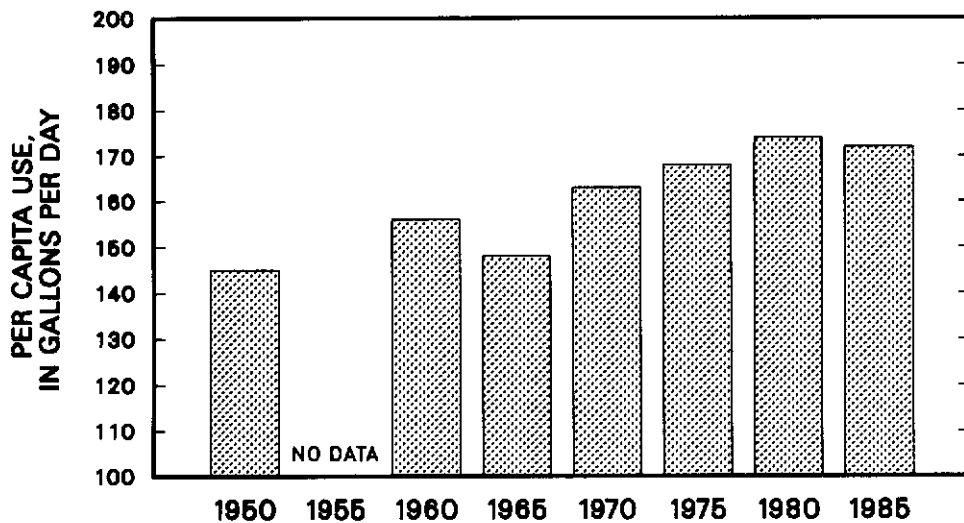


Figure 17.—Historical public-supply per capita in Florida, in 5-year intervals, 1950–85. (Modified from Leach 1983.)

Table 6.—Domestic self-supplied population, per capita, water withdrawals in Florida by county, 1985

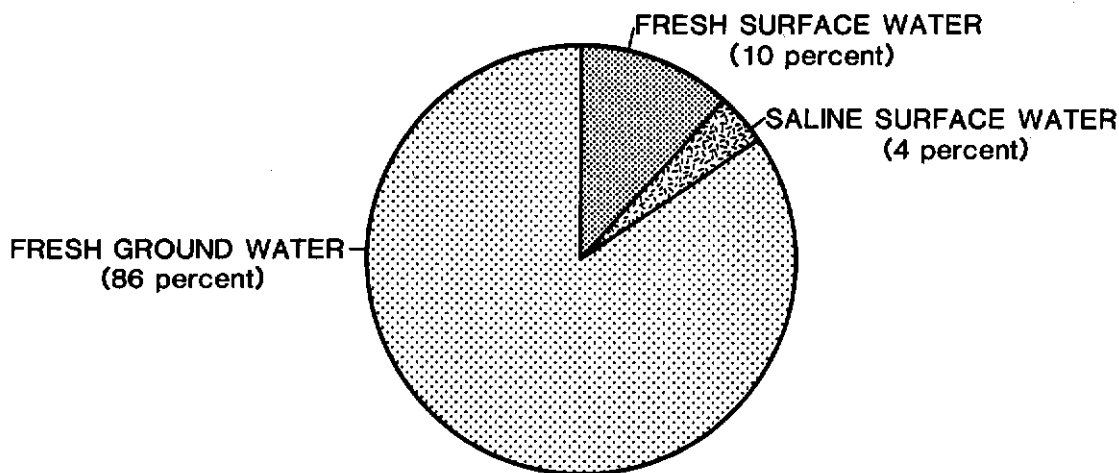
[Mgal/d = million gallons per day]

County	Self-supplied population	Per capita	Withdrawals, in Mgal/d		
			Ground	Surface	Total
Alachua	46,384	167	7.78	0.00	7.78
Baker	13,078	142	1.86	.00	1.86
Bay	30,918	180	5.56	.00	5.56
Bradford	15,525	170	2.60	.00	2.60
Brevard	37,494	150	5.62	.00	5.62
Broward	17,411	170	2.96	.00	2.96
Calhoun	6,690	138	.92	.00	.92
Charlotte	27,349	118	2.98	.00	2.98
Citrus	39,346	199	7.83	.00	7.83
Clay	20,799	130	2.70	.00	2.70
Collier	28,417	117	3.32	.00	3.32
Columbia	27,928	174	4.86	.00	4.86
Dade	68,685	194	13.32	.00	13.32
De Soto	15,282	108	1.68	.00	1.68
Dixie	4,704	141	.66	.00	.66
Duval	96,257	161	15.50	.00	15.50
Escambia	30,018	157	4.71	.00	4.71
Flagler	1,957	157	.31	.00	.31
Franklin	909	160	.15	.00	.15
Gadsden	17,267	112	2.30	.00	2.30
Gilchrist	5,408	215	1.16	.00	1.16
Glades	4,801	117	.56	.00	.56
Gulf	4,849	153	.74	.00	.74
Hamilton	3,913	137	.95	.00	.95
Hardee	12,267	148	1.82	.00	1.82
Hendry	5,478	143	.78	.00	.78
Hernando	7,727	124	.96	.00	.96
Highlands	15,040	184	2.77	.00	2.77
Hillsborough	37,820	160	6.05	.00	6.05
Holmes	11,064	183	2.02	.00	2.02
Indian River	34,564	211	7.29	.00	7.29
Jackson	25,659	160	4.10	.00	4.10
Jefferson	8,668	149	1.29	.00	1.29
Lafayette	3,566	162	.58	.00	.58
Lake	44,344	192	8.52	.00	8.52
Lee	57,558	153	8.81	.00	8.81
Leon	28,124	157	4.42	.00	4.42
Levy	14,893	145	2.17	.00	2.17
Liberty	3,360	120	.40	.00	.40
Madison	9,628	197	1.90	.00	1.90
Manatee	3,486	124	.43	.00	.43
Marion	87,685	174	15.26	.00	15.26
Martin	36,093	208	7.50	.00	7.50
Monroe	0	160	.00	.00	.00
Nassau	22,529	176	3.97	.00	3.97
Okaloosa	15,282	143	2.19	.00	2.19
Okeechobee	11,060	143	1.58	.00	1.58
Orange	31,578	192	6.07	.00	6.07
Osceola	34,099	140	4.76	.00	4.76
Palm Beach	26,125	213	5.56	.00	5.56
Pasco	65,470	130	8.25	.00	8.25
Pinellas	26,018	143	3.72	.00	3.72
Polk	90,929	200	18.17	.00	18.17
Putnam	38,718	164	6.35	.00	6.35
St. Johns	16,013	133	2.13	.00	2.13
St. Lucie	43,250	148	6.40	.00	6.40
Santa Rosa	6,226	132	.82	.00	.82
Sarasota	25,302	119	3.14	.00	3.14
Seminole	21,727	167	3.63	.00	3.63
Sumter	17,757	156	2.41	.00	2.41
Suwannee	16,433	149	2.45	.00	2.45
Taylor	7,459	152	1.13	.00	1.13
Union	6,686	129	.86	.00	.86
Volusia	39,144	136	5.32	.00	5.32
Wakulla	6,900	94	.65	.00	.65
Walton	3,585	135	.48	.00	.48
Washington	7,857	146	1.15	.00	1.15
Totals:	1,592,560	172	259.29	.00	259.29

Each water management district collected data from these systems by direct contact, Consumptive Use Permit files, or Monthly Operating Reports from the FDER files.

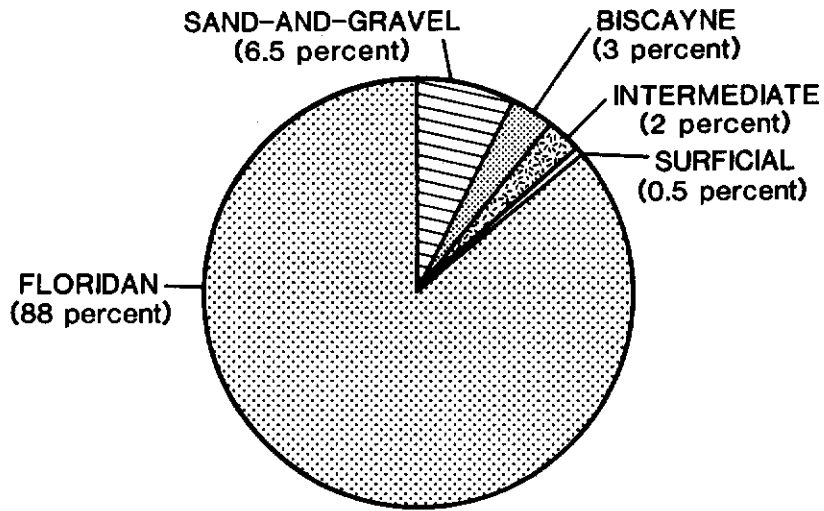
Total water withdrawn by commercial-industrial self-supplied systems was 736 Mgal/d, of which 96 percent was freshwater (fig. 18). Industrial use accounted for the majority (92 percent) of withdrawals. An additional 142 Mgal/d and 251 Mgal/d were delivered by public-supply systems to industrial and commercial users, respectively (fig. 14). Fresh ground-water withdrawals accounted for 632 Mgal/d, fresh surface-water withdrawals totaled 77 Mgal/d, and saline surface-water withdrawals the remaining 27 Mgal/d. The Floridan aquifer system supplied 554 Mgal/d of ground water withdrawn for this category in 1985 (fig. 19). Commercial-industrial consumptive use was estimated at 244 Mgal/d, or 33 percent of withdrawals and deliveries. This number could not be derived accurately from wastewater returns because many of the self-supplied systems discharge waste into public systems and the numbers generated by the FDER wastewater returns were incomplete. Wastewater returns according to the FDER files for industry in 1985 equaled 271 Mgal/d.

