Factors that Affect Public-Supply Water Use in Florida, with a Section on Projected Water Use to the Year 2020

By Richard L. Marella

U.S. GEOLOGICAL SURVEY

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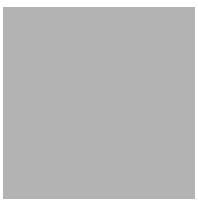

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CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
inches (in.)	25.4	millimeter
inches per year (in/yr)	25.4	millimeters per year
gallons per day (gal/d)	0.003785	cubic meters per day
million gallons per day (Mgal/d)	0.003785	cubic meters per second
billion gallons per day (Ggal/d)	3.785	cubic meters per second
gallons (gal)	3.785	liter

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C = 5/9 \times (°F - 32)$$

Additional Information:

mg/L = milligrams per liter
RO = reverse osmosis

GLOSSARY

[References in "Glossary" are listed in "Selected References"]

Commercial water use. Water for motels, hotels, restaurants, office buildings, and other commercial facilities, and institutions, both civilian and military. The water may be obtained from a public supply or may be self-supplied.

Community water system. A public-water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

Consumptive use. That part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment. Also referred to as water consumed and water depletion.

Desalination or desalting. Refers to the removal of salts from water. Desalination is primarily used for public supply water to ensure that it meets Florida Department of Environmental Regulation secondary drinking water standards. The three primary types of desalination are: (1) distillation processes, (2) electrodialysis processes, and (3) reverse osmosis processes (Buros, 1989). The reverse osmosis processes are the most commonly used in Florida with some electrodialysis processes used (Dykes and Conlon, 1989). See "Reverse osmosis."

Domestic water use. Water for household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens. Also called residential water use. The water may be obtained from a public supply or may be self-supplied.

Evapotranspiration. A collective term that includes water discharged to the atmosphere as a result of evaporation from the soil and surface-water bodies and by plant transpiration.

Freshwater. Water that contains less than 1,000 mg/L (milligrams per liter) of dissolved solids: generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses. Generally, freshwater is considered potable water.

Industrial water use. Water used for industrial purposes as fabrication, processing, washing, and cooling, and includes such industries as steel, chemical and allied products, paper and allied products, mining, and petroleum refining. The water may be obtained from a public supply or may be self-supplied.

Million gallons per day (Mgal/d). A rate of flow of water.

Nonresident population. The number of persons who live in or visit Florida who do not consider it their usual place of residence. Tourists and seasonal or parttime residents are considered nonresident population.

Other water use. Water used for such purposes as heating or cooling, irrigation (public-supplied only), lake augmentation, and other nonspecific uses. The water may be obtained from a public supply or may be self-supplied. This category may also be referred to as miscellaneous water use.

Per capita use. The average amount of water used per person during a standard time period, generally per day.

Public supply. Water withdrawn by public and private water suppliers and delivered to groups of users. Public suppliers provide water for a variety of uses, such as domestic, commercial, industrial, thermoelectric power, public water use, and other water use. See also commercial water use, domestic water use, industrial water use, thermoelectric power water use, public water use, and other water use.

Public-supply deliveries. Water provided for multiple users through a public-supply distribution system.

Public water use. Water supplied from a public-water supply and used for such purposes as firefighting, street washing, and municipal parks and swimming pools. This also includes water lost to leakage or unaccountable water losses.

Pumpage. Water withdrawal from a specific site, utility, or well.

Reclaimed sewage or wastewater. Wastewater treatment-plant effluent that has been diverted or intercepted for use before it reaches a natural waterway or aquifer.

Recycled water. Water that is used more than one time before it passes back into the natural hydrologic system.

Resident population. The number of persons who live in the State that consider it their usual place of residence. College students, military personnel, and inmates of penal institutions are counted as permanent residents. Tourists and seasonal or parttime residents are considered nonresident population.

Residential water use. See domestic water use.

Reuse. See reclaimed sewage or wastewater.

Reverse osmosis (RO). Refers to the process of removing salts from water using a membrane. With RO, the product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed and disposed. This differs from electrodialysis (ED), where the salts are extracted from the feedwater also using a membrane by using an electrical current to separate the irons. The positive ions go through one membrane, while the negative ions through a different membrane, leaving the end product of freshwater. In this report, reverse osmosis will include any water treated through both RO and ED. See "Desalination."

Saline water. Water that contains more than 1,000 milligrams per liter of dissolved solids.

Self-supplied water. Water withdrawn from a surface- or ground-water source by a user rather than being obtained from a public supply.

Sewage. Wastewater carried off by sewers and drains.

Sewage treatment. The processing of wastewater for the removal or reduction of contained solids or other undesirable constituents.

South Atlantic-Gulf Region. Includes all of Florida and South Carolina and parts of Alabama, Georgia, North Carolina, Mississippi, and Virginia. This area is the same as that used by Solley and others, 1988, and the State Hydrologic Unit Maps (Seaber and others, 1984).

Thermoelectric power water use. Water used in the process of the generation of thermoelectric power. The water may be obtained from a public supply or may be self-supplied.

Transpiration. Process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface.

Wastewater. Water that carries wastes from homes, businesses, and industries.

Water transfer. Artificial conveyance of water from one area to another. This may be referred to as an import or export of water from one county to another.

Withdrawal. Water removed from the ground or diverted from a surface-water source for use.

Factors that Affect Public-Supply Water Use in Florida, with a Section on Projected Water Use to the Year 2020

By Richard L. Marella

Abstract

Public-supply water use in Florida increased 242 percent between 1960 and 1987 from 530 Mgal/d (million gallons per day) to 1,811 Mgal/d. This change is primarily a result of increases in population and tourism since 1960. Public-supply utilities provide water to a variety of users. In 1985, 71 percent of the water used for public supply was delivered for residential uses, 15 percent for commercial uses, 9 percent for industrial uses, and the remaining 5 percent for public use or other uses. Residential use of public-supply water in Florida has increased nearly 280 Mgal/d, but has decreased in the proportion of total deliveries from 80 to 71 percent between 1975 and 1985. This trend resulted from increased tourism and related commercial services associated with population and visitors.

One of several factors that influences public-supply water use in Florida is the increase in resident population, which increased from 4.95 million in 1960 to more than 12.0 million in 1987. Additionally, Florida's nonresident population increased from 18.8 million visitors in 1977, to 34.1 million visitors in 1987, and the part of Florida's population that relies on public-supply water increased from 68 percent in 1960, to 86 percent in 1987.

The public supply per capita use was multiplied by the projected populations for each county for the years 2000, 2010, and 2020 to forecast public-supply water use. Using medium projections, Florida's population is expected to increase to nearly 16 million in the year 2000, to 18 million in the year 2010, and to almost 20 million in the year 2020, of which an estimated 13.5 million people will be supplied water from public-supply water systems in the year 2000, 15 million in 2010, and nearly 17 million by the year 2020. Public-supply water use is expected to increase to a projected (medium) 2,310 Mgal/d in the year 2000, 2,610 Mgal/d in the year 2010, and 2,890 Mgal/d in the year 2020. If the population exceeds the medium projections for the years 2000, 2010, and 2020, high projections estimate public-supply water use could reach 2,570 Mgal/d in 2000, 3,210 Mgal/d in 2010, and 3,900 Mgal/d in 2020. Palm Beach County is projected to have the largest increase in public-supply water use, from 168 Mgal/d used in 1987 to a medium projected 338 Mgal/d for 2020. Dade County's public-supply water use is projected (medium) to increase to nearly 471 Mgal/d for 2020, the largest county use in Florida.

Water demand options, such as conservation, restrictions, education programs, leak detection and repair programs, and more realistic pricing practices can reduce the demand for freshwater. Increased use of alternative sources of water, such as reclaimed wastewater and desalinated seawater also can reduce the demand for freshwater. Because the water demand projections in this report are based primarily on population projections, they should represent an upper limit of actual future demand if the population projections prove sound. Any additional water demand options implemented in the future at the State, county, or public-supply facility level may significantly reduce per capita use and result in public-supply use less than projected in this report.

INTRODUCTION

With more than 12 million people in 1987, Florida ranks fourth in the Nation in resident population, behind California (27.7 million), New York (17.6 million), and Texas (16.8 million) (Shoemyen and others, 1988, p. 632). Florida's population has more than doubled since 1960, increasing from 4.95 million people in 1960 to more than 12 million in 1987 (Shoemyen and others, 1988, p. 5), and may surpass 20 million by the year 2020 (Smith and Bayya, 1989). In addition to resident population, nearly 34.1 million people visited Florida in 1987 (Florida Division of Tourism, 1988). This influx of permanent residents and tourists has created great demands on Florida's water resources. Public-supply water systems supplied water to 86 percent of Florida's population in 1987 compared to 68 percent in 1960 (MacKichan and

Kammerer, 1961). Public-supply water use in Florida increased from 530 Mgal/d in 1960 (MacKichan and Kammerer, 1961) to 1,811 Mgal/d in 1987 an increase of 242 percent (Marella, 1990).

The increased demand for water in Florida has led to water shortages, encroachment of saltwater into freshwater aquifers, and increased competition for water in some parts of the State. Mandatory temporary water-use restrictions have been instituted in many areas to reduce demand, and building moratoriums have been suggested. To avoid future crises, information is needed about the factors that affect public-supply demand and about projections of future use.

Maintaining a statewide water-use data base provides the information needed for making future decisions on water use based on historical trends. Through the cooperation of the Florida Department of Environmental Regulation, and the participation and support from the water management districts (Northwest Florida Water Management District, St. Johns River Water Management District, South Florida Water Management District, Southwest Florida Water Management District, and the Suwannee River Water Management District) (fig. 1) this statewide water-use data base has been developed and maintained. This report is a result of a cooperative effort between the U.S. Geological Survey, and the Florida Department of Environmental Regulation to study the factors affecting public supply water demands in Florida, and provide a set of usable public-supply projections that can be updated periodically.

Purpose and Scope

The purpose of this report is to (1) present historical public-supply water-use data for Florida and show trends, (2) discuss factors that affect public-supply water use in Florida, and (3) present public-supply water-use projections to the year 2020.

Public-supply water use and related data are presented for 1950 to 1987. Data are reported on county and State level for public-supply water use, population served, public-supply per capita, public-supply water deliveries, and other pertinent categories. Much of these data are from published reports, or from files of unpublished data.

The projections made in this report are based on current (1980's) economic and political conditions. Changes in the current economy, such as a recession, or in local or State governmental policy, such as growth-management constraints (building moratoriums, land-use policy changes), and implementation of water demand management options may affect the accuracy of these projections. Water demand options, such as conservation, restrictions, education programs, leak detection and repair programs, and more realistic pricing practices can reduce the demand for freshwater. Increased use of alternative sources of water, such as reclaimed wastewater and desalinated seawater also can reduce the demand for freshwater. Because the water demand projections in this report are based primarily on population projections, they should represent an upper limit of actual future demand if the population projections prove sound. Any additional water demand options implemented in the future at the State, county, or public-supply facility level may significantly reduce per capita use and result in public-supply use less than projected in this report. The coefficients used to project future water use in this report are derived from historical trends and from conditions in the 1980's.

Previous Investigations

As part of the U.S. Geological Survey National Water-Use Information Program, water-use data are collected and compiled for each State every 5 years. Public-supply data for 1950 (MacKichan, 1951), 1955 (MacKichan, 1957), and 1960 (MacKichan and Kammerer, 1961) were published for the United States and provided water use data at the State level for Florida. After 1960, in addition to the national program, public-supply water-use data was published for all 67 counties in Florida for 1965 (Pride, 1975), 1970 (Pride, 1973); 1975 (Leach, 1978), 1977 (Leach and Healy, 1980), 1980 (Leach, 1983), 1985 (Marella, 1988), and 1987 (Marella, 1990).

Several reports have been published in Florida that detail or examine factors that affect public-supply water use. These include Lynne and Gibbs (1976), Lewis and others (1981), Rodan and Lynne (1981), and Lynne and others (1984). These reports vary in degree of detail and the area of study, but do provide good information regarding many of the factors that affect public-supply water use in Florida.

Few statewide assessments of future public-supply water use have been performed on a county level in Florida. Two recent publications include: Florida Advisory Council on Intergovernmental Relations (1984), and Leach (1984). Both assessments used the single coefficient method (the 1980 public-supply per capita), and provided public-supply projections for counties but do not include projections for changes in per capita use or in the population served by public supply for each county.