Commercial-industrial self-supplied withdrawals fluctuated very little seasonally during 1985. Withdrawals are highest in February and lowest in December (fig. 20). February and March were high-use months primarily due to increases in citrus and vegetable processing. Low withdrawals in December are often a result of plant shutdowns during the holidays.



736 million gallons per day
total commercial-industrial self-supplied withdrawals

Figure 18.—Commercial-industrial self-supplied water withdrawals in Florida by source, 1985.



632 million gallons per day
commercial-industrial self-supplied ground-water withdrawals

Figure 19.—Commercial-industrial self-supplied ground-water withdrawals in Florida by aquifer, 1985.

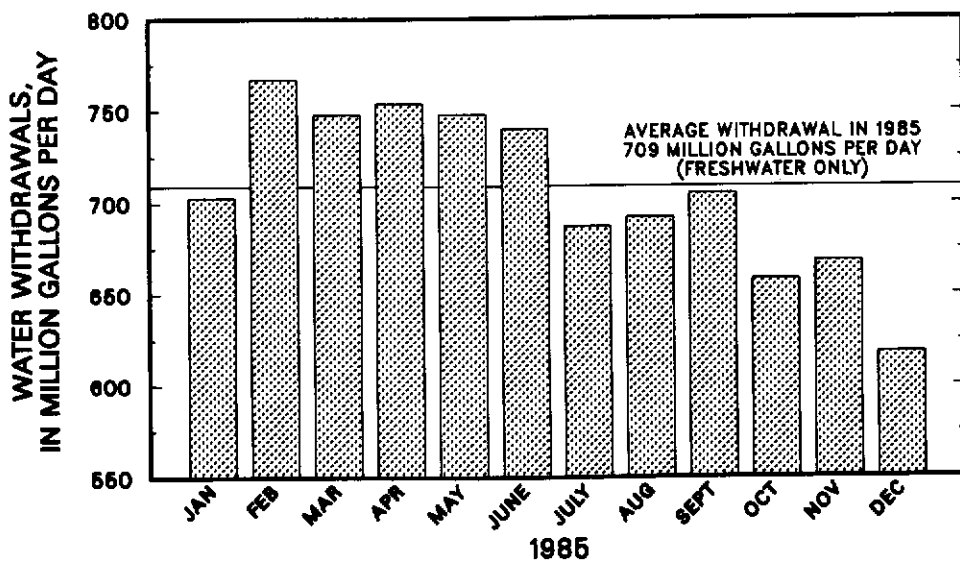
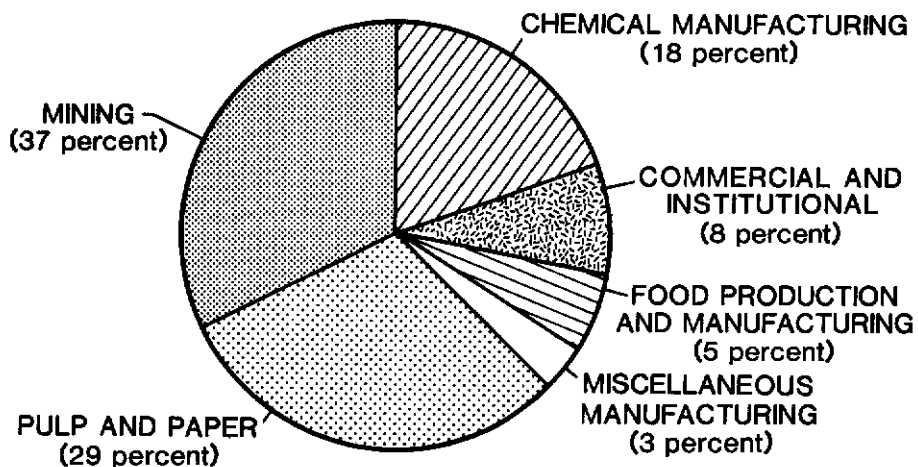


Figure 20.—Monthly commercial-industrial self-supplied water withdrawals in Florida, 1985.

Mining was the largest single water user within this category in 1985 (fig. 21) with a total withdrawal of 258 Mgal/d. Of this total, 148 Mgal/d was for mining limestone and sand, 98 Mgal/d for phosphate, and 13 Mgal/d for other minerals. Mining operations are located throughout Florida but are heaviest in the central part of the State. Some of the mining withdrawal values may be part of the dewatering process in the mining operation. The pulp and paper industry withdrew 203 Mgal/d in 1985. This industry is located in the heavily forested area in north and west Florida. Together, mining and pulp and paper industries accounted for 66 percent of industrial withdrawals in Florida.

Polk County accounted for the largest amount (19 percent) of commercial-industrial self-supplied freshwater withdrawals in 1985. Polk County withdrawals totaled 137 Mgal/d of which 98.5 percent were industrial withdrawals and the remaining commercial withdrawals. The majority (85 percent) of industrial withdrawals in Polk County was for phosphate mining or food production. Other counties with significant commercial-industrial self-supplied freshwater withdrawals in 1985 were Sumter, Putnam, Escambia and Taylor Counties (table 7). These four counties, plus Polk County, accounted for 49 percent of the total commercial-industrial withdrawals.

Self-supplied commercial-industrial freshwater withdrawals decreased 231 Mgal/d between 1975-85 (fig. 22). However, for the same period, deliveries to commercial and industrial users from public-supply systems increased 228 Mgal/d. Because of the cost of producing water and treating wastewater, many industries that were formerly self supplied now receive and discharge water to public-supply systems.



709 million gallons per day
total commercial-industrial self-supplied freshwater withdrawals

Figure 21.—Commercial-industrial self-supplied water use in Florida by category, 1985.

Table 7.—Commercial-industrial self-supplied water withdrawals in Florida by county, 1985

[In million gallons per day]