Terminology

The term "potable water" refers to water that meets the secondary drinking water standards set by the Florida Department of Environmental Regulation (FDER) that are

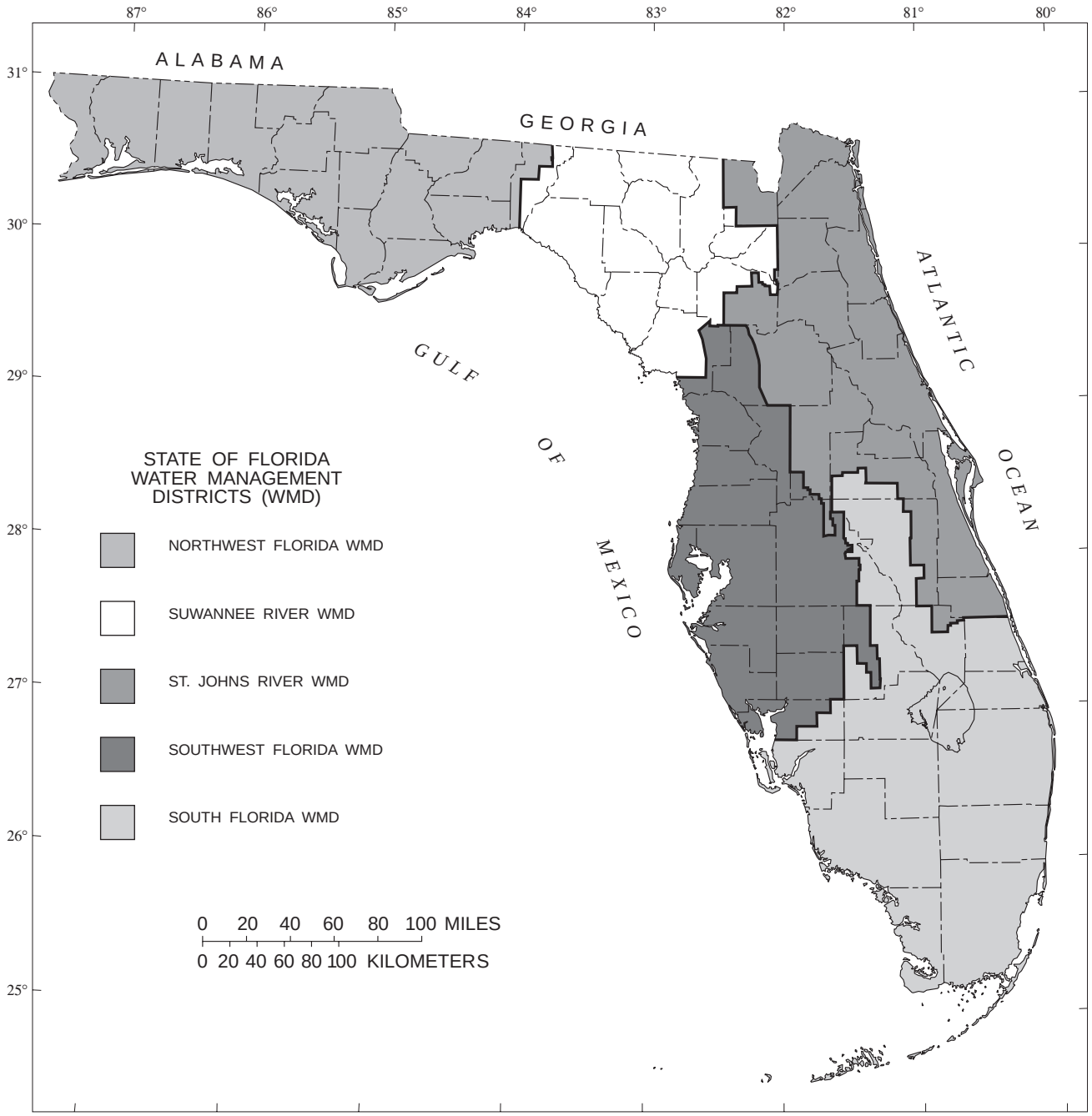

Figure 1. Location of water-management districts in Florida. (Modified from Marella, 1990.)

imposed on public-supply water systems (Florida Department of Environmental Regulation, 1990). Potable water is considered safe for human consumption. Chloride and dissolved solids concentrations in potable water are less than or equal to 250 mg/L and 500 mg/L, respectively. Freshwater that exceeds these chloride and dissolved solids limits is either diluted with fresher water or treated a by a desalination process (reverse osmosis or electrodialysis) to meet potable standards for public supply. This treated or diluted water is often referred to as slightly saline or nonpotable water.

The term “public supply” refers to water supplied by a government or publicly owned utility (for example, city, county, State, and others) or a privately owned water system for public distribution. Public suppliers provide water (deliveries) to a variety of users, such as domestic (residential), commercial, industrial, thermoelectric power and other use (fig. 2). According to the FDER, any water-

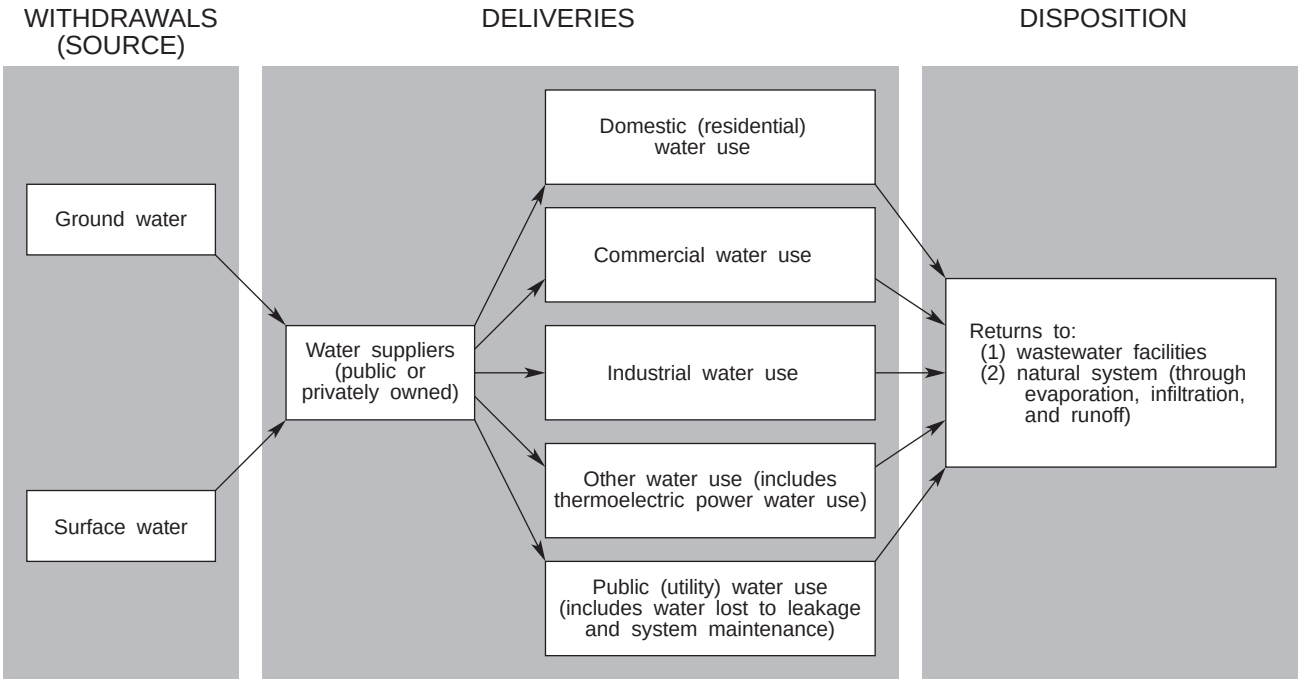

Figure 2. Public-supply water use in Florida (modified from Linaweaver and others, 1967 and Marella, 1990).

supply system that serves more than 25 permanent residents, or has more than 15 or more year-round service connections is considered a public supply (Florida Department of Environmental Regulation, 1990, p. 6). A public supplier may have several water-supply systems under its operations or ownership.

The term "water use" for the public-supply category refers to water withdrawals, deliveries, and disposition (fig. 2).

Acknowledgments

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FACTORS THAT AFFECT PUBLIC-SUPPLY WATER USE IN FLORIDA

Many factors affect public-supply water use in Florida. Five broad categories of factors that affect water demands are: (1) population, (2) climate, (3) socioeconomic conditions, (4) water pricing practices, (5) water conservation and alternative supply sources. These factors can vary in degree of influence within the State. This section will examine each factor and how it affects public-supply water use throughout Florida.

Public-Supply Setting in Florida

In 1985, the amount of freshwater withdrawn in Florida totaled 6,259 Mgal/d. Ground water accounted for 64 percent of the water withdrawn and surface water 36 percent (Marella, 1988, p. 7). Agricultural irrigation accounted for most of the fresh ground-water withdrawals (41 percent) followed by public supply (36.5 percent), self-supplied commercial/industrial (16 percent), self-supplied domestic (6 percent) and thermoelectric power generation (0.5 percent). Agricultural irrigation also accounted for most of the fresh surface-water withdrawals

(60 percent), followed by thermoelectric power generation (28 percent), public supply (8 percent), and self-supplied commercial/industrial (4 percent) in 1985. Overall, public supply accounted for 26.5 percent of the total freshwater withdrawn in Florida for 1985.

Withdrawals

In 1987, the FDER, had more than 2,300 active public suppliers (community systems) on file (Marella, 1990). For 1987, public-supply water use and related data (included withdrawals, population, and per capita use) were collected for the largest public water suppliers in Florida. This inventory included systems that served 400 people or more, or withdrew more than 0.01 Mgal/d (10,000 gallons of water per day). Total water withdrawn by these 969 utilities amounted to 1,811 Mgal/d and served an estimated 10.4 million people (Marella, 1990).

Public suppliers obtain water from either ground- or surface-water sources or purchase it from other utilities. Ground water is the primary source for public-supply water in Florida because it is readily available and is of quality suitable for most uses in most areas of the State. Additionally, ground water usually requires very little treatment before distribution and thus is generally cheaper. In 1985, Florida ranked second in the Nation behind California (Solley and others, 1988) in ground-water withdrawals for public supply. Ground water accounted for 90 percent (1,635 Mgal/d) of the public-supply withdrawals in Florida for 1987 (Marella, 1990).

Dade County (fig. 3) had the largest public-supply withdrawals in the State for 1987 with 365.2 Mgal/d (Marella, 1990). Four other counties with public-supply withdrawals greater than 100 Mgal/d in 1987 were Broward, Hillsborough, Orange, and Palm Beach (table 1). These five counties accounted for more than 55 percent of the public-supply withdrawals statewide in 1987.

To help meet public-supply demands, several counties transfer (import) water from adjacent counties. In 1987, 127.9 Mgal/d of public-suppy water was withdrawn from one county for use in another (Marella, 1990). Of the five counties that imported water in 1987, Monroe County imported 100 percent of its water for public supply from Dade County and Pinellas County imported 67 percent of its water for public supply from adjacent Hillsborough and Pasco Counties (table 1). Other counties involved in importing or exporting public-supply water include Brevard, Charlotte, De Soto, Manatee, Orange and Sarasota.

Deliveries

Public-supply water is delivered for the following categories of use: residential (domestic use), commercial, industrial, thermoelectric power use, public use (water utility), and other use (fig. 2). In 1985, public-supply withdrawals totaled 1,677 Mgal/d, of which 71 percent was delivered for residential use, 15 percent for commercial, 9 percent industrial, 3 percent public use (water utility), and 2 percent for other use (Marella, 1988, p. 18).

Public-supply water deliveries for residential use includes water for indoor and outdoor household use. Indoor uses include water used for bathing, cooking, drinking, washing, and waste disposal; outdoor uses include lawn and garden watering, car washing, filling swimming pools, and possibly caring for livestock. Dade County had the largest amount of residential deliveries from public supply, followed by Palm Beach and Broward Counties (table 2). In 1985, Florida had a higher percentage (71 percent) of residential water deliveries of the total public-supply use than the South Atlantic-Gulf Region (63 percent) and the nationwide average of 57.5 percent (Solley and others, 1988, p. 11). Some reasons for the high percentage of residential deliveries from public supply in Florida include: a relatively high number of housing units (because many units are second homes or rental units); a high percentage of residential water use for outdoor purposes; and because many large commercial and industrial water users in the State do not obtain their water from public-supply water systems.

Total water used for commercial purposes in Florida equaled 305 Mgal/d in 1985, of which 82 percent (250.9 Mgal/d) was delivered from public-water suppliers and the remaining 18 percent was self-supplied by the users (Solley and others, 1988, p. 21). Commercial use of public-supply water accounted for 15 percent of the public-supply water deliveries in Florida (Marella, 1988, p. 18). This percentage is similar to the averages for the South Atlantic-Gulf Region (14.5 percent) and the Nation (15.6 percent) for 1985 (Solley and others, 1988, p. 19).

Total freshwater used by industry equaled 537 Mgal/d in 1985, of which 26.5 percent (142.2 Mgal/d) was delivered from public-water suppliers and the remaining 73.5 percent was self-supplied (Solley and others, 1988, p. 33). Industrial deliveries accounted for 9 percent of the public-supply water use in Florida (Marella, 1988, p. 18) in 1985. This percentage was substantially lower than the averages for the South Atlantic-Gulf Region (16.4 percent) and the Nation (15.7 percent) in 1985 (Solley and others, 1988, p. 31).

Public use of public-supply water accounted for 3 percent, and other uses (including thermoelectric power use) accounted for 2 percent of the public-supply water in 1985 (Marella, 1988, p. 18). However, more recent data from the public suppliers indicates that the use of water for public purposes should range between 7 and 15 percent, especially when these values include system water losses.