County	Ground water			Surface water			Totals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	3.61	0.00	3.61	0.00	0.00	0.00	3.61	0.00	3.61
Baker	.66	.00	.66	.00	.00	.00	.66	.00	.66
Bay	.61	.00	.61	.92	.00	.92	1.53	.00	1.53
Bradford	4.34	.00	4.34	.00	.00	.00	4.34	.00	4.34
Brevard	.24	.00	.24	.00	.00	.00	.24	.00	.24
Broward	1.36	.00	1.36	.00	.00	.00	1.36	.00	1.36
Calhoun	.00	.00	.00	.00	.00	.00	.00	.00	.00
Charlotte	.00	.00	.00	.00	.00	.00	.00	.00	.00
Citrus	.85	.00	.85	.00	.00	.00	.85	.00	.85
Clay	7.31	.00	7.31	4.43	.00	4.43	11.74	.00	11.74
Collier	4.67	.00	4.67	.00	.00	.00	4.67	.00	4.67
Columbia	.09	.00	.09	.00	.00	.00	.09	.00	.09
Dade	15.78	.00	15.78	.00	.00	.00	15.78	.00	15.78
De Soto	.37	.00	.37	.00	.00	.00	.37	.00	.37
Dixie	.94	.00	.94	.00	.00	.00	.94	.00	.94
Duval	38.08	.00	38.08	.00	25.29	25.29	38.08	25.29	63.37
Escambia	34.54	.00	34.54	16.89	.00	16.89	51.43	.00	51.43
Flagler	.10	.00	.10	.00	.00	.00	.10	.00	.10
Franklin	.00	.00	.00	.00	.00	.00	.00	.00	.00
Gadsden	1.96	.00	1.96	.00	.00	.00	1.96	.00	1.96
Gilchrist	.08	.00	.08	.00	.00	.00	.08	.00	.08
Glades	1.48	.00	1.48	.00	.00	.00	1.48	.00	1.48
Gulf	.42	.00	.42	31.68	.00	31.68	32.10	.00	32.10
Hamilton	38.79	.00	38.79	.00	.00	.00	38.79	.00	38.79
Hardee	4.83	.00	4.83	.00	.00	.00	4.83	.00	4.83
Hendry	.50	.00	.50	.00	.00	.00	.50	.00	.50
Hernando	26.74	.00	26.74	.00	.00	.00	26.74	.00	26.74
Highlands	.51	.00	.51	.00	.00	.00	.51	.00	.51
Hillsborough	34.36	.00	34.36	.00	.00	.00	34.36	.00	34.36
Holmes	.00	.00	.00	.00	.00	.00	.00	.00	.00
Indian River	.12	.00	.12	.00	.00	.00	.12	.00	.12
Jackson	.81	.00	.81	.00	.00	.00	.81	.00	.81
Jefferson	.00	.00	.00	.00	.00	.00	.00	.00	.00
Lafayette	.08	.00	.08	.00	.00	.00	.08	.00	.08
Lake	12.24	.00	12.24	3.41	.00	3.41	15.65	.00	15.65
Lee	6.87	.00	6.87	.00	.00	.00	6.87	.00	6.87
Leon	.33	.00	.33	.00	.00	.00	.33	.00	.33
Levy	.41	.00	.41	2.28	.00	2.28	2.69	.00	2.69
Liberty	.00	.00	.00	.00	.00	.00	.00	.00	.00
Madison	.46	.00	.46	.00	.00	.00	.46	.00	.46
Manatee	3.30	.00	3.30	.00	.00	.00	3.30	.00	3.30
Marion	.93	.00	.93	1.93	.00	1.93	2.86	.00	2.86
Martin	.17	.00	.17	.00	.00	.00	.17	.00	.17
Monroe	.00	.00	.00	.00	.00	.00	.00	.00	.00
Nassau	37.40	.00	37.40	.00	1.58	1.58	37.40	1.58	38.98
Okaloosa	5.82	.00	5.82	.00	.00	.00	5.82	.00	5.82
Okeechobee	.12	.00	.12	.00	.00	.00	.12	.00	.12
Orange	15.23	.00	15.23	1.02	.00	1.02	16.25	.00	16.25
Osceola	3.20	.00	3.20	.00	.00	.00	3.20	.00	3.20
Palm Beach	2.22	.00	2.22	.54	.00	.54	2.76	.00	2.76
Pasco	19.91	.00	19.91	.00	.00	.00	19.91	.00	19.91
Pinellas	.05	.00	.05	.00	.00	.00	.05	.00	.05
Polk	135.93	.00	135.93	1.14	.00	1.14	137.07	.00	137.07
Putnam	43.07	.00	43.07	9.98	.00	9.98	53.05	.00	53.05
St. Johns	.08	.00	.08	.00	.00	.00	.08	.00	.08
St. Lucie	2.25	.00	2.25	.00	.00	.00	2.25	.00	2.25
Santa Rosa	6.59	.00	6.59	.00	.00	.00	6.59	.00	6.59
Sarasota	.49	.00	.49	.00	.00	.00	.49	.00	.49
Seminole	4.96	.00	4.96	.00	.00	.00	4.96	.00	4.96
Sumter	57.76	.00	57.76	.00	.00	.00	57.76	.00	57.76
Suwannee	.95	.00	.95	1.43	.00	1.43	2.38	.00	2.38
Taylor	45.21	.00	45.21	1.63	.00	1.63	46.84	.00	46.84
Union	.02	.00	.02	.00	.00	.00	.02	.00	.02
Volusia	.64	.00	.64	.00	.00	.00	.64	.00	.64
Wakulla	.00	.00	.00	.00	.00	.00	.00	.00	.00
Walton	.69	.00	.69	.00	.00	.00	.69	.00	.69
Washington	.00	.00	.00	.00	.00	.00	.00	.00	.00
Totals:	631.53	.00	631.53	77.28	26.87	104.15	708.81	26.87	735.68

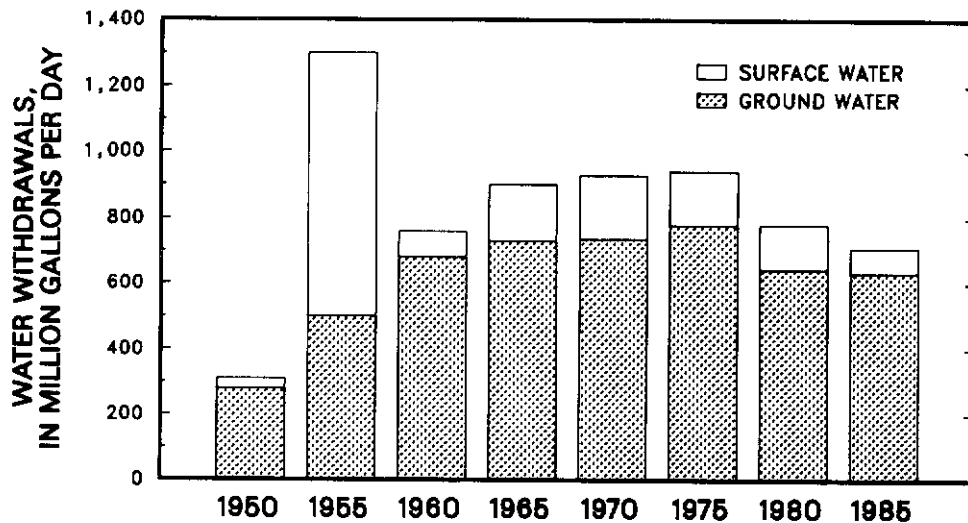


Figure 22.—Historical commercial-industrial self-supplied freshwater withdrawals in Florida by source, in 5-year intervals, 1950–85. (Modified from Leach, 1983.)

Economic conditions are changing industrial water use and withdrawal trends in Florida. Phosphate mining and manufacturing withdrawals have decreased 79 Mgal/d (81 percent), and pulp and paper processing has decreased 22 Mgal/d (11 percent) since 1975. At the same time, withdrawals for limestone and sand mining, which are used primarily for roads and concrete products, increased 60 Mgal/d (68 percent), reflecting the overall economic growth in Florida. Water conservation practices and permitting restrictions on withdrawals and discharges in Florida over the last 10 years have also had effects in water-use declines for this category.

Agricultural Irrigation and Nonirrigation

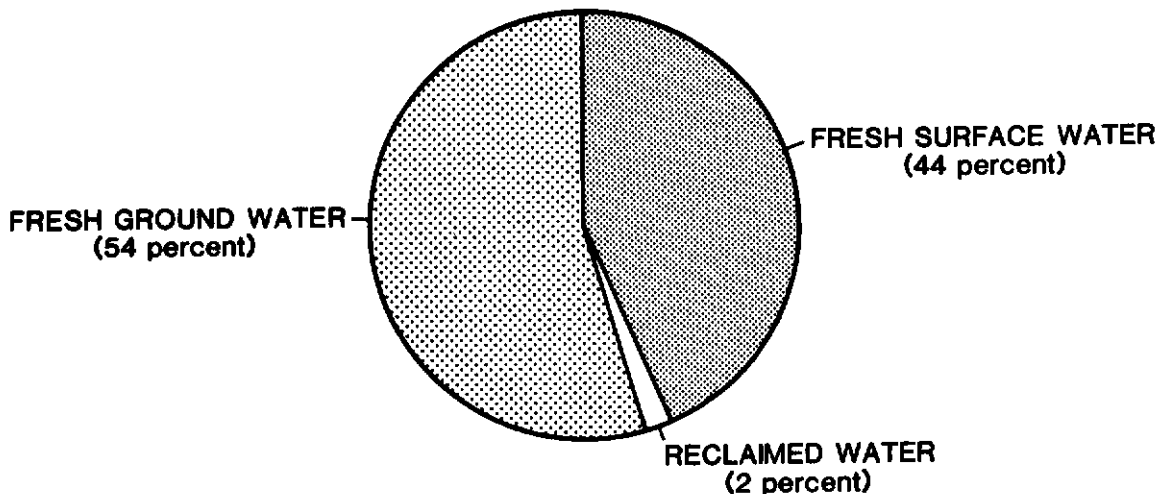
Agricultural water use includes withdrawals for irrigation and non-irrigation. Irrigation withdrawals include supplementing rainfall for the growth of commercial crops, ornamentals, and grasses. Nonirrigation withdrawals include water used for livestock, both drinking and washdown, and augmentation for fish farming. Withdrawals were calculated for this category in two steps. First, the number of acres irrigated and method of irrigation for each of the 29 crops inventoried within every county was determined. In 1985, these data were supplied to each water management district by the agricultural extension agent in each county. Other sources for acreage data included water management district Consumptive Use Permit files and the Florida Crop and Livestock reporting service. The second step was to determine the amount of supplemental irrigation water needed to grow each crop for 1985 as well as the water necessary to overcome the inefficiency of the irrigation system. This determination was made by each water management district, utilizing a variety of methods and information services

including the modified Blaney-Criddle¹ irrigation model, "Irrigation Water Requirements, 1970, revised" (U.S. Soil Conservation Service, 1970), the University of Florida "AFSIRS" computer model (Smajstrla, 1986), the "Florida Irrigation Guide" (U.S. Soil Conservation Service, 1982), and selected agricultural monitoring programs (for example, benchmark farms) throughout the State. Once this supplemental irrigation requirement was determined, that figure was multiplied by the number of acres irrigated and a water-use value was derived.