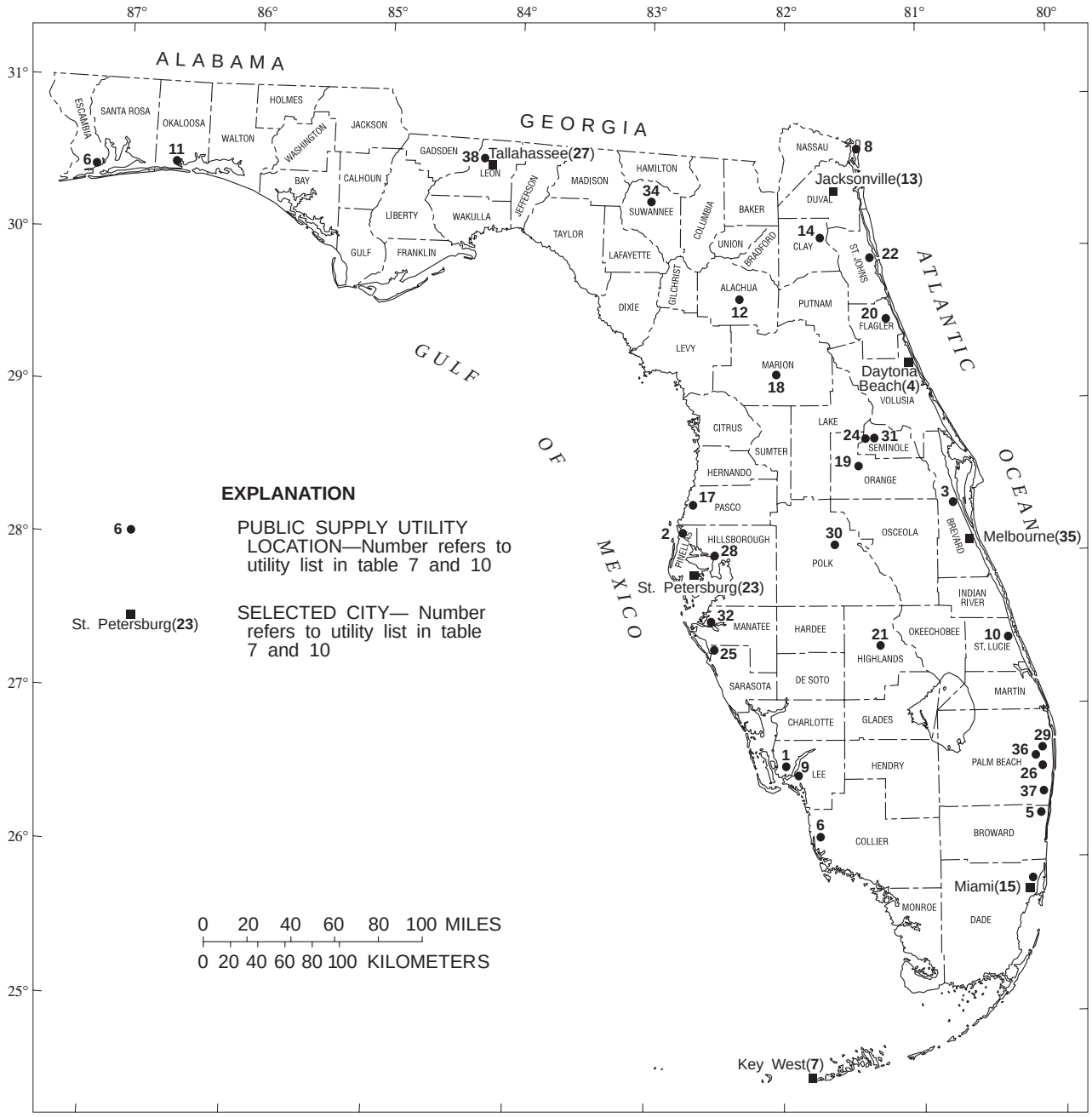

Figure 3. Counties, selected cities, and selected utilities in Florida.

Public-supply water used for these two categories totaled 87.9 Mgal/d in 1985, of which 64 percent (56.7 Mgal/d) was for public use and 36 percent (31.2 Mgal/d) was for other uses (table 2).

Trends

Public-supply water use for Florida has increased rapidly since water-use data were first collected (fig. 4). Public-supply use for 1950 was 170 Mgal/d (MacKichan, 1951, p. 6); by 1960 it was 530 Mgal/d (MacKichan and Kammerer, 1961, p. 13); and by 1987 the public-supply water use totaled 1,811 Mgal/d (Marella, 1990)--an overall increase of 965 percent between 1950 and 1987. During the 1960's, public-supply water use increased approximately 35 Mgal/d per year. However, during the 1970's, public supply increased approximately 48 Mgal/d per year and during the 1980's the average increase per year was approximately 64 Mgal/d per year.

Table 1. Population in Florida and public supply, water use, withdrawals, and transfers by county, 1987

[Public supply data from Marella, 1990; total population source from Shoemyen and others, 1988, p. 5-7]

	Population		Public supply, in million gallons per day (per capita use in gallons per day)						
			Use		Withdrawals			Transfers	
County	Total[1]	Served by public supply	Total	Per capita	Total	Ground	Surface	Imported	Exported
Alachua	179,715	135,572	21.88	161	21.88	21.88	0.00	0.00	0.00
Baker	18,364	4,315	.63	146	.63	.63	.00	.00	.00
Bay	129,679	96,825	22.53	233	22.53	6.47	16.06	.00	.00
Bradford	24,120	8,648	1.49	172	1.49	1.49	.00	.00	.00
Brevard	371,735	330,518	49.18	149	25.69	10.08	15.61	23.49	.00
Broward	1,180,985	1,154,499	207.64	180	207.64	207.64	.00	.00	.00
Calhoun	9,720	2,683	.40	149	.40	.40	.00	.00	.00
Charlotte	88,230	93,426	10.25	110	10.46	3.03	7.43	.00	.21
Citrus	81,863	48,057	7.79	162	7.79	7.79	.00	.00	.00
Clay	95,325	69,687	9.92	142	9.92	9.92	.00	.00	.00
Collier	126,631	97,838	29.30	299	29.30	24.69	4.61	.00	.00
Columbia	41,506	11,774	2.23	189	2.23	2.23	.00	.00	.00
Dade	1,802,427	1,731,374	352.10	203	365.24	365.24	.00	.00	13.14
De Soto	22,890	7,927	.81	102	.79	.79	.00	.02	.00
Dixie	9,866	3,896	.60	154	.60	.60	.00	.00	.00
Duval	664,132	561,345	94.28	168	94.28	94.28	.00	.00	.00
Escambia	278,419	232,225	36.76	158	36.76	36.76	.00	.00	.00
Flagler	19,243	17,502	2.56	146	2.56	2.56	.00	.00	.00
Franklin	8,538	7,663	1.52	198	1.52	1.52	.00	.00	.00
Gadsden	46,187	23,073	3.36	146	3.36	1.93	1.43	.00	.00
Gilchrist	7,098	1,468	.40	272	.40	.40	.00	.00	.00
Glades	7,357	2,254	.26	115	.26	.26	.00	.00	.00
Gulf	12,001	6,389	1.02	160	1.02	1.02	.00	.00	.00
Hamilton	9,355	5,367	.83	155	.83	.83	.00	.00	.00
Hardee	22,095	8,941	1.35	151	1.35	1.35	.00	.00	.00
Hendry	24,572	17,988	3.16	176	3.16	3.16	.00	.00	.00
Hernando	79,718	77,398	10.48	135	10.48	10.48	.00	.00	.00
Highlands	63,540	50,539	7.82	155	7.82	7.82	.00	.00	.00
Hillsborough	801,392	702,915	105.16	150	122.60	63.64	58.96	.00	17.44
Holmes	16,289	4,461	.88	197	.88	.88	.00	.00	.00
Indian River	83,515	49,207	11.98	243	11.98	11.98	.00	.00	.00
Jackson	43,729	15,740	2.47	157	2.47	2.47	.00	.00	.00
Jefferson	11,924	2,898	.62	214	.62	.62	.00	.00	.00
Lafayette	5,053	938	.16	171	.16	.16	.00	.00	.00
Lake	137,138	91,493	17.66	193	17.66	17.66	.00	.00	.00
Lee	293,713	234,202	33.53	143	33.53	30.96	2.57	.00	.00
Leon	176,470	138,240	23.06	167	23.06	23.06	.00	.00	.00
Levy	23,879	7,841	1.33	170	1.33	1.33	.00	.00	.00
Liberty	4,974	1,366	.21	154	.21	.21	.00	.00	.00
Madison	15,858	6,390	1.36	213	1.36	1.36	.00	.00	.00
Manatee	181,684	178,491	24.64	138	34.93	.00	34.93	.00	10.29
Marion	174,614	82,533	13.21	160	13.21	13.21	.00	.00	.00
Martin	88,964	51,955	10.11	195	10.11	10.11	.00	.00	.00
Monroe	74,523	73,500	13.14	179	.00	.00	.00	13.14	.00
Nassau	43,994	20,735	3.54	171	3.54	3.54	.00	.00	.00
Okaloosa	149,033	117,492	18.53	158	18.53	18.53	.00	.00	.00
Okeechobee	27,745	15,240	2.00	131	2.00	.00	2.00	.00	.00
Orange	603,339	586,968	116.25	198	139.74	139.74	.00	.00	23.49
Osceola	87,556	54,396	7.51	138	7.51	7.51	.00	.00	.00
Palm Beach	789,533	759,846	168.48	222	168.48	137.02	31.46	.00	.00
Pasco	254,696	210,669	23.00	109	83.87	83.87	.00	1.24	62.11
Pinellas	828,700	846,348	118.33	140	40.02	40.02	.00	79.55	1.24
Polk	389,056	312,880	60.17	192	60.17	60.17	.00	.00	.00
Putnam	62,476	20,831	3.28	157	3.28	3.28	.00	.00	.00
St. Johns	75,133	58,132	7.56	130	7.56	7.56	.00	.00	.00
St. Lucie	128,381	81,503	12.33	151	12.33	12.33	.00	.00	.00
Santa Rosa	66,221	64,608	9.15	142	9.15	9.15	.00	.00	.00
Sarasota	251,253	199,358	30.26	152	19.78	18.45	1.33	10.48	.00
Seminole	254,837	231,550	40.86	176	40.86	40.86	.00	.00	.00
Sumter	29,307	9,704	1.13	116	1.13	1.13	.00	.00	.00
Suwannee	26,231	8,689	1.33	153	1.33	1.33	.00	.00	.00
Taylor	18,775	10,519	1.59	151	1.59	1.59	.00	.00	.00
Union	10,722	4,000	.61	153	.61	.61	.00	.00	.00
Volusia	330,939	290,994	40.27	138	40.27	40.27	.00	.00	.00
Wakulla	13,695	6,156	.68	110	.68	.68	.00	.00	.00
Walton	27,509	24,647	3.14	127	3.14	3.14	.00	.00	.00
Washington	15,447	6,685	1.00	150	1.00	1.00	.00	.00	.00
Totals	12,043,608	10,393,311	1,811.07	174	1,811.07	1,634.68	176.39	127.92	127.92

[1]From Shoemyen and others, 1988, p. 5-7.

Table 2. Public-supply water deliveries in Florida, by county, 1985

[<, less than; modified from Shoemyen and others, 1987, p. 196-197; Marella, 1988; other includes water used for thermoelectric power generation, irrigation, and heating and cooling; values may not add to totals because of independent rounding]

	Public-supplied water deliveries by category of use (in million gallons per day)										
	Total	Residential		Commercial		Industrial		Public (utility)		Other	
County	use	Use	Percent	Use	Percent	Use	Percent	Use	Percent	Use	Percent
Alachua	21.25	14.79	70	3.09	15	2.98	14	0.07	<1	0.32	<1
Baker	.60	.52	87	.02	3	.00	0	.02	3	.04	7
Bay	31.92	16.59	52	12.44	39	.64	2	1.93	6	.32	1
Bradford	1.34	.79	59	.26	19	.27	20	.01	1	.01	1
Brevard	45.40	36.66	81	3.18	7	1.24	3	4.32	10	.00	0
Broward	187.95	124.05	66	37.59	20	24.43	13	1.88	1	.00	0
Calhoun	.39	.27	69	.12	31	.00	0	.00	0	.00	0
Charlotte	10.64	8.93	84	1.06	10	.11	1	.54	5	.00	0
Citrus	6.55	5.77	88	.52	8	.13	2	.13	2	.00	0
Clay	8.40	7.48	89	.20	2	.08	1	.62	7	.02	<1
Collier	25.38	20.55	81	3.55	14	.25	1	1.03	4	.00	0
Columbia	1.99	.80	40	.87	44	.30	15	.02	1	.00	0
Dade	328.43	216.76	66	65.68	20	42.70	13	3.29	1	.00	0
De Soto	.68	.60	88	.06	9	.01	1	.01	1	.00	0
Dixie	.64	.57	89	.05	8	.02	3	.01	2	.00	0
Duval	84.86	53.12	63	10.61	13	9.50	11	5.35	6	6.28	7
Escambia	37.62	19.81	53	1.97	5	7.72	21	2.02	5	6.10	16
Flagler	2.22	1.95	88	.08	4	.02	1	.17	8	.00	0
Franklin	1.20	.84	70	.24	20	.06	5	.06	5	.00	0
Gadsden	2.73	1.87	69	.46	17	.25	9	.15	5	.00	0
Gilchrist	.34	.30	88	.03	9	.00	0	.01	3	.00	0
Glades	.25	.21	84	.02	8	.01	4	.01	4	.00	0
Gulf	.98	.88	90	.08	8	.01	1	.01	1	.00	0
Hamilton	.73	.51	70	.07	10	.11	15	.04	5	.00	0
Hardee	1.32	1.12	85	.13	10	.05	4	.02	2	.00	0
Hendry	2.89	2.31	80	.14	5	.30	10	.14	5	.00	0
Hernando	7.88	6.42	81	.90	11	.40	5	.12	2	.04	1
Highlands	7.88	5.90	75	.39	5	1.50	19	.09	1	.00	0
Hillsborough	114.09	84.08	74	10.03	9	16.99	15	1.72	2	1.27	1
Holmes	.82	.66	80	.14	17	.00	0	.02	2	.00	0
Indian River	8.84	6.83	77	.42	5	.36	4	.84	10	.39	4
Jackson	2.44	1.22	50	.36	15	.79	32	.07	3	.00	0
Jefferson	.60	.43	72	.15	25	.00	0	.02	3	.00	0
Lafayette	.15	.12	80	.01	7	.01	7	.01	7	.00	0
Lake	15.34	12.11	79	1.03	7	.80	5	1.07	7	.33	2
Lee	31.73	27.92	88	2.54	8	.32	1	.95	3	.00	0
Leon	22.06	12.57	57	6.83	31	.22	1	2.06	9	.38	2
Levy	1.19	.83	70	.11	9	.11	9	.14	12	.00	0
Liberty	.25	.20	80	.03	12	.00	0	.02	8	.00	0
Madison	1.18	.60	51	.30	25	.24	20	.04	3	.00	0
Manatee	21.49	18.22	85	1.35	6	.88	4	.54	3	.50	2
Marion	11.89	9.45	79	.68	6	.65	5	1.11	9	.00	0
Martin	9.33	7.50	80	.58	6	.39	4	.86	9	.00	0
Monroe	11.34	3.98	35	4.71	42	.00	0	2.65	23	.00	0
Nassau	3.04	1.52	50	.26	9	.86	28	.40	13	.00	0
Okaloosa	17.36	11.45	66	3.47	20	.00	0	.20	1	2.24	13
Okeechobee	1.93	1.31	68	.19	10	.06	3	.37	19	.00	0
Orange	100.50	60.60	60	18.29	18	8.84	9	8.22	8	4.55	5
Osceola	5.69	4.83	85	.40	7	.12	2	.14	2	.20	4
Palm Beach	146.55	128.52	88	8.80	6	7.33	5	1.17	1	.73	1
Pasco	21.11	19.01	90	1.70	8	.00	0	.40	2	.00	0
Pinellas	115.08	84.12	73	25.66	22	.46	<1	3.61	3	1.23	1
Polk	54.90	41.39	75	7.91	14	3.62	7	1.64	3	.34	1
Putnam	2.97	2.24	75	.15	5	.13	4	.44	15	.01	<1
St. Johns	7.01	5.79	83	.14	2	.06	1	.51	7	.51	7
St. Lucie	10.83	8.66	80	.66	6	.97	9	.40	4	.14	1
Santa Rosa	7.60	4.60	61	2.32	31	.08	1	.53	7	.07	1
Sarasota	26.73	22.70	85	2.93	11	.73	3	.30	1	.07	<1
Seminole	34.86	27.57	79	1.81	5	1.39	4	1.30	4	2.79	8
Sumter	1.31	1.07	82	.12	9	.09	7	.03	2	.00	0
Suwannee	1.33	.94	71	.16	12	.16	12	.07	5	.00	0
Taylor	1.58	1.11	70	.16	10	.24	15	.07	4	.00	0
Union	.52	.42	81	.06	12	.03	6	.01	2	.00	0
Volusia	36.40	27.30	75	2.26	6	2.18	6	2.48	7	2.18	6
Wakulla	.59	.55	93	.02	3	.00	0	.02	3	.00	0
Walton	2.99	2.48	83	.20	7	.00	0	.16	5	.15	5
Washington	1.03	.91	88	.10	10	.00	0	.02	2	.00	0
State values	1,677.11	1,196.18	71	250.85	15	142.20	9	56.68	3	31.21	2

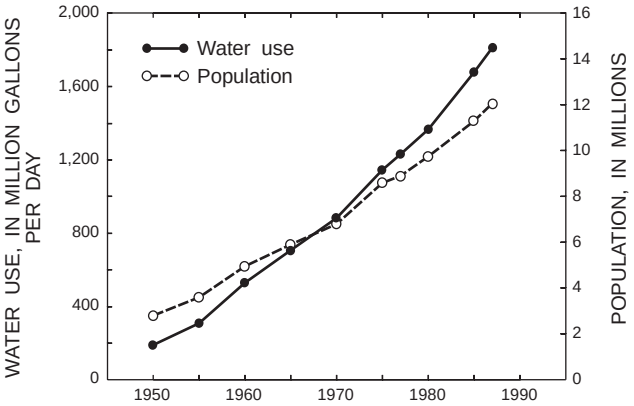

Figure 4. Historical public-supply water use and total population in Florida, 1950-87 (from Dietrich, 1978; Shoemyen and others, 1988; and Marella, 1990).

In 1965, Dade was the only county using more than 100 Mgal/d (196.4 Mgal/d); by 1987, six counties (Broward, Dade, Hillsborough, Orange, Palm Beach, and Pinellas) used more than 100 Mgal/d (table 3). Combined, these six counties accounted for 59 percent of the public-supply water use in 1987. The largest increases in public-supply water use between 1965 and 1987 occurred in Wakulla (3,400 percent), Hernando (2,000 percent), Flagler (1,200 percent), and Citrus (1,014 percent) Counties. All 67 counties increased public-supply water use between 1965 and 1987, and only 11 counties had an increase of less than 100 percent (table 3). More recently, seven counties (Hernando, Citrus, Monroe, Flagler, Seminole, St. Johns, and Charlotte) have more than doubled their use of public-supply water between 1980 and 1987.

Two trends exist in public-supply water use in Florida over the past 10 years; first, the deliveries for all categories are increasing in quantity, and second, the proportion of each category's use is changing. Public-supply deliveries to residential use has increased nearly 273 Mgal/d between 1975 and 1985; however, the proportion of the total deliveries has decreased from 81 percent to 71 percent (table 4). Evidence of this trend can be seen in many counties. In 1975, 24 counties had a percentage of residential water use of 90 percent or greater. The number of counties with 90 percent or greater residential water use dropped to 15 in 1980, and to 3 in 1985. Public-supply deliveries for commercial use has increased 167 Mgal/d between 1975 and 1985, and the proportion of the total deliveries has increased from 7 to 15 percent (table 4). This trend can be attributed to the increase in commercial establishments (for example, hotels, motels, and restaurants) as a result of the increase in population and tourism between 1975 and 1985.

Public-supply deliveries for industrial use has increased 61 Mgal/d between 1975 and 1985, and the proportion of the total deliveries has increased from 7 percent to 9 percent (table 4). This trend is a result of the changes in manufacturing throughout the State. Florida is becoming less dependent on rural industries that are tied to agricultural and natural resources (for example, lumber, phosphate, and pulp), which usually use self-supplied water, and moving toward industries that are keyed to advanced technology (for example, computer development, defense hardware, and medical equipment) and obtain water from public systems because of their urban location (Florida Bureau of Economic Analysis, 1987). Public and other uses accounted for 5 percent of public-supply use in both 1975 and 1985, but has increased 30 Mgal/d over this time.

Population

One of the major factors that affects public-supply water use in Florida is population. The three elements of population that are most likely to affect public-supply water use are: (1) magnitude of resident population in Florida, (2) percentage of population served by public-supply water systems, and (3) magnitude of nonresident population.

Magnitude of Resident Population in Florida

Because residential use is the largest use sector for public-supply water, it is reasonable to expect that resident population will have the greatest influence on public-supply demands in Florida. Over the period 1950-87, the two variables (public-supply use and residential population; see fig. 4) increased concurrently, and have a correlation coefficient of 0.9993. A correlation coefficient of 0.9993 out of a possible 1.00 indicates that the trend of public-supply water use in Florida closely follows that of the resident population. Therefore, an evaluation of residential population patterns and trends is critical to determining public-supply water use.

The resident population in Florida has been growing at a rate of approximately 300,000 people per year since 1960. Many trends exist within the resident population growth in Florida. First, most of the population increase in Florida results from net migration. During 1980-87 Florida's population increased 2.30 million people, with nearly 89 percent of this increase due to net migration (University of Florida, 1988, p. 28) into the State (table 5). Second, the largest total resident population gains between 1980 and 1987 occurred in six of the most populated counties in Florida. Population increases of more than 100,000 people between 1980 and 1987 occurred in Palm Beach (212,800), Dade (176,900), Broward (162,700), Hillsborough (154,400), Orange (132,500), and Pinellas (100,200) Counties (table 5). These six counties accounted for 41 percent of the nearly 2.30 million new residents. Third, many counties that were once considered rural, with little population growth, have increased substantially in population. Counties that increased 50 percent or more in population between 1980 and 1987 (table 5) include Hernando (79 percent), Osceola (78 percent), Flagler (76 percent), Charlotte (51 percent), and Citrus (50 percent).

Table 3. Historical public-supply water use in Florida by county

[From Pride, 1973; Leach, 1978; Leach and Healy, 1980; Leach, 1983; Marella, 1988; Marella, 1990; values may not add to totals because of independent rounding]

County	Public supply water-use in million gallons per day							Percent change		
	1965	1970	1975	1977	1980	1985	1987	1965-87	1970-87	1980-87
Alachua	8.6	22.3	14.9	16.5	18.2	21.3	21.9	154	-2	20
Baker	.2	.3	.5	.6	.6	.6	.6	215	110	5
Bay	5.1	38.1*	34.5*	39.0*	39.5*	31.9*	22.5	341	-41	-43
Bradford	.3	.7	.8	1.1	1.1	1.3	1.5	400	114	36
Brevard	24.5	26.5	27.1	30.1	28.8	45.4	49.2	101	86	71
Broward	74.9	103.0	139.8	155.9	184.4	188.0	207.6	177	102	13
Calhoun	.2	.2	.3	.3	.3	.4	.4	100	100	21
Charlotte	1.7	2.6	4.1	4.0	4.9	10.6	10.3	506	296	109
Citrus	.7	.2	.6	.7	.9	6.6	7.8	1,014	3,800	757
Clay	1.0	1.6	5.0	5.0	6.1	8.4	9.9	890	519	62
Collier	3.3	5.9	11.9	14.1	19.3	25.4	29.3	788	397	52
Columbia	1.2	1.7	1.7	1.8	2.0	2.0	2.2	83	29	9
Dade	196.4	206.9	264.6	274.2	306.5	328.4	352.1	79	70	15
De Soto	.7	.5	.8	.7	.7	.7	.8	16	62	14
Dixie	.4	.4	.4	.5	.6	.6	.6	50	50	9
Duval	60.0	67.8	95.4	93.6	59.6	84.9	94.3	57	39	58
Escambia	17.4	20.3	27.8	30.5	30.5	37.6	36.9	112	82	21
Flagler	.2	.3	.6	.6	.8	2.2	2.6	1,200	767	238
Franklin	.5	.5	1.0	1.1	1.0	1.2	1.5	200	200	50
Gadsden	1.8	2.0	2.1	2.6	2.2	2.7	3.4	89	70	52
Gilchrist	.1	.1	.4	.5	.4	.3	.4	300	300	11
Glades	.1	.1	.2	.2	.2	.3	.3	200	200	43
Gulf	.4	.5	.8	.9	1.0	1.0	1.0	150	100	3
Hamilton	.2	.5	.6	.8	.7	.7	.8	300	60	18
Hardee	.8	.7	1.2	1.0	1.3	1.3	1.4	75	100	10
Hendry	.5	1.4	2.1	1.6	2.0	2.9	3.2	540	129	60
Hernando	.5	.6	.8	.9	1.1	7.9	10.5	2,000	1,650	821
Highlands	5.0	4.7	4.3	3.7	5.0	7.9	7.8	56	66	58
Hillsborough	43.8	51.8	59.9	70.1	84.7	114.1	104.6	139	102	23
Holmes	.2	.3	.2	.6	.6	.8	.9	350	200	41
Indian River	1.5	3.1	4.5	5.8	6.2	8.8	12.0	700	287	93
Jackson	1.5	1.6	1.8	2.0	2.2	2.4	2.5	67	56	16
Jefferson	.3	.4	.4	.6	.5	.6	.6	100	50	22
Lafayette	.1	.1	.1	.2	.1	.2	.2	100	100	67
Lake	8.0	10.0	9.9	9.9	11.4	15.3	17.7	121	77	55
Lee	4.3	8.3	16.8	19.0	29.8	31.7	33.5	679	304	12
Leon	9.0	12.0	15.8	17.0	17.2	22.1	23.1	157	93	34
Levy	.4	.9	1.0	1.1	1.1	1.2	1.3	233	48	21
Liberty	.1	.2	.1	.1	.1	.3	.2	110	5	62
Madison	.7	.6	1.1	1.1	1.0	1.2	1.4	100	133	46
Manatee	6.4	9.9	18.9	22.4	20.9	21.5	25.0	291	153	20
Marion	3.8	3.9	6.2	6.1	6.8	11.9	13.2	247	238	94
Martin	1.9	1.6	5.7	5.5	6.2	9.3	10.1	432	531	64
Monroe	5.9	6.8	7.7	7.2	3.8	11.3	13.1	122	93	248
Nassau	1.2	2.0	2.4	3.1	2.8	3.0	3.5	192	75	26
Okaloosa	7.5	7.9	9.3	12.8	12.9	17.4	18.5	147	134	43
Okeechobee	.9	.6	1.0	1.3	1.6	1.9	2.0	122	233	29
Orange	49.0	50.5	63.4	67.3	69.4	100.5	116.3	137	130	68
Osceola	3.3	2.7	3.7	4.0	4.2	5.7	7.5	127	178	79
Palm Beach	38.7	55.3	94.4	96.3	123.8	146.6	168.5	335	205	36
Pasco	2.1	2.0	3.0	3.6	11.9	21.1	22.6	976	1,030	90
Pinellas	45.8	60.0	77.0	88.7	102.9	115.1	118.3	158	97	15
Polk	26.4	27.7	31.2	30.4	35.5	54.9	60.2	128	117	69
Putnam	2.0	2.7	2.6	3.1	2.9	3.0	3.3	65	22	15
St. Johns	3.0	2.5	2.7	2.9	3.5	7.0	7.6	153	204	117
St. Lucie	3.2	4.3	6.2	6.7	9.7	10.8	12.3	284	186	27
Santa Rosa	1.1	2.4	3.4	4.4	5.8	7.6	9.9	800	313	70
Sarasota	6.9	11.3	10.3	10.8	19.5	26.7	30.3	339	168	55
Seminole	4.2	6.3	10.5	12.6	14.0	34.9	40.9	874	549	193
Sumter	.5	.8	.6	.9	1.0	1.3	1.1	126	41	11
Suwannee	.6	.6	1.1	1.2	1.1	1.3	1.3	122	122	25
Taylor	1.0	1.2	1.4	1.7	1.5	1.6	1.6	60	33	7
Union	.2	.1	.6	.6	.6	.5	.6	300	500	5
Volusia	13.0	19.2	25.1	26.6	26.6	36.4	40.3	210	110	52
Wakulla	.02	.2	.3	.4	.6	.6	.7	3,400	250	25
Walton	.9	.7	1.1	1.0	1.6	3.0	3.1	249	349	94
Washington	.3	.4	.6	.8	.9	1.0	1.0	233	150	9
State values	706.4	883.3	1,145.9	1,231.9	1,366.2	1,677.1	1,811.1	156	105	33

*Includes water sold directly to an industrial water user prior to treatment and distribution.