Agriculture was the largest user of freshwater in Florida in 1985. Total withdrawals equaled 2,979 Mgal/d, of which 54 percent (1,646 Mgal/d) was ground water and 44 percent surface water (fig. 23). An additional 51 Mgal/d of reclaimed wastewater was used for irrigation purposes. This cumulative withdrawal ranks Florida as the largest irrigation withdrawal State east of the Mississippi River (Solley and others, 1988).

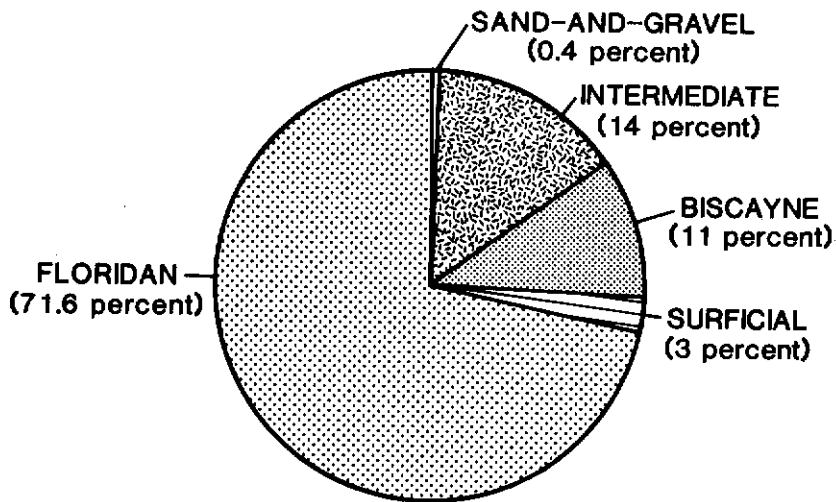
Estimated agricultural irrigation consumptive use totaled 2,078 Mgal/d, or 69 percent, of water withdrawn for this category. This represents the amount of water that the plant or crop consumes and was derived by using the evapotranspiration (ET) rates generated for each crop. Consumptive use for agricultural nonirrigation uses was estimated at 100 percent of withdrawals. The Floridan aquifer system was the largest producer of ground water for agricultural irrigation in 1985 (fig. 24), accounting for 72 percent of total withdrawals.

¹Use of brand or trade names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.



**3,030 million gallons per day total agricultural irrigation withdrawals
includes 51 million gallons per day of reclaimed water**

Figure 23.—Agricultural irrigation water withdrawals in Florida by source, 1985.



1,646 million gallons per day
 agricultural irrigation ground-water withdrawals

Figure 24.—Agricultural irrigation ground-water withdrawals in Florida by aquifer, 1985.

Agricultural irrigation also displays the greatest seasonal variation in withdrawals. Irrigation demands fluctuated from a peak in April to a low in December (fig. 25). This fluctuation of more than 2,000 Mgal/d was the result of intense crop production and extremely dry conditions during the early spring. The months of March, April, and May account for 35 percent of the water used for irrigation but only 17 percent of the yearly rainfall. In contrast, the months of July, August, and September account for 45 percent of the rainfall but only 20 percent of the irrigation use.

Agricultural irrigation data were collected for 1985 for four crop categories: vegetable, fruit, field, ornamentals, and grasses. Within these 4 categories, 29 specific crops and 3 miscellaneous crops were delineated (table 8). The number of acres farmed (not including residential) totaled 3.89 million acres. Ninety percent of this acreage, excluding improved pasture, is irrigated. The majority of acreage (58 percent) is irrigated by flood systems. The remaining is irrigated by sprinkler (26 percent) and low pressure/low volume systems (16 percent).

Of the four major crop types, fruit crops were the largest users of water for irrigation (fig. 26) in 1985, accounting for 38 percent of the agricultural water use. Of this, citrus accounted for the largest amount of irrigated acres (32 percent) and water withdrawals (34 percent). Other large water withdrawal crops include sugarcane (17 percent), improved pasture (7 percent) and golf course turf grass (6 percent). Acreage and water withdrawals for the 29 specific crops are shown in table 8.

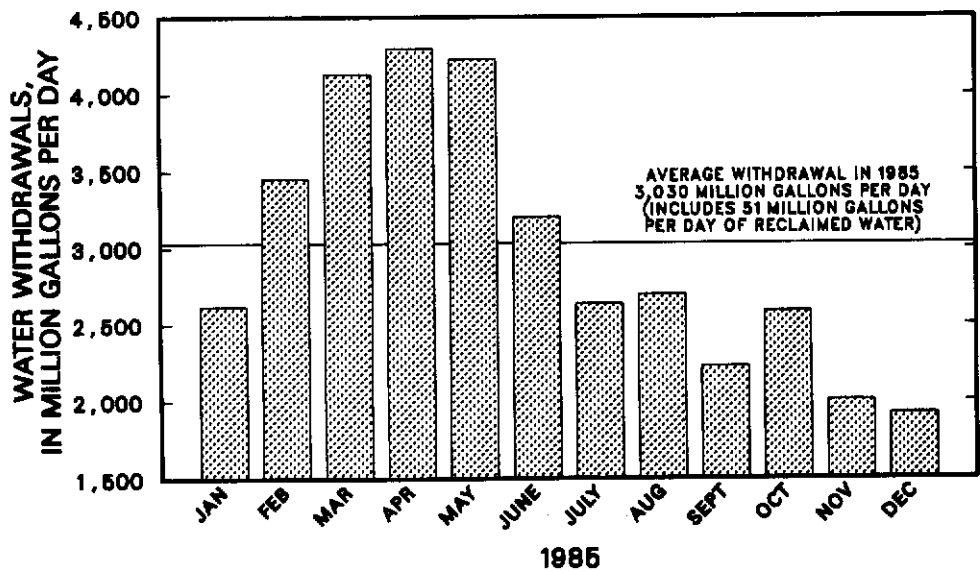
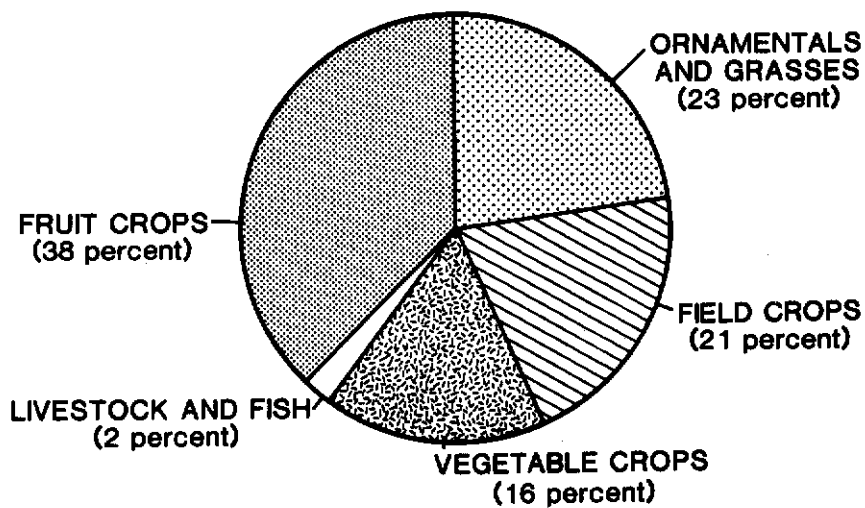


Figure 25.—Monthly agricultural irrigation water withdrawals in Florida, 1985.



3,030 million gallons per day
total agricultural irrigation water use

Figure 26.—Agricultural irrigation water use in Florida by major crop type, 1985.