Table 4. Historical public-supply water deliveries for Florida

[Mgal/d, million gallons per day; from Leach, 1978; Leach, 1983; Marella, 1988; values may not add to totals because of independent rounding]

Year	Residential use		Commercial use		Industrial use		Public and other uses	
	Mgal/d	percent	Mgal/d	percent	Mgal/d	percent	Mgal/d	percent
1975	923	81	84	7	81	7	58	5
1980	1,101	81	123	9	84	6	59	4
1985	1,196	71	251	15	142	9	88	5

Percentage of Population Served by Public-Supply Water Systems

As a result of growth in population, the number of public-supply systems increased from 1,400 in 1975, to more than 2,300 in 1985 (Greg Parker, Florida Department of Environmental Regulation, oral commun., 1990). Additionally, many public and private utilities have increased their production capacity and expanded water and sewer service into unincorporated areas. In 1970, 40 percent of the State's population lived in unincorporated areas (University of Florida, 1976), and 76 percent of the population was served by public-supply water systems (Pride, 1973); however, in 1987, 49 percent of the State's population lived in unincorporated areas (University of Florida, 1988, p. 27), and 86 percent of the population was served by public-supply water systems.

A plot of data on historical population served indicates that the percentage of the State's population served by public supply may approach about 90 percent (fig. 5).

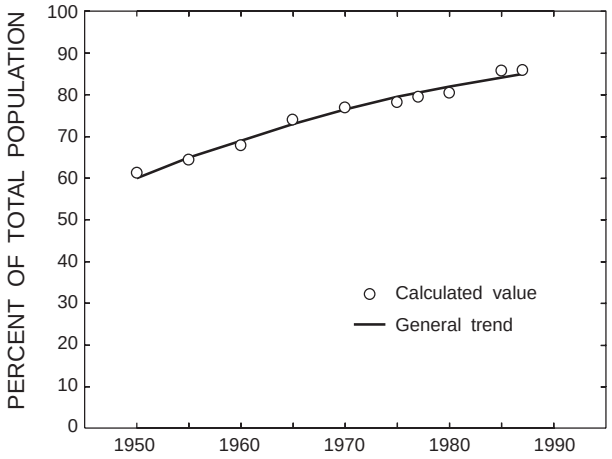

Figure 5. Historical percentage of population served by public supply in Florida, 1950-87 (modified from Pride, 1973; Leach and Healy, 1980; Leach 1983; Marella, 1988; and Marella 1990).

Due to the rural nature of many areas in Florida, a small percentage of the State's population will continue to be supplied by individual wells or by small water systems. If this public supply-population trend continues, then it is likely that between 255,000 and 285,000 of the 300,000 new residents of Florida per year will be requiring public-supplied water.

Magnitude of Nonresident Population

Another contributing element to public-supply water use in Florida is the magnitude of nonresident population. Florida's nonresident population increased from 18.8 million visitors in 1977 to nearly 34.1 million visitors in 1987 (Florida Division of Tourism, 1988) (fig. 6). The increase can be attributed to the opening of several large amusement or recreation facilities during the 1970's and 1980's and the promotion of tourism by the State.

Florida's visitors can be divided into two general categories: those who stay for a short period of time, generally less than a month, and those who stay for a longer period, generally between 1 to 6 months. In 1987, an estimated 94 percent of Florida's visitors stayed less than a month, and 6 percent stayed longer than a month (Florida Division of Tourism, 1988). The long-stay visitors generally travel to the southwest coast (43 percent) and the southeast coast (32 percent) (Smith, 1988). The short-stay visitors generally travel to the central Florida area (25 percent) or the coastal areas (Florida Division of Tourism, 1988). January through June generally attract most visitors.

The effect that nonresident populations have on public water systems can be observed by comparing the two groups of visitors. The first group, short-stay visitors, primarily affects the commercial deliveries (for example, hotels or motels, restaurants, and laundry facilities) from public-supply systems and generally affects demands seasonally.

Table 5. Population growth, cause, and change in Florida, by county, 1980 and 1987

[Modified from the University of Florida, 1988, p. 28-9]

County	Population in thousands			Percent	Type of growth	
	1980	1987	Net change	Change	Migration	Natural
Alachua	151.3	179.7	28.4	19	63	37
Baker	15.3	18.4	3.1	20	61	39
Bay	97.7	129.7	31.9	33	79	21
Bradford	20.0	24.1	4.1	20	78	22
Brevard	273.0	371.7	98.8	36	90	10
Broward	1,018.3	1,181.0	162.7	16	97	3
Calhoun	9.3	9.7	.4	5	52	48
Charlotte	58.4	88.2	29.8	49	111	-11
Citrus	54.7	81.9	27.2	50	109	-9
Clay	67.1	95.3	28.2	42	84	16
Collier	86.0	126.6	40.6	48	92	8
Columbia	35.4	41.5	6.1	17	66	34
Dade	1,625.5	1,802.4	176.9	11	63	37
De Soto	19.0	22.9	3.9	20	82	18
Dixie	7.8	9.9	2.1	28	81	19
Duval	571.0	664.1	93.1	16	55	45
Escambia	233.8	278.4	44.6	19	65	35
Flagler	10.9	19.2	8.3	76	99	1
Franklin	7.7	8.5	.8	11	70	30
Gadsden	41.6	46.2	4.6	11	38	62
Gilchrist	5.8	7.1	1.3	23	77	23
Glades	6.0	7.4	1.4	24	95	5
Gulf	10.7	12.0	1.3	13	76	24
Hamilton	8.8	9.4	.6	7	19	81
Hardee	20.4	22.1	1.7	14	18	82
Hendry	18.6	24.6	6.0	32	65	35
Hernando	44.5	79.7	35.2	79	104	-4
Highlands	47.5	63.5	16.0	34	104	-4
Hillsborough	646.9	801.4	154.5	24	77	23
Holmes	14.7	16.3	1.6	11	93	7
Indian River	59.9	83.5	23.6	39	98	2
Jackson	39.2	43.7	4.5	12	78	22
Jefferson	10.7	11.9	1.2	11	50	50
Lafayette	4.0	5.1	1.1	26	90	10
Lake	104.9	137.1	32.2	31	102	-2
Lee	205.3	293.7	88.4	43	98	2
Leon	148.7	176.5	27.8	19	63	37
Levy	19.9	23.9	4.0	20	89	11
Liberty	4.3	5.0	.7	17	71	29
Madison	14.9	15.9	1.0	7	28	72
Manatee	148.4	181.7	33.3	22	106	-6
Marion	122.5	174.6	52.1	43	93	7
Martin	64.0	89.0	25.0	39	102	-2
Monroe	63.1	74.5	11.4	18	80	20
Nassau	32.9	44.0	11.1	34	79	21
Okaloosa	109.9	149.0	39.1	36	73	27
Okeechobee	20.3	27.7	7.4	37	79	21
Orange	470.9	603.3	132.4	28	78	22
Osceola	49.3	87.6	38.3	78	93	7
Palm Beach	576.7	789.5	212.8	38	97	3
Pasco	193.7	254.7	61.0	31	114	-14
Pinellas	728.5	828.7	100.2	14	128	-28
Polk	321.7	389.1	67.4	21	80	20
Putnam	50.5	62.5	12.0	24	86	14
St. Johns	51.3	75.1	23.8	46	95	5
St. Lucie	87.2	128.4	41.2	47	90	10
Santa Rosa	56.0	66.2	10.2	18	57	43
Sarasota	202.3	251.3	49.0	24	117	-17
Seminole	179.8	254.8	75.0	42	87	13
Sumter	24.3	29.3	5.0	21	91	9
Suwannee	22.3	26.2	3.9	18	85	15
Taylor	16.5	18.8	2.3	14	67	33
Union	10.2	10.7	.5	5	37	63
Volusia	258.8	330.9	72.2	28	105	-5
Wakulla	10.9	13.7	2.8	26	82	18
Walton	21.3	27.5	6.2	29	93	7
Washington	14.5	15.5	1.0	6	78	22
State values	9,746.9	12,043.6	2,296.6	24	89	11

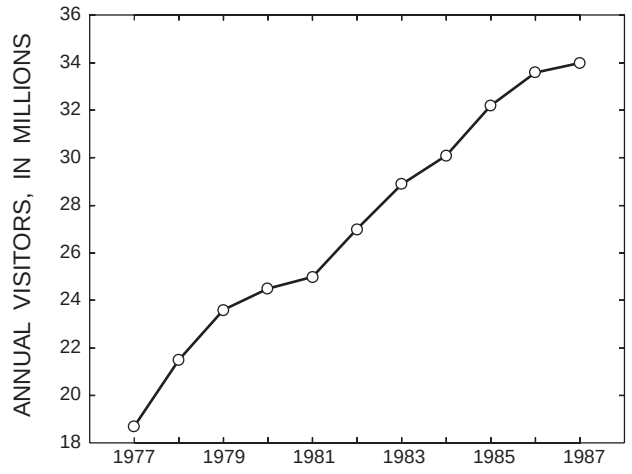

Figure 6. Annual visitors to Florida, 1977-87 (modified from Florida Department of Commerce, unpublished data).

For example, the city of Daytona Beach (Volusia County), which has a high percentage of commercial water use (primarily due to large numbers of visitors) shows many daily peaks centered around several events related to visitors during 1987 for public-supply water use (fig. 7). These events affect the public-supply system by increasing water needed by hotels, restaurants, and other commercial establishments caused by the influx of visitors during these times. The longer-staying visitors have a longer-term effect on public-supply water use, because their water needs are similar to a permanent resident throughout their stay. Collier and Lee Counties have a large number of seasonal residents, which tends to be greatest during February, March, and April. The public-supply water use for both counties shows an increase in water usage during those months and a decrease in May and June (fig. 8). This varies from the State total monthly usage, which increases in May and June.

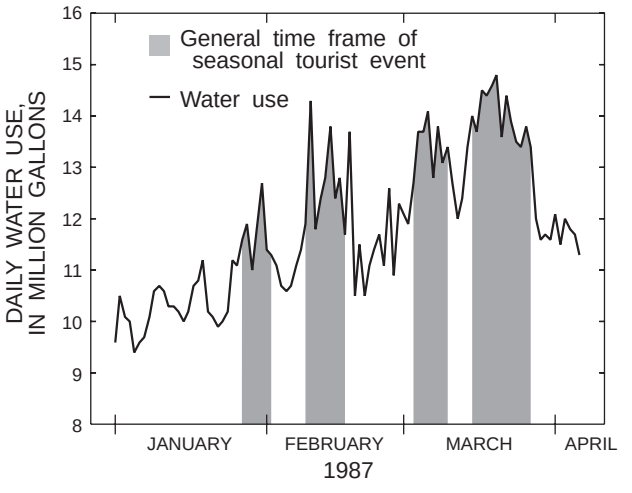

Figure 7. Daily public-supply water use for the city of Daytona Beach, winter 1987 (modified from the city of Daytona Beach, unpublished data).

The influx of visitors and large number of temporary housing facilities cause an added demand for water, primarily from public-supply sources. Florida had an estimated 108,000 seasonal housing units and more than 5,000 hotels or motels (312,000 units) and 2,100 rental condominiums in 1987 (Shoemyen and others, 1988, p. 56-57). Water demands for a hotel or motel range from 117 to 168 gal/d per unit; water demands for seasonal housing range around 250 gal/d per unit (Woodcock, 1984).

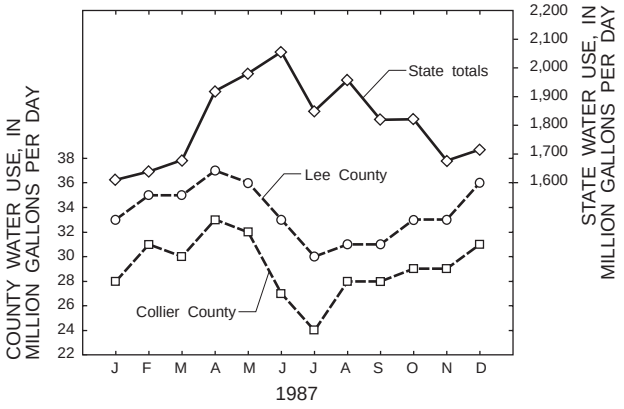

Figure 8. Monthly public-supply water use for Collier and Lee Counties, and for Florida during 1987 (from Marella, 1990).

Climate

Climate also affects public-supply water use in Florida. Two variables, precipitation (rainfall) and temperature, exert the strongest influence on demands primarily because of the amount of residential water use that is used for lawn and garden watering. To illustrate the effects that lawn and garden watering have on public-supply in Florida, water use can be compared to the wastewater returns. Assuming that public-supply water used for indoor purposes is generally returned to a wastewater facility for treatment and water used for outdoor purposes is not, the difference between water use and wastewater returns help depict the magnitude of water used for outdoor purposes, such as lawn and garden watering. For example, in the city of Tallahassee (Leon County), where the number of customers served by the water and wastewater section are relatively the same, as the water-use volumes increase (primarily due to insufficient rainfall), the wastewater returns do not, indicating the amount and timing of water used for outdoor purposes (fig. 9). Conversely, when wastewater returns increase at a higher rate than water use, it is usually a result of increased rainfall, causing stormwater runoff and infiltration into the wastewater system

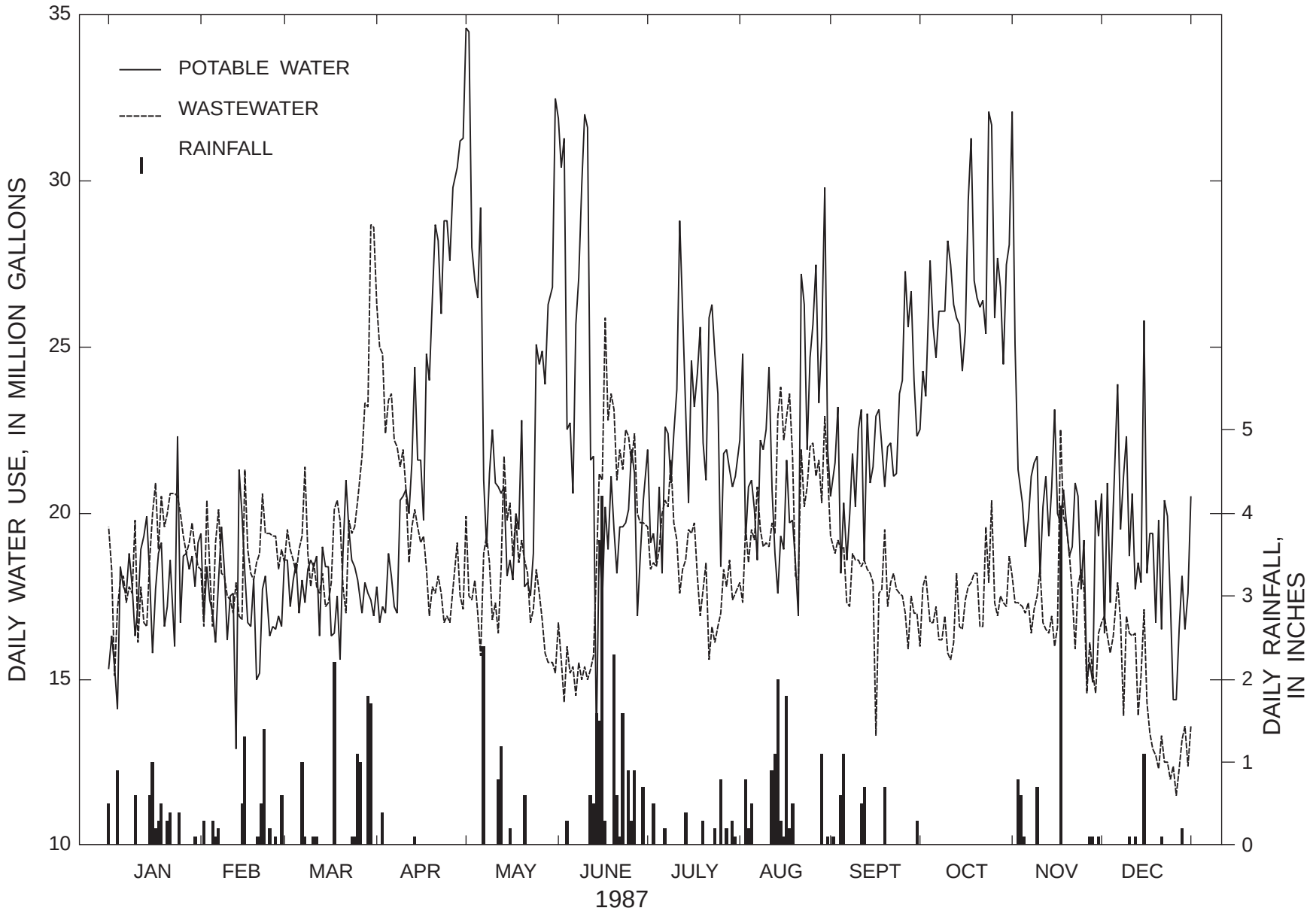

Figure 9. Daily public-supply water use, wastewater returns, and rainfall for the city of Tallahassee during 1987 (modified from the city of Tallahassee, unpublished data; and the National Oceanic Atmospheric Administration,1988).

coupled with a decrease in use (Keith Turner, city of Tallahassee, oral commun., 1989). Therefore, it appears that in Tallahassee, as in most areas of the State, a large percentage of public-supply water is used for outdoor purposes, particularly during periods of low rainfall.

Precipitation

Florida receives more than 52 in/yr of mean annual rainfall, with variations in the State ranging from 40 inches in the Florida Keys (fig. 3) to 64 inches in extreme northwest Florida (Bridges and Foose, 1985). Inconsistencies in rainfall affect public-supply water use because of the great amount of water used for lawn and garden watering. Generally, from March through June, rainfall throughout Florida naturally decreases and, consequently, public-supply water use increases (fig. 10). Further examination of these 4 months details the effects daily

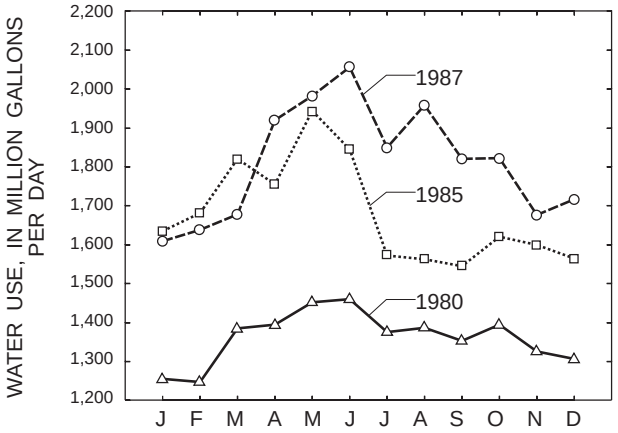

Figure 10. Monthly public-supply water use in Florida for 1980, 1985, and 1987 (modified from Leach, 1983; Marella, 1988; and Marella, 1990).

rainfall has on public-supply water use in Florida. In the city of Daytona Beach (Volusia County), public-supply water use increased during periods of little or no rainfall, whereas water use was substantially lowered when significant rainfall occurred (fig. 11). In Daytona Beach, like most areas in the State, inconsistent or insufficient rainfall will increase the demand on public-supply water for outdoor uses.

Long-term rainfall deficits or droughts also affect public-supply water use in Florida. When cumulative rainfall amounts decrease below normal for an extended period of time, water-use habits continue as they do during the normal dry time. For example, most of Florida experienced a severe drought between the summer of 1980 and the fall of 1981 (Waller, 1985). Observing the historical public-supply water-use trend for the St. Johns River Water Management District (SJRWMD) from 1978 to 1988, shows the effects that the dry years (1980-81) had on water use (fig. 12). The trend in public-supply water use in the SJRWMD shows an increase over time, however, the years of 1980 and 1981 exceed normal growth primarily because of the increase in demand caused by the drought.

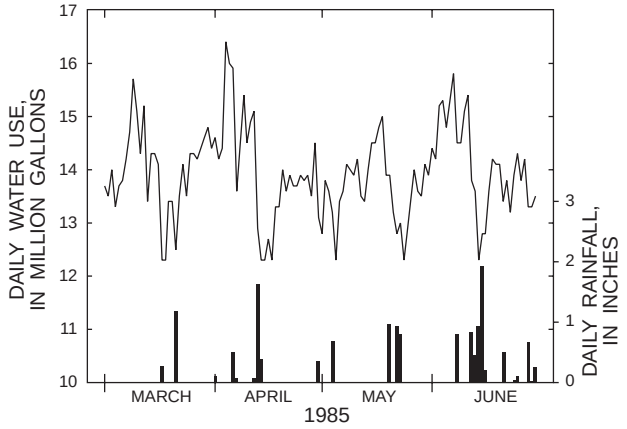

Figure 11. Daily public-supply water use and rainfall for the city of Daytona Beach during March, April, May, and June 1985 (modified from the city of Daytona Beach, unpublished data; and the National Oceanic Atmospheric Administration, 1986).

Temperature

The mean monthly temperature in Florida ranges from a low in January of 51 °F in Tallahassee to a high in July of 84 °□F in Key West (National Oceanic Atmospheric Administration, 1982). The potential for evapotranspiration (ET) increases in Florida during March, April, and May (Smajstrla and others, 1984), the same period that temperatures increase and, consequently, water consumption for grasses and plants increase. The increase in water consumption and the relatively low rainfall during months with substantial ET result in an increase in irrigation requirements for grasses, plants, and other vegetation.

Additionally, the nearly year-round warm temperatures in Florida result in a longer growing season and, consequently, a longer period of outdoor water use. In south Florida, the potential for lawn watering can be year-round; in central and northern Florida, it can range from 8 to 10 months.

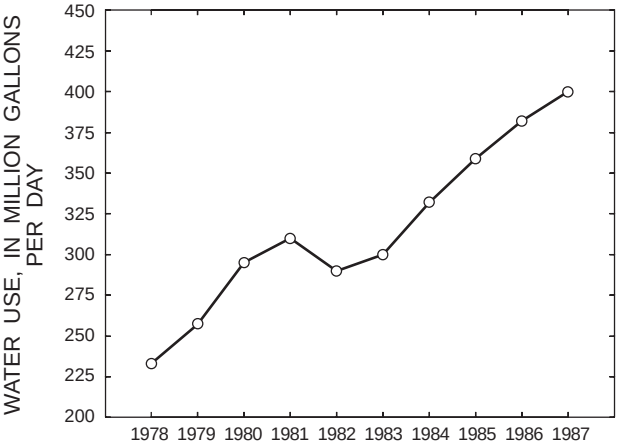

Figure 12. Historical public-supply water use in the St. Johns River Water Management District, 1978-87 (modified from Florence, 1990).

Subfreezing temperatures also affect public-supply use. In the northern part of the State, many of the housing structures are built above the ground and have water pipes exposed to the weather. During subfreezing temperatures, many households leave water running to prevent damage from frozen pipes. For example, between 1977 and 1989, the city of Jacksonville (Duval County) experienced four annual peak water-use days during subfreezing temperaures in December or January (table 6).

Table 6. Public-supply water use (pumpage) for the city of Jacksonville, 1977-88

[Mgal/d, million gallons per day; from city of Jacksonville Water Department]

Fiscal year[1]	Annual average Mgal/d	Maximum daily pumpage Mgal/d	Maximum daily pumpage Date
1977-78	53.6	68.9	July 3, 1978
1978-79	55.0	63.1	July 2, 1979
1979-80	55.4	74.3	June 17, 1980
1980-81	55.8	71.3	May 1, 1981
1981-82	51.6	70.2	Jan. 12, 1982
1982-83	49.9	64.5	Aug. 24, 1983
1983-84	54.9	97.0	Dec. 26, 1983
1984-85	56.1	117.1	Jan. 22, 1985
1985-86	58.4	103.8	Jan. 28, 1986
1986-87	60.6	79.1	June 12, 1987
1987-88	60.9	84.1	June 25, 1988

[1]The fiscal year calendar is from October 1 through September 30.

Socioeconomic Factors

Three general socioeconomic factors can influence public-supply water use in Florida: (1) income, (2) household size, and (3) type of housing unit (single family or multifamily).

Income

Income can affect public-supply water use, especially for residential use. In Florida, the median family income increased from $8,000 in 1959 to $18,000 in 1979 (Economic Report to the President, 1987) and affected residential water demands. First, higher income increases one's ability to purchase and use water-intensive appliances and facilities; for example, higher income households are more apt to have additional bathrooms, larger yards, swimming pools, outdoor landscaping, and lawn irrigation systems (Linaweaver and others, 1967; Lewis and others, 1981). Second, higher income households are less likely to be concerned about the cost of water or the amount paid for water services.

It appears that income affected public-supply water use in Florida during the 1950's and into the 1970's, as most of the State's households acquired indoor plumbing and appliances that use water (for example, washing machines and dishwashers). In 1950, 59 percent of the households in Florida had indoor plumbing facilities. This number increased to 65 percent in 1960, 92 percent in 1970, and to more than 98 percent by 1980 (Diane Murphy, U.S. Bureau of Census, oral commun., 1990). Most of the increase in indoor plumbing and acquisition of water-using appliances occurred during the 1950's and 1960's and its effect on residential-water demands is seen by the increased per capita water use during the 1950's and 1960's (fig. 13). It is difficult to assess the effect that income has on public-supply water use, especially in recent years, because there are so many variables. In areas with fixed income households (for example, retirement areas), income may have more of an effect on reducing water use, as income is often limited.