Table 8.—Irrigation acreage and water use by crop type in Florida, 1985

Crop type	Acres		Water use, in million gallons per day			
	Farmed	Irrigated ¹	Ground water	Surface water	Reclaimed water ²	Total
Vegetable crops						
Cabbage	10,685	10,685	13.73	0.02	0.00	13.75
Carrots	20,200	20,200	7.34	11.08	.00	18.42
Cucumbers	24,998	24,548	46.86	.03	.00	46.89
Peppers	23,297	23,092	39.51	.11	.00	39.62
Potatoes	32,621	27,441	37.97	.79	.00	38.76
Tomatoes	58,154	58,154	132.58	2.99	.00	135.57
Sweet corn	65,810	65,360	26.95	47.97	.00	74.32
Watercress	150	150	7.81	.00	.00	7.81
Miscellaneous	122,170	113,120	84.28	37.72	.00	122.00
Fruit crops						
Blueberries	1,054	848	0.83	0.00	0.00	0.83
Citrus	645,361	610,720	523.68	485.91	.00	1,009.59
Grapes	377	381	.33	.00	.00	.33
Peaches	3,403	1,203	1.70	.11	.00	1.81
Pecans	7,521	2,970	2.63	.00	.00	2.63
Strawberries	4,750	4,750	16.15	.81	.00	16.96
Watermelons	53,820	47,125	47.15	4.29	.00	51.44
Miscellaneous	25,541	25,340	58.25	.36	.00	58.61
Field crops						
Field corn	87,524	42,629	34.56	17.83	7.47	52.39
Peanuts	26,604	18,586	8.90	2.90	.00	11.80
Rice	3,300	3,300	.00	7.69	.00	7.69
Sorghum	13,167	7,875	6.16	.63	2.24	6.79
Soybeans	69,704	9,835	6.01	1.35	3.74	7.36
Sugarcane	379,250	379,250	.00	505.41	.00	505.41
Tobacco	7,140	6,674	6.89	.14	.00	7.03
Wheat	26,547	10,533	3.51	1.52	.00	5.03
Miscellaneous	36,359	6,915	6.57	.24	.00	6.81
Ornamentals and grasses						
Ferns	6,787	6,682	27.46	4.83	0.00	32.29
Flowers and foliage	11,144	11,124	47.07	11.56	.00	58.63
Woody ornamentals	21,731	17,918	81.22	18.34	.00	99.56
Improved pasture	1,985,065	246,438	163.62	58.95	3.52	222.57
Sod	34,442	32,642	29.27	39.45	1.14	68.72
Turf grass	83,079	74,037	119.65	61.84	32.48	181.49
Miscellaneous agricultural						
Livestock	0	0	37.84	8.12	0.00	45.96
Fish farming	92	0	20.43	.00	.00	20.43
Totals:	3,891,847	³1,910,505	1,646.31	1,332.99	50.59	2,979.30

¹ Includes acreage for double cropping.

² Reclaimed water not included in totals.

³ Includes: sprinkler acreage, 489,569; low pressure acreage, 314,727; and flood acreage, 1,106,209.

Palm Beach County accounted for the single largest amount of total irrigation withdrawals (nearly 19 percent) and acreage irrigated (23 percent) in Florida. Palm Beach County total withdrawals equaled 553 Mgal/d of which 95 percent (525 Mgal/d) was surface water, making Palm Beach County the largest user of surface water for irrigation in 1985. Other counties that withdrew more than 100 Mgal/d of surface water for irrigation were St. Lucie, Hendry, Martin, and Indian River (table 9). These five counties accounted for more than 80 percent of surface-water withdrawals used for irrigation in 1985. Dade County had the largest withdrawal of ground water for 1985, followed by Polk, Hillsborough, and Brevard Counties. Each of these four counties withdrew more than 100 Mgal/d and accounted for 26 percent of ground-water withdrawals for irrigation in 1985.

Table 9.—Agricultural irrigation water withdrawals in Florida by county, 1985

[In million gallons per day; does not include reclaimed water-use values]

County	Ground water			Surface water			Totals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	15.52	0.00	15.52	0.04	0.00	0.04	15.56	0.00	15.56
Baker	2.95	.00	2.95	2.19	.00	2.19	5.14	.00	5.14
Bay	1.28	.00	1.28	.89	.00	.89	2.17	.00	2.17
Bradford	.97	.00	.97	.00	.00	.00	.97	.00	.97
Brevard	100.32	.00	100.32	25.70	.00	25.70	126.02	.00	126.02
Broward	37.84	.00	37.84	5.10	.00	5.10	42.94	.00	42.94
Calhoun	.34	.00	.34	.03	.00	.03	.37	.00	.37
Charlotte	43.12	.00	43.12	3.77	.00	3.77	46.89	.00	46.89
Citrus	8.60	.00	8.60	.70	.00	.70	9.30	.00	9.30
Clay	2.85	.00	2.85	.88	.00	.88	3.73	.00	3.73
Collier	84.85	.00	84.85	5.47	.00	5.47	90.32	.00	90.32
Columbia	2.87	.00	2.87	.05	.00	.05	2.92	.00	2.92
Dade	117.18	.00	117.18	4.50	.00	4.50	121.68	.00	121.68
De Soto	72.20	.00	72.20	2.27	.00	2.27	74.47	.00	74.47
Dixie	1.82	.00	1.82	.15	.00	.15	1.97	.00	1.97
Duval	18.80	.00	18.80	1.37	.00	1.37	20.17	.00	20.17
Escambia	5.22	.00	5.22	.48	.00	.48	5.70	.00	5.70
Flagler	6.31	.00	6.31	.93	.00	.93	7.24	.00	7.24
Franklin	1.63	.00	1.63	.00	.00	.00	1.63	.00	1.63
Gadsden	2.59	.00	2.59	6.54	.00	6.54	9.13	.00	9.13
Gilchrist	3.83	.00	3.83	.00	.00	.00	3.83	.00	3.83
Glades	13.67	.00	13.67	66.12	.00	66.12	79.79	.00	79.79
Gulf	1.89	.00	1.89	2.17	.00	2.17	4.06	.00	4.06
Hamilton	2.91	.00	2.91	.00	.00	.00	2.91	.00	2.91
Hardee	86.21	.00	86.21	.00	.00	.00	86.21	.00	86.21
Hendry	29.77	.00	29.77	158.06	.00	158.06	187.83	.00	187.83
Hernando	5.28	.00	5.28	.00	.00	.00	5.28	.00	5.28
Highlands	89.24	.00	89.24	14.16	.00	14.16	103.40	.00	103.40
Hillsborough	107.90	.00	107.90	3.45	.00	3.45	111.35	.00	111.35
Holmes	2.20	.00	2.20	.43	.00	.43	2.63	.00	2.63
Indian River	28.43	.00	28.43	107.18	.00	107.18	135.61	.00	135.61
Jackson	10.35	.00	10.35	10.00	.00	10.00	20.35	.00	20.35
Jefferson	6.31	.00	6.31	1.36	.00	1.36	7.67	.00	7.67
Lafayette	6.50	.00	6.50	.26	.00	.26	6.76	.00	6.76
Lake	28.78	.00	28.78	4.89	.00	4.89	33.67	.00	33.67
Lee	27.04	.00	27.04	5.07	.00	5.07	32.11	.00	32.11
Leon	3.36	.00	3.36	2.17	.00	2.17	5.53	.00	5.53
Levy	10.37	.00	10.37	2.17	.00	2.17	12.54	.00	12.54
Liberty	.44	.00	.44	.00	.00	.00	.44	.00	.44
Madison	2.46	.00	2.46	.00	.00	.00	2.46	.00	2.46
Manatee	89.01	.00	89.01	.91	.00	.91	89.92	.00	89.92
Marion	21.06	.00	21.06	1.96	.00	1.96	23.02	.00	23.02
Martin	28.80	.00	28.80	118.43	.00	118.43	147.23	.00	147.23
Monroe	1.60	.00	1.60	.00	.00	.00	1.60	.00	1.60
Nassau	1.73	.00	1.73	.93	.00	.93	2.66	.00	2.66
Okaloosa	2.30	.00	2.30	.00	.00	.00	2.30	.00	2.30
Okeechobee	22.74	.00	22.74	3.34	.00	3.34	26.08	.00	26.08
Orange	47.92	.00	47.92	52.90	.00	52.90	100.82	.00	100.82
Osceola	40.04	.00	40.04	5.58	.00	5.58	45.62	.00	45.62
Palm Beach	28.76	.00	28.76	524.58	.00	524.58	553.34	.00	553.34
Pasco	22.42	.00	22.42	.87	.00	.87	23.29	.00	23.29
Pinellas	10.25	.00	10.25	.55	.00	.55	10.80	.00	10.80
Polk	109.98	.00	109.98	8.33	.00	8.33	118.31	.00	118.31
Putnam	17.20	.00	17.20	.96	.00	.96	18.16	.00	18.16
St. Johns	41.00	.00	41.00	1.07	.00	1.07	42.07	.00	42.07
St. Lucie	48.80	.00	48.80	163.62	.00	163.62	212.42	.00	212.42
Santa Rosa	1.87	.00	1.87	.15	.00	.15	1.82	.00	1.82
Sarasota	19.64	.00	19.64	.47	.00	.47	20.11	.00	20.11
Seminole	23.21	.00	23.21	2.06	.00	2.06	25.27	.00	25.27
Sumter	16.78	.00	16.78	.35	.00	.35	17.14	.00	17.14
Suwannee	16.49	.00	16.49	.22	.00	.22	16.71	.00	16.71
Taylor	.81	.00	.81	.00	.00	.00	.81	.00	.81
Union	.71	.00	.71	.00	.00	.00	.71	.00	.71
Volusia	36.56	.00	36.56	6.50	.00	6.50	43.06	.00	43.06
Wakulla	.04	.00	.04	.00	.00	.00	.04	.00	.04
Walton	1.89	.00	1.89	.52	.00	.52	2.41	.00	2.41
Washington	.89	.00	.89	.14	.00	.14	1.03	.00	1.03
Totals:	1,646.31	.00	1,646.31	1,332.99	.00	1,332.99	2,979.30	.00	2,979.30

The number of acres irrigated totaled 1.9 million for Florida in 1985. Palm Beach, Brevard, Hendry, and Polk Counties each had more than 100,000 acres irrigated in 1985. These four counties accounted for 41 percent of the irrigated acreage in 1985. The number of agricultural acres irrigated increased by 70,000 between 1975-85, despite losses to freezes and urbanization. This increase results in part from the replanting of freeze-damaged acreage and more farms developing the capability to irrigate.

Agricultural water withdrawals increased nearly 49 Mgal/d since 1975 (fig. 27). Specifically, ground-water withdrawals increased 356 Mgal/d while surface water withdrawals decreased 307 Mgal/d. In addition to ground-water and surface-water withdrawals, reclaimed water use for irrigation increased from near 0 to 51 Mgal/d. This increase in ground water can be attributed to the need for the good quality and dependable supply of water that ground water can provide. In contrast, surface-water sources are often less dependable for either quantity or quality, particularly during dry conditions. In 1975, surface water accounted for 56 percent of irrigation withdrawals whereas in 1985 only 45 percent was surface water.

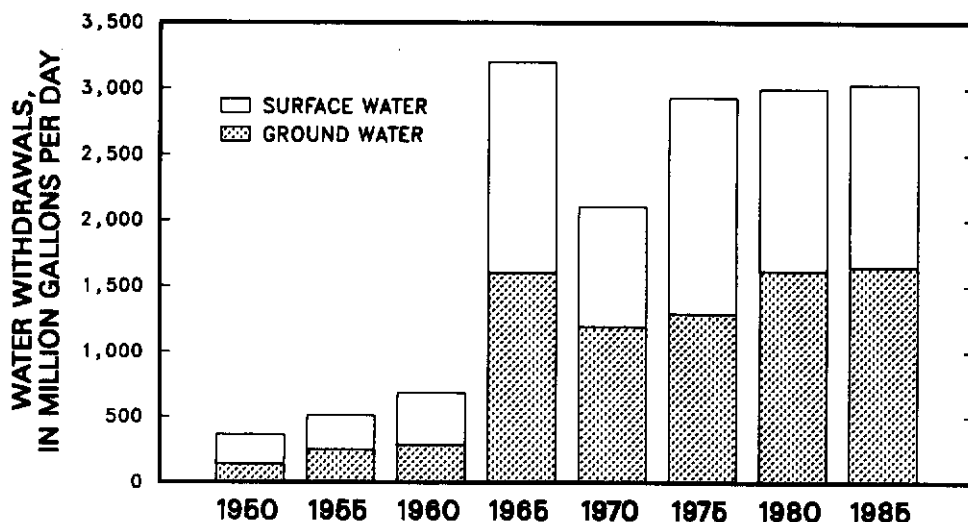


Figure 27.—Historical agricultural irrigation freshwater withdrawals in Florida by source, in 5-year intervals, 1950-85. (1965 estimates of the number of acres irrigated and withdrawal amounts were considered to have been too high.) (Modified from Leach, 1983.)

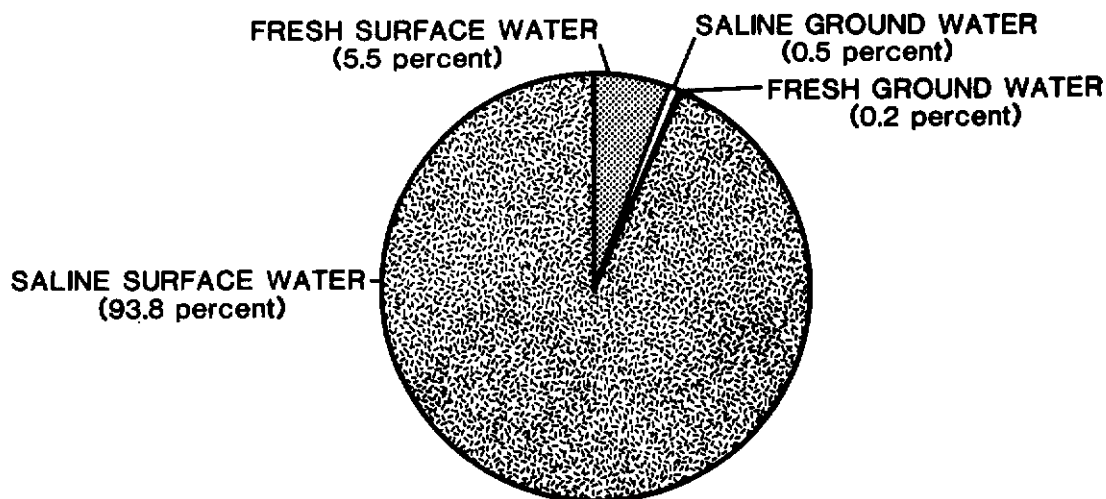
Thermoelectric Power Generation

In 1985, withdrawal and power-generation data were collected for 50 self-supplied thermoelectric powerplants in Florida. Power-generation data were also collected for two hydroelectric plants. Data were collected by the water management districts and the U.S. Geological Survey through Consumptive Use Permit files or by direct contact. Withdrawal data were collected for ground and surface, fresh and saline sources.

Total water withdrawals for the 50 self-supplied thermoelectric powerplants in Florida amounted to 11,406 Mgal/d but only 6 percent was fresh-water (fig. 28). Ninety-seven percent of the freshwater was from surface water and 3 percent from ground-water sources. Water consumed for thermoelectric power generation was 0.2 percent of withdrawals in 1985. The Floridan aquifer system accounted for more than 95 percent of ground-water withdrawals (fig. 29) and included 59 Mgal/d of saline-water withdrawals.

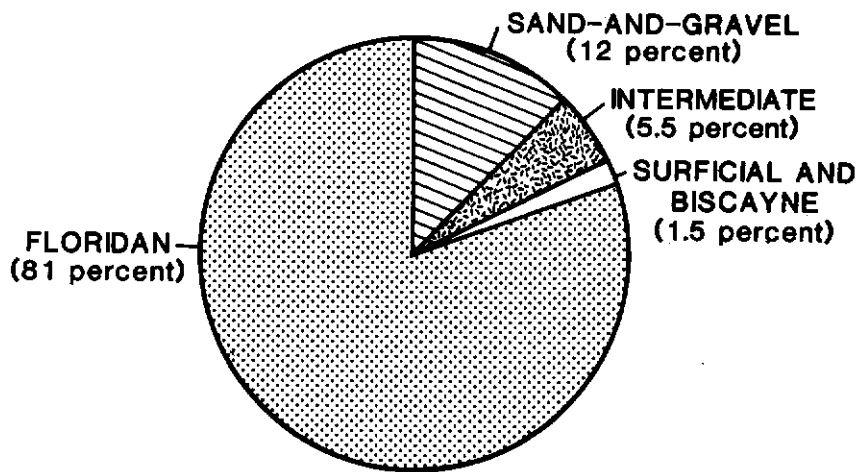
Withdrawals for thermoelectric power generation fluctuate from month to month (fig. 30). These monthly fluctuations are often a result of power-plant shutdowns for maintenance. Because the majority of withdrawals are from large surface-water bodies and are returned to the source, these fluctuations have little adverse effect on the hydrologic system.

Of the total water withdrawn, more than 99.8 percent was used for cooling purposes. This water is used for one-time cooling or recirculated several times before being returned to its surface source. The remaining 0.2 percent of water, which is primarily ground water, is used for boiler makeup or domestic purposes throughout the plant and is almost 100 percent consumed.



11,406 million gallons per day
total thermoelectric power generation withdrawals

Figure 28.—Thermoelectric power generation water withdrawals in Florida by source, 1985.



19 million gallons per day
total self-supplied power generation fresh ground-water withdrawals

Figure 29.—Thermoelectric power generation ground-water withdrawals in Florida by aquifer, 1985.

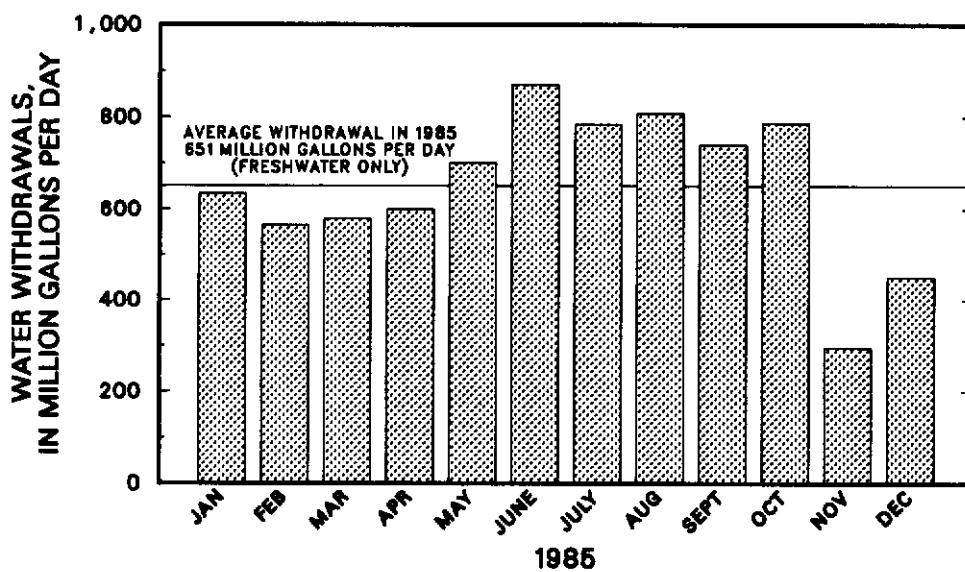


Figure 30.—Monthly thermoelectric power generation freshwater withdrawals in Florida, 1985.