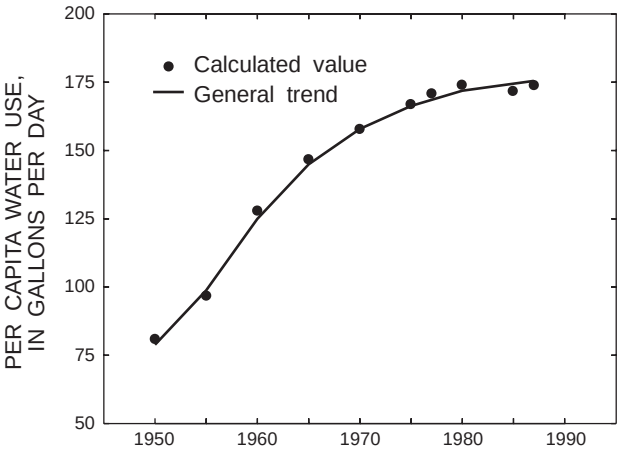

Figure 13. Historical public-supply per capita water use in Florida, 1950-87 (modified from Leach, 1984; Marella, 1988; and Marella, 1990).

Household Size

Another socioeconomic influence on public-supply residential water use is the diminishing size of households and the increase in their number. In Florida, the average household size decreased from 3.10 persons in 1960 (Smith, 1980) to 2.46 persons in 1987 (Smith and Bucca, 1988). During this same time (1960-87), the population of Florida increased by nearly 7.10 million. Consequently, the number of households has been increasing at a fast rate (fig. 14). The number of households increased from 1.55 million in 1960 to 4.8 million in 1987 (Shoemyen and others, 1988). The decreasing size of households has probably resulted in an increase in water use per person (Schefter, 1990). In Florida, however, the public-supply water use per capita for residential use only, decreased from 137 gal/d in 1970 (Pride, 1973) to 123 gal/d in 1985 (Solley and others, 1988, p. 17), indicating that although water use per household may decrease, it can be offset by the increase in number of households in Florida.

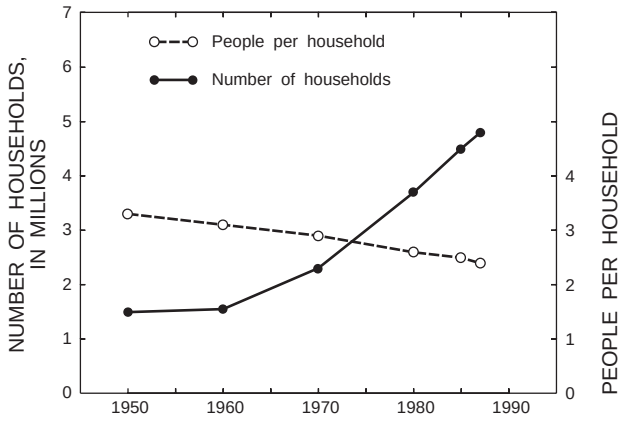

Figure 14. Number of households and number of people per household in Florida, 1950-87 (modified from Shoemyen and others, 1987; and Scott Coty, Bureau of Economic and Business Research, University of Florida, oral commun., 1990).

Type of Housing Unit

A third socioeconomic influence that affects public-supply water use is the type of housing unit. The number of households in Florida increased from 3.7 million to 4.8 million between 1980 and 1987, an increase of nearly 30 percent (Shoemyen and others, 1988, p. 48-49). During the same time more than 1.34 million building permits were issued for new housing construction (Shoemyen and others, 1988). Of these permits, 53 percent were for single family dwellings and the remainder for multifamily dwellings. The water used per single family dwelling ranges from 250 to 500 gal/d per unit and the water used per multifamily dwelling ranges between 100 to 200 gal/d per unit (Kammerer, 1982; Woodcock, 1984). Because the water required per unit for single-family dwellings is much greater than for multi-family dwellings, the increase in single family dwelling construction in the 1980's may influence long-term water use.

Water Pricing Practices

The cost of goods to the consumer can influence how much the goods are used. Several factors can be given to show the influence, or lack thereof, that the cost of water has on public-supply water use. These factors include the cost of producing water, water-rate structures, and sewage charges.

Cost of Producing Water

Many factors affect the cost of producing water for public-water systems. Some of the most prevalent factors include: availability and quality of the water resources, geographic or physical location, demand, customer constituency, level of treatment, age of system, size of storage and distribution systems, and the level of general funding or grants (Giardina, 1989).

In Florida, operating costs have remained low because of older more heavily depreciated capital equipment, and the higher volume of production (Lynne and others, 1984). Additionally, the use of ground water, which generally requires little treatment before distribution, generally lowers the cost of water in Florida. Because of outside funding or revenues, rates may not truly reflect the actual cost of these factors. Therefore, water customers generally pay for the cost necessary to process and convey the water to where it is ultimately used, as the rates used by most utilities have been set to cover these costs and net a normal profit. However, rates typically do not include fees for water scarcity or replacement cost of a limited resource (water). Generally, utilities in areas where potable water is scarce do not have higher water rates than areas where potable water is abundant, with the exception of the city of Key West, served by the Florida Keys Aqueduct Authority. During the 1970's and 1980's, areas where potable water was less abundant often had the same or lower water rates than areas where water was more abundant. For example, Miami, Sarasota, St. Petersburg, Tampa, and West Palm Beach, located in areas that may have problems with water availability or water quality have some of the lowest water rates per 1,000 gallons in the State (table 7). This implies that these water rates do not truly reflect the cost of potable water as a generally scarce commodity (Lynne and others, 1984). However, the Florida Keys Aqueduct Authority, which imports water from nearly 150 miles away or uses RO (backup use only) for public-supply use in Key West (Marella, 1989), has a higher water rate than those of other areas with deficient resources.

The price paid by public-supply water users in Florida is comparble to prices of other States. In 1984, a survey conducted by the American Water Works Association (AWWA) showed the average price of water paid by a residential user from the 25 utilities surveyed in Florida was $2.09 per 1,000 gallons (American Water Works Association, 1986). This compared closely to the survey's national average of $2.00 per 1,000 gallons (table 8).

Water-Rate Structures

Water-rate structures can affect the use of public-supply water, particularly in the residential sector. Three general rate structures are used in Florida: declining block rate (decreasing block rate), increasing block rate, and uniform rate. A decreasing block rate has decreased unit charges as the customer uses more water; an increasing block rate has increased unit charges as the customer uses more water; and a uniform rate remains fixed regardless of the amount used (table 9).

Table 7. Residential water rates for selected utilities in Florida for 1978-79, and 1988-89

[N/A,data not available; water rates are based on the purchase of 10,000 gallons for residential customers with the smallest meter size; ACT Systems Inc., 1980; Lynne and others, 1984; Marella, 1990]

Site No.[1]	Utility	County	Ownership	1978-79 Population served[2]	1978-79 Cost per 1,000 gallons	1978-79 Monthly cost for 10,000 served[3]	1988-89 Population gallons[4]	1988-89 Cost per 1,000 gallons	1988-89 Monthly cost for 10,000 gallons[3]
1	Cape Coral, City of	Lee	Public	22,000	$1.52	$15.20	45,772	$1.95	$19.60
2	Clearwater, City of	Pinellas	Public	98,831	1.11	11.10	102,000	1.79	17.90
3	Cocoa, City of	Brevard	Public	100,000	.92	9.20	123,673	1.00	13.00
4	Daytona Beach, City of	Volusia	Public	65,000	1.50	17.12	80,436	1.39	16.90
5	Deerfield Beach, City of	Broward	Public	42,000	.50	10.00	44,313	1.01	15.90
6	Escambia County Utilities	Escambia	Public	170,000	.63	8.25	178,567	.96	15.90
7	Fla. Keys Aqueduct Auth.	Monroe	Public	47,000	4.32	41.68	73,500	5.56	55.60
8	Fla. Public Utility Co.	Nassau	Private	9,000	N/A	N/A	11,928	.68	13.48
9	Ft. Myers, City of	Lee	Public	36,000	.77	7.70	42,044	1.25	14.30
10	Ft. Pierce, City of	St. Lucie	Public	11,000	.85	8.46	45,947	1.58	15.80
11	Ft. Walton Bch., City of	Okaloosa	Public	23,000	.82	8.20	23,030	.82	8.20
12	Gainesville Regional Ut.	Alachua	Public	75,000	.84	9.90	116,650	.82	11.10
13	Jacksonville, City of	Duval	Public	311,351	.68	6.80	355,080	.51	9.50
14	Kingsley Service Company	Clay	Private	25,000	N/A	N/A	42,644	.49	13.95
15	Miami/Dade Water Authority	Dade	Public	1,000,000	.56	5.60	1,536,813	.92	9.20
16	Naples, City of	Collier	Public	47,600	.87	8.72	39,506	.90	9.00
17	New Port Richey, City of	Pasco	Public	25,000	.88	8.80	13,700	1.30	13.00
18	Ocala, City of	Marion	Public	35,000	.73	7.30	44,267	.70	13.20
19	Orlando Utilities Com.	Orange	Public	268,000	.59	5.90	355,950	.53	7.60
20	Palm Coast Utility Corp.	Flagler	Private	3,500	.90	13.50	11,500	2.64	34.10
21	Placid Lakes Utility Inc.	Highlands	Private	N/A	N/A	N/A	2,195	.85	15.35
22	St. Augustine, City of	St. Johns	Public	25,000	1.02	10.19	15,757	3.30	32.96
23	St. Petersburg, City of	Pinellas	Public	260,000	.72	8.95	315,000	.98	14.20
24	Sanlando Utility Corp.	Seminole	Private	18,000	N/A	N/A	32,849	.35	7.43
25	Sarasota, City of	Sarasota	Public	55,000	.73	9.90	51,250	1.68	16.80
26	Seacoast Utility Co.	Palm Beach	Private	N/A	N/A	N/A	68,538	1.59	22.20
27	Tallahassee, City of	Leon	Public	100,000	.39	6.15	123,060	.84	12.00
28	Tampa, City of	Hillsborough	Public	250,000	.57	5.70	434,000	1.03	11.80
29	West Palm Beach Utilities	Palm Beach	Public	78,000	.44	5.53	87,466	.66	20.30
30	Winter Haven, City of	Polk	Public	25,000	.82	8.20	34,900	.74	22.92

[1]Refer to figure 3 for approximate location.
[2]Population served is for 1980.
[3]Monthly charges include appropriate base and service charges, but does not include any surcharges or taxes.
[4]Population served is for 1987.
[5]Data for the city of Pensacola, which is now supplied water through Escambia County Utilities.
[6]Service area includes the city of Key West.
[7]1984 rates.
[8]Base charge ($15.52) includes water, sewer, and garbage service fees.

Historically, decreasing block rates were very common in Florida, especially for residential-water users. These rates allowed or encouraged customers to use more water, by lowering the rate as more water was used. However, during the late 1970's and early 1980's public-supply water demands because of population growth and several dry years stressed the production capacities of many water suppliers. This forced many suppliers to lower water usage to help meet the higher demands, especially during the dryer seasons, and one of the most immediate and effective ways to accomplish this was to change the rate structures, primarily for residential users. Changing from the traditional decreasing block rate to a uniform or increasing block rate quickly changed consumption patterns by financially encouraging less water use and discouraging high use. The rate change occurred primarily in the residential-rate structures and generally did not affect commercial or industrial users, as they often depend on substantial quantities of water to conduct business. This change in rates produced several benefits for suppliers: first, it acted as a conservation program by lowering peak demands and overall consumption, and second, it provided utilities with increased revenues, as those who used more water paid more per unit than in the past.

Currently, most utilities in the State use a uniform rate structure, with several using increasing block rates. Rates often include basic service charges, fees for minimal use, taxes, and surcharges. Base or services charges are often substantial and often comprise a large part of the total bill. Residential water-rate structures for selected water systems in Florida are listed in table 10. This table also indicates that in most cases the water source, utility location (county), or utility ownership (private or public) has little to do with price structures, with perhaps the exception of the Florida Keys Aqueduct Authority.