Table 10.—Thermoelectric power generation water withdrawals in Florida by county, 1985

[In million gallons per day]

County	Ground water			Surface water			Totals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	3.26	0.00	3.26	0.00	0.00	0.00	3.26	0.00	3.26
Baker	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bay	.74	.00	.74	.00	264.60	264.60	.74	264.60	265.34
Bradford	.00	.00	.00	.00	.00	.00	.00	.00	.00
Brevard	.31	.00	.31	.00	1,157.88	1,157.88	.31	1,157.88	1,158.19
Broward	.07	.00	.07	.00	694.14	694.14	.07	694.14	694.21
Calhoun	.00	.00	.00	.00	.00	.00	.00	.00	.00
Charlotte	.00	.00	.00	.00	.00	.00	.00	.00	.00
Citrus	1.37	.00	1.37	.00	2,277.00	2,277.00	1.37	2,277.00	2,278.37
Clay	.00	.00	.00	.00	.00	.00	.00	.00	.00
Collier	.00	.00	.00	.00	.00	.00	.00	.00	.00
Columbia	.00	.00	.00	.00	.00	.00	.00	.00	.00
Dade	.00	.00	.00	.00	.99	.99	.00	.99	.99
De Soto	.00	.00	.00	.00	.00	.00	.00	.00	.00
Dixie	.00	.00	.00	.00	.00	.00	.00	.00	.00
Duval	2.06	.00	2.06	.00	454.13	454.13	2.06	454.13	456.19
Escambia	2.20	.00	2.20	241.40	.00	241.40	243.60	.00	243.60
Flagler	.00	.00	.00	.00	.00	.00	.00	.00	.00
Franklin	.00	.00	.00	.00	.00	.00	.00	.00	.00
Gadsden	.00	.00	.00	.00	.00	.00	.00	.00	.00
Gilchrist	.00	.00	.00	.00	.00	.00	.00	.00	.00
Glades	.00	.00	.00	.00	.00	.00	.00	.00	.00
Gulf	.00	.00	.00	.00	.00	.00	.00	.00	.00
Hamilton	.00	.00	.00	.00	.00	.00	.00	.00	.00
Hardee	.00	.00	.00	.00	.00	.00	.00	.00	.00
Hendry	.00	.00	.00	.00	.00	.00	.00	.00	.00
Hernando	.00	.00	.00	.00	.00	.00	.00	.00	.00
Highlands	.00	.00	.00	9.11	.00	9.11	9.11	.00	9.11
Hillsborough	.05	.00	.05	.00	2,327.86	2,327.86	.05	2,327.86	2,327.91
Holmes	.00	.00	.00	.00	.00	.00	.00	.00	.00
Indian River	.31	.00	.31	.00	18.44	18.44	.31	18.44	18.75
Jackson	.74	.00	.74	100.89	.00	100.89	101.63	.00	101.63
Jefferson	.00	.00	.00	.00	.00	.00	.00	.00	.00
Lafayette	.00	.00	.00	.00	.00	.00	.00	.00	.00
Lake	.00	.00	.00	.00	.00	.00	.00	.00	.00
Lee	.12	.00	.12	.00	248.92	248.92	.12	248.92	249.04
Leon	4.27	.00	4.27	.00	.00	.00	4.27	.00	4.27
Levy	.00	.00	.00	.00	.00	.00	.00	.00	.00
Liberty	.00	.00	.00	.00	.00	.00	.00	.00	.00
Madison	.00	.00	.00	.00	.00	.00	.00	.00	.00
Manatee	.44	.00	.44	2.51	.00	2.51	2.95	.00	2.95
Marion	.00	.00	.00	.00	.00	.00	.00	.00	.00
Martin	.49	.00	.49	24.50	.00	24.50	24.99	.00	24.99
Monroe	.00	59.11	59.11	.00	.00	.00	.00	59.11	59.11
Nassau	.00	.00	.00	.00	.00	.00	.00	.00	.00
Okaloosa	.00	.00	.00	.00	.00	.00	.00	.00	.00
Okeechobee	.00	.00	.00	.00	.00	.00	.00	.00	.00
Orange	.00	.00	.00	.00	.00	.00	.00	.00	.00
Osceola	.00	.00	.00	.00	.00	.00	.00	.00	.00
Palm Beach	.00	.00	.00	.00	325.25	325.25	.00	325.25	325.25
Pasco	.00	.00	.00	.00	1,131.40	1,131.40	.00	1,131.40	1,131.40
Pinellas	.00	.00	.00	.00	495.80	495.80	.00	495.80	495.80
Polk	1.38	.00	1.38	68.97	.00	68.97	70.35	.00	70.35
Putnam	.68	.00	.68	9.13	.00	9.13	9.81	.00	9.81
St. Johns	.00	.00	.00	.00	.00	.00	.00	.00	.00
St. Lucie	.00	.00	.00	.00	1,254.28	1,254.28	.00	1,254.28	1,254.28
Santa Rosa	.00	.00	.00	.00	.00	.00	.00	.00	.00
Sarasota	.00	.00	.00	.00	.00	.00	.00	.00	.00
Seminole	.00	.00	.00	.00	.00	.00	.00	.00	.00
Sumter	.00	.00	.00	.00	.00	.00	.00	.00	.00
Suwannee	.08	.00	.08	64.95	.00	64.95	65.03	.00	65.03
Taylor	.00	.00	.00	.00	.00	.00	.00	.00	.00
Union	.00	.00	.00	.00	.00	.00	.00	.00	.00
Volusia	.16	.00	.16	111.25	15.25	126.50	111.41	15.25	126.66
Wakulla	.01	.00	.01	.00	29.05	29.05	.01	29.05	29.06
Walton	.00	.00	.00	.00	.00	.00	.00	.00	.00
Washington	.00	.00	.00	.00	.00	.00	.00	.00	.00
Totals:	18.74	59.11	77.85	632.71	10,694.99	11,327.70	651.45	10,754.10	11,405.55

Water was withdrawn for self-supplied thermoelectric power generation in only 26 of Florida's 67 counties in 1985 (table 10). Hillsborough County accounted for the largest amount of saline water withdrawals (22 percent) and Escambia County accounted for the largest amount of freshwater withdrawals (37 percent) for thermoelectric power generation in 1985. There are two plants that withdraw saline ground water (59 Mgal/d) for cooling purposes in Monroe County. Several plants use reclaimed wastewater for cooling in Osceola and Polk Counties.

Total water withdrawals for thermoelectric power generations decreased more than 1.7 bgd (billion gallons per day) from 1975 to 1985 (fig. 31). In the same period of time, power production was up 17 percent. During this 10-year period, powerplants began recycling cooling water after routing the water to cooling ponds or cooling towers.

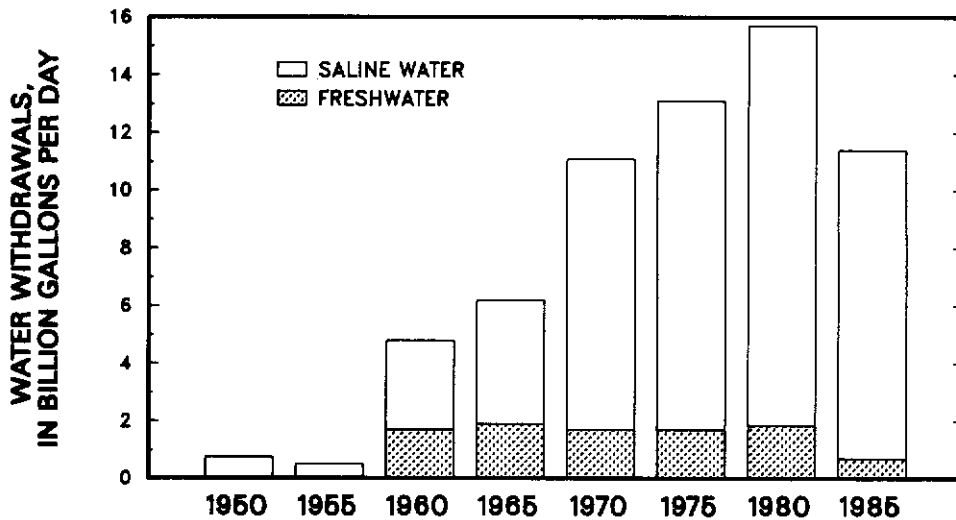


Figure 31.—Historical thermoelectric power generation water withdrawals in Florida by source, in 5-year intervals, 1950-85. (Modified from Leach, 1983.)

Miscellaneous Water Withdrawals and Uses

Miscellaneous water uses in Florida include water withdrawn for residential lawn irrigation and residential heat pump and air conditioning units that are not supplied by public systems. These withdrawals were not included under the previous sections because they fail to fit under one specific category. These withdrawal data were only collected for certain counties or areas and, because of this inconsistency, these values were not included in the State summaries.

Residential lawn irrigation includes withdrawals (from wells) for the sole purpose of irrigating a residential lawn with no domestic or other use involved. This category was not included under turf grass in agricultural irrigation primarily because turf grass included only commercial irrigation and not residential. Data were estimated for only 17 of 67 counties.

Residential heat pumps and air conditioning units include withdrawals (from wells) for use in a heat exchange for a heating/air conditioning unit. Many of these withdrawals also serve as irrigation when the unit is operating. Restrictions on these withdrawals now require return wells to these units, but existing systems continue to discharge to the surface. Data for these withdrawals existed in only 4 of 67 counties.

Unused discharge from free flowing wells was also included in this section. An estimated 15,000 free-flowing wells exist in the State (Healy, 1978), and many of these wells are being plugged as a result of water management district programs. Data were available for 19 of the 67 counties.

Total withdrawals for this category were 105 Mgal/d, all of which was ground water. Heat pumps and air conditioning units accounted for 43 Mgal/d, free-flowing wells for 33 Mgal/d, and residential lawn watering for 29 Mgal/d. Although the quantities of water withdrawn were not delineated by aquifer, the majority of heat pump and air conditioning units and free-flowing wells are open to the Floridan. Shallow aquifers are the primary source for residential lawn watering wells. In all, 34 counties have some withdrawal data for this category. These counties are shown in table 11 for the withdrawal type that was inventoried within that county.

SUMMARY

In 1985, the total water withdrawn for use in Florida was 17,057 Mgal/d, of which 6,259 Mgal/d, or nearly 37 percent was freshwater and 10,798 Mgal/d was saline. Ground water accounted for 64 percent of freshwater withdrawals and surface water accounted for more than 99 percent of saline withdrawals. An estimated 43 percent, or 2,730 Mgal/d, of freshwater withdrawals was consumptive use in 1985. Total wastewater discharged from wastewater-treatment facilities equaled 1,392 Mgal/d of which 51 Mgal/d was reused for irrigation purposes.

With more than 4,000 Mgal/d of ground water withdrawn, Florida ranked sixth in the Nation in ground-water withdrawals for 1985. Ground water is the primary source of freshwater in Florida because it is readily available and is generally of good quality. The Floridan aquifer system, which underlies the entire State, supplied more than 62 percent of the total ground water withdrawn in 1985. Fresh ground water accounted for 64 percent of Florida's total freshwater use, up from 51 percent in 1980 and 48 percent in 1975. This increase of more than 718 Mgal/d in 10 years indicates the importance of ground water in Florida. In contrast to ground water, surface-water withdrawals have been declining due to both more efficient use and problems with quality and quantity reliability.

Agricultural irrigation was the largest user of both fresh ground water (41 percent) and fresh surface water (60 percent) in 1985. Public supply accounted for 36.5 percent of fresh ground-water withdrawals followed by commercial-industrial (16 percent), domestic self supplied (6 percent),

Table 11.--Miscellaneous water withdrawals in Florida by county, 1985

[In million gallons per day; -- = no data]

County	Lawn irrigation	Heat pumps	Flowing wells	Total
Alachua	--	0.97	--	0.97
Baker	--	--	--	--
Bay	--	--	--	--
Bradford	--	--	--	--
Brevard	--	27.34	26.00	53.34
Broward	--	--	--	--
Calhoun	--	--	--	--
Charlotte	2.27	--	--	2.27
Citrus	2.20	--	--	2.20
Clay	--	--	.79	.79
Collier	--	--	--	--
Columbia	--	--	--	--
Dade	--	--	--	--
De Soto	--	--	--	--
Dixie	--	--	--	--
Duval	--	5.63	.51	6.14
Escambia	--	--	--	--
Flagler	--	--	.08	.08
Franklin	--	--	--	--
Gadsden	--	--	--	--
Gilchrist	--	--	--	--
Glades	--	--	--	--
Gulf	--	--	--	--
Hamilton	--	--	--	--
Hardee	.07	--	--	.07
Hendry	--	--	--	--
Hernando	2.19	--	--	2.19
Highlands	1.10	--	--	1.10
Hillsborough	6.86	--	--	6.86
Holmes	--	--	--	--
Indian River	--	--	.49	.49
Jackson	--	--	--	--
Jefferson	--	--	--	--
Lafayette	--	--	--	--
Lake	--	--	.49	.49
Lee	--	--	--	--
Leon	--	--	--	--
Levy	1.30	--	--	1.30
Liberty	--	--	--	--
Madison	--	--	--	--
Manatee	1.49	--	--	1.49
Marion	1.87	--	1.71	3.58
Martin	--	--	--	--
Monroe	--	--	--	--
Nassau	--	--	.02	.02
Okaloosa	--	--	--	--
Okeechobee	--	--	--	--
Orange	--	.82	.02	.84
Osceola	--	--	--	--
Palm Beach	--	--	--	--
Pasco	.90	--	--	.90
Pinellas	--	--	--	--
Polk	4.37	--	--	4.37
Putnam	--	2.30	.55	2.85
St. Johns	--	.10	1.04	1.14
St. Lucie	--	--	--	--
Santa Rosa	--	--	--	--
Sarasota	3.70	--	--	3.70
Seminole	--	--	.12	.12
Sumter	.50	--	--	.50
Suwannee	--	--	--	--
Taylor	--	--	--	--
Union	--	--	--	--
Volusia	--	6.23	1.26	7.49
Wakulla	--	--	--	--
Walton	--	--	--	--
Washington	--	--	--	--
Totals:	28.82	43.39	33.08	105.29

and thermoelectric power generation (0.5 percent). An additional 105 Mgal/d of ground water was withdrawn for miscellaneous use and are not included in these totals. Thermoelectric power generation accounted for 28 percent of the fresh surface-water withdrawals, followed by public supply (8 percent) and commercial-industrial self supplied (4 percent). Thermoelectric power accounted generation for more than 99 percent of saline-water withdrawals. Between 1975-85, freshwater withdrawals for public supply increased 514 Mgal/d, domestic self supplied increased 58 Mgal/d, and agricultural irrigation increased 49 Mgal/d, whereas commercial-industrial self-supplied withdrawals decreased 231 Mgal/d and thermoelectric power generation withdrawals decreased 1,044 Mgal/d.

Seasonal fluctuations of withdrawals for each category vary dramatically between months. The two categories most affected by seasonality are agricultural irrigation and public supply. In 1985, agricultural irrigation demands fluctuated more than 2,000 Mgal/d from a peak in April to a low in December. This fluctuation is a result of intense crop production and extremely dry conditions during the spring months. Public-supply demands fluctuated more than 400 Mgal/d from May (peak) to September (low). This fluctuation is a result of seasonal differences in residential demand, primarily for lawn irrigation and tourism. Overall, more than 40 percent of the year's freshwater withdrawals occurred from March through June.

Palm Beach County withdrew the largest amount of freshwater and Hillsborough County withdrew the largest amount of saline water in 1985. Four counties withdrew more than 200 Mgal/d of fresh ground water (Dade, Polk, Hillsborough, and Broward) and two counties withdrew more than 200 Mgal/d of fresh surface water (Palm Beach and Escambia). The following counties withdrew the largest amount of freshwater for each category: Palm Beach (agricultural irrigation), Dade (public supply), Polk (domestic self supplied and commercial-industrial self supplied) and Escambia (thermoelectric power generation).

In 1985, 162 Mgal/d of public-supplied water was withdrawn from counties other than the county of use. The largest importer of public-supplied water is Pinellas County which is supplied with more than 100 Mgal/d from adjacent Hillsborough and Pasco Counties.

Total freshwater withdrawals have increased almost 388 Mgal/d (excluding fresh surface-water withdrawals for thermoelectric power generation) between 1975-85. Increases in population, tourism, and irrigated acreage have accounted for increases in withdrawals. Florida's population increase of nearly 3 million people between 1975-85, plus an increase of nearly 13 million in tourism, are the primary reasons for the increase in public-water demands. Irrigated agricultural acreage increased by 70,000 acres between 1975 and 1985 despite losses to freezes and urbanization between 1975 and 1985. As these growth trends continue (as anticipated), so will the demand for water to support these activities in Florida for future years.

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