Table 8. Average public-supply water rates by State for 1984

[Rates based on the purchase of 7,500 gallons and include the base charge and the cost per 1,000 gallons; from American Water Works Association, 1986]

State	No. of utilities surveyed	Cost per 1,000 gallons for 7,500 gallons: Minimum monthly charge	Cost per 1,000 gallons for 7,500 gallons: Cost for 7,500 gallons	Cost per 1,000 gallons for 7,500 gallons: Cost per 1,000 gallons
Alabama	5	$3.76	$10.28	$1.87
Alaska	1	1.72	12.90	1.95
Arizona	5	6.39	11.58	2.40
Arkansas	4	2.55	10.48	1.74
California	58	3.43	9.39	1.71
Colorado	8	3.83	11.40	2.03
Connecticut	7	5.02	13.61	2.48
Delaware	1	8.64	10.37	2.53
Florida	25	4.34	11.37	2.09
Georgia	5	3.70	13.73	2.32
Hawaii	5	1.61	8.95	1.41
Idaho	2	5.32	7.84	1.75
Illinois	13	4.87	15.37	2.70
Indiana	15	4.76	16.90	2.89
Iowa	8	2.97	9.57	1.67
Kansas	6	3.87	15.24	2.55
Kentucky	4	2.83	8.45	1.50
Louisiana	9	3.68	10.74	1.92
Maine	1	4.32	9.72	1.87
Maryland	6	1.30	7.75	1.21
Massachusetts	7	2.14	7.90	1.34
Michigan	17	2.69	8.15	1.45
Minnesota	4	2.48	9.08	1.54
Mississippi	1	3.30	7.40	1.43
Missouri	8	3.88	11.80	2.09
Nebraska	3	1.69	5.56	0.97
Nevada	2	7.45	4.95	1.65
New Hampshire	2	6.47	7.47	1.86
New Jersey	17	4.12	13.48	2.35
New Mexico	2	5.10	16.25	2.85
New York	22	3.29	9.97	1.77
North Carolina	8	2.05	9.04	1.48
North Dakota	1	2.65	9.53	1.62
Ohio	22	4.24	12.42	2.22
Oklahoma	3	2.55	9.83	1.65
Oregon	4	3.24	6.96	1.36
Pennsylvania	16	5.70	15.67	2.85
Rhode Island	3	5.31	23.49	3.84
South Carolina	2	.00	8.13	1.08
South Dakota	1	3.00	8.60	1.55
Tennessee	8	4.52	12.32	2.25
Texas	20	4.13	10.79	1.99
Utah	5	5.64	8.70	1.91
Vermont	1	3.82	18.65	3.00
Virginia	12	3.14	10.91	1.87
Washington	11	5.99	9.88	2.12
Washingtom D.C.	1	0.00	19.95	2.66
West Virginia	8	5.52	17.30	3.04
Wisconson	11	1.83	7.15	1.20
Wyoming	2	2.85	8.27	1.48
Survey average	413	3.84	11.14	2.00

Wastewater Services

Generally, the cost of purchasing water is only part of the customer's total cost, as bills are often a combination of both water and wastewater charges. Because most of the population served by potable water suppliers is also provided wastewater (sewer) services, the cost of discharging water may also influence public-supply water use in Florida. Wastewater charges are often substantially greater than drinking-water charges (fig. 15). In Florida, the utilities' cost to treat and discharge wastewater is generally high because equipment is generally newer or newly renovated, and less depreciated, and wastewater must often be treated beyond the secondary level to meet discharge regulations, or expensive land application systems must be used to discharge secondary treated water (David York, Florida Department of Environmental Regulation, oral commun., 1989). The result of higher wastewater charges affects residential users who water their lawns or gardens, as they often pay for both the water and the wastewater charges, even though the water used for outdoor purposes does not go into the wastewater system.

Table 9. Examples of residential water-rate structures used in Florida during the 1980's

Consumption, in gallons	Type of water rate (price per 1,000 gallons, in dollars): Decreasing	Uniform	Increasing
0 to 5,000	1.75	1.50	1.00
5,000 to 10,000	1.50	1.50	1.25
10,000 to 20,000	1.25	1.50	1.50
20,000 and more	1.00	1.50	1.75

Water Conservation and Alternatives

Historically in Florida, water supplies were generally considered unlimited in terms of both quantity and quality, and water conservation or alternatives did not appear to be needed. However, due to Florida's population growth and related water demands, both conservation and alternative water sources will play an important role in meeting future water-supply demands, especially in areas that are experiencing problems with quantity or quality of water.

Water Conservation

Many conservation methods are implemented because of natural conditions or constraints on system distribution. For example, short-term conservation measures meant to immediately affect the water user, such as restrictions placed upon a residential water user prohibiting lawn watering on specific days, were placed at various times during 1987 by one of the five water management districts.

Table 10. Water rates and rate structures for selected utilities in Florida for 1988-89

[Rates are for residential customers with smallest available meter size and are within the city limits; GW, ground water; SW, surface water; rate structures: I, increasing; U, uniform; D, decreasing]

Site No.[1]	Supplier/Utility	County	Water source	Rate structure	1988-89 Water rates for residential customers: Base or service cost	Minimum billing: Gallons	Minimum billing: Cost	Rate per 1,000 gallon over minimum	Rate intervals, in gallons	Tax rate, in percent
31	Altamonte Spg., City of	Seminole	GW	I	$0.00	3,000	$ 3.23		0 - 3,000	8
								$ 1.08	3,000 - 7,000	
								1.22	over - 7,000	
32	Bradenton, City of	Manatee	SW	I	6.95	0	0.00	1.22	0 - 3,000	10
								1.74	over 3,000	
3	Cocoa, City of	Brevard	GW	U	3.00	0	0.00	1.00		
4	Daytona Beach, City of	Volusia	GW	U	3.04	2,000	2.78		0 - 2,000	
								1.39	over 2,000	
5	Deerfield Beach, City of	Broward	GW	U	5.84	0	0.00	1.01		
6	Escambia County Ut.	Escambia	GW	U	6.27	0	0.00	0.96		
7	Fla. Keys Aqueduct Authority (City of Key West)	Monroe	GW	U	0.00	2,000	10.16		0 - 2,000	
								5.68	over 2,000	
9	Ft. Myers, City of	Lee	GW	U	1.75	0	0.00	1.25		
10	Ft. Pierce, City of	St. Lucie	GW	U	0.00	3,000	7.70		0 - 3,000	
								1.15	over 3,000	
11	Ft. Walton Beach, City of	Okaloosa	GW	U	0.00	4,000	4.00		0 - 4,000	10
								0.70	over 4,000	
33	Indian River County Utilities	Indian River	GW[2]	U	7.16	0	0.00	1.99		6
13	Jacksonville, City of	Duval	GW	U	4.40	0	0.00	0.51		10
34	Live Oak, City of	Suwannee	GW	U	0.00	3,000	6.00		0 - 3,000	10
								0.89	over 3,000	
35	Melbourne, City of	Brevard	SW	U	2.50	0	0.00	1.20		10
15	Miami/Dade Water Authority	Dade	GW	U	0.00	4,500	4.13		0 - 4,500	
								0.92	over 4,500	
19	Orlando Utilties Commission	Orange	GW	D	2.35	0	0.00	0.53	0 -70,000	
								0.45	over 70,000	
20	Palm Coast Utilities	Flagler	GW	U	7.74	0	0.00	2.64		
36	Palm Beach County Utilities	Palm Beach	GW	I	5.20	0	0.00	0.55	0 - 4,000	
								0.90	4,000 -10,000	
								2.22	over 10,000	
23	St. Petersburg, City of	Pinellas	GW	I	4.38	0	0.00	0.98	0 -10,000	10
								1.03	10,000 -20,000	
								1.13	over 20,000	
37	Seacoast Utility Company	Palm Beach	GW	U	6.26	0	0.00	1.59		
27	Tallahasse, City of	Leon	GW	U	3.55	2,500	2.09		0 - 2,500	
								0.84	over 2,500	
38	Talquin Electric Cooperative	Leon	GW	I	7.50	0	0.00	0.90	0 - 5,000	
								1.20	5,000 -20,000	
								1.30	over 20,000	
28	Tampa, City of	Hillsborough	SW	U	1.50	0	0.00	1.03		
39	Vero Beach, City of	Indian River	GW	I	0.00	3,000	7.80		0 - 3,000	10
								1.25	3,000 -30,000	
								2.40	30,000 -50,000	
								3.15	over 50,000	

[1]Refer to figure 2 for approximate location.
[2]Water treated through revese osmosis.

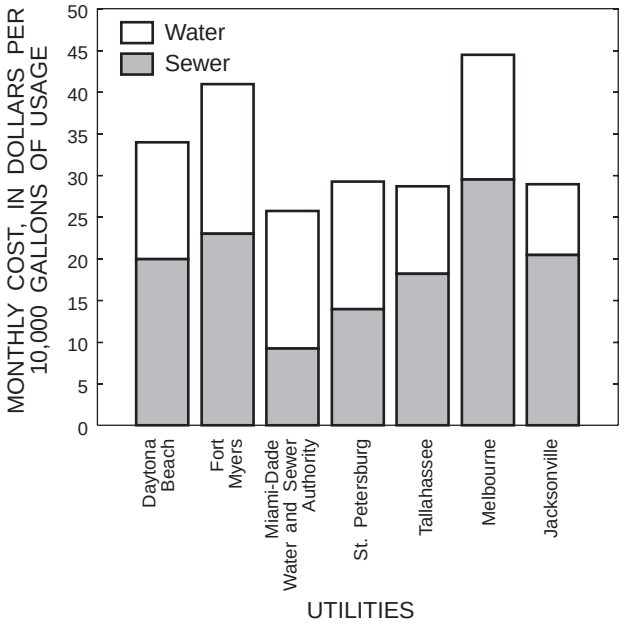

Figure 15. Monthly residential water and sewer cost for selected utilities in Florida, 1989.

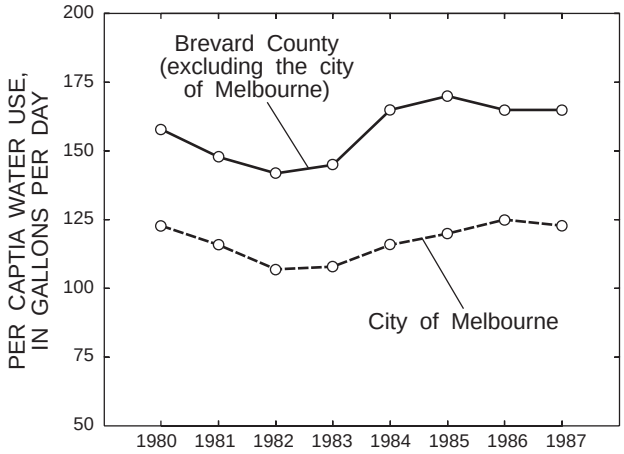

Figure 16. Historical public-supply per capita water use for the city of Melbourne and Brevard County, 1980-87 (source: the city of Melbourne; and the St. Johns River Water Management District, unpublished data).

These measures, however, only provided a temporary solution to a resource or production problem and restrictions were again placed on several counties during 1988 and 1989. Long-term water conservation measures are meant to have a more lasting effect on demands. For example, a law passed in 1982 by the Florida Legislature, entitled The Water Conservation Act, requires all new residential construction to include water-saving flow-restricting shower heads and toilets (Lynne and others, 1984, p. 243).

The effects that a conservation or restriction measure has on public-supply water use is often difficult to isolate. During the early 1980's, the city of Melbourne (Brevard County) imposed a mandatory water conservation program that limited outdoor uses of city-supplied water, including lawn watering (City of Melbourne, 1981). Melbourne has managed to curtail and maintain lower per capita use of public-supply water compared to Brevard County as a whole since 1980 (fig. 16). Much time and effort have been spent in developing public awareness of water-use habits and resource problems by water managers, suppliers, and agencies, and this heightened awareness may prove to be a major contributor to public-supply water conservation in the future.

Alternative Water-Supply Sources for Public-Supply Customers

Two alternative water sources can provide water primarily for outdoor use, to residences on public-supply water systems. The first is the use of shallow wells, and the second is the use of reclaimed wastewater. Use of both of these alternatives can lower utility water demands while providing water needed primarily for lawn upkeep which, generally, does not require the same quality needed for indoor uses.

Florida contains abundant ground-water resources, and many public-supply customers have tapped these aquifers for lawn watering. These wells range in depth from 15 feet to several hundred feet, and can be found in most areas of the State. In many areas, these irrigation wells are numerous and often very dense. An example of the density of lawn irrigation wells can be found in Brevard County, where in 1977-78 a study conducted by the U.S. Geological Survey and Brevard County, inventoried approximately 16,500 lawn-irrigation wells (Skipp, 1988). The areas inventoried were already receiving water from public-supply systems, because the ground water in these areas is unfit for potable purposes. In Volusia County, an estimated 3,200 lawn-irrigation wells were permitted by the county as of 1988 (Phelps, 1990).

Although private lawn-irrigation wells exist statewide, very few counties permit or inventory their numbers or location; therefore, very little data exist on the number of private lawn-irrigation wells that exist in Florida. However, the number of private lawn-irrigation wells in Florida is believed to be substantial.

The other alternative source of water used for lawn irrigation is reclaimed wastewater. In 1985, an estimated 1,122 Mgal/d of wastewater was treated and discharged from municipal or private wastewater facilities in Florida (Marella, 1988, p. 12). Of this total, nearly 51 Mgal/d was reused in some capacity. The city of St. Petersburg in Pinellas County used the largest amount of reclaimed wastewater (20 Mgal/d) in 1985. The city provided reclaimed wastewater for irrigation in 1987 to nearly 5,400 customers, most of whom already receive drinking water from the city. This water was used by 5,107 residential and 249 commercial customers (including golf courses), for irrigation purposes (David Schumister, City of St. Petersburg, written commun., 1989). The cost to a

customer in St. Petersburg for using reclaimed wastewater in 1987-88 was $0.30 per 1,000 gallons compared to the cost of drinking water of $1.42 per 1,000 gallons plus the wastewater charge of $1.52 per 1,000 gallons (both water and wastewater charges include base fees and taxes) (City of St. Petersburg, 1988). In addition to providing the customer an inexpensive source of water for irrigation, the utility is able to reduce the use of potable water. St. Petersburg public-supply water use including reclaimed water, for example, has increased from 28 Mgal/d in 1970 to about 60 Mgal/d in 1987, however, potable freshwater use has only increased to about 40 Mgal/d in 1987 (fig. 17) (Johnson, 1989).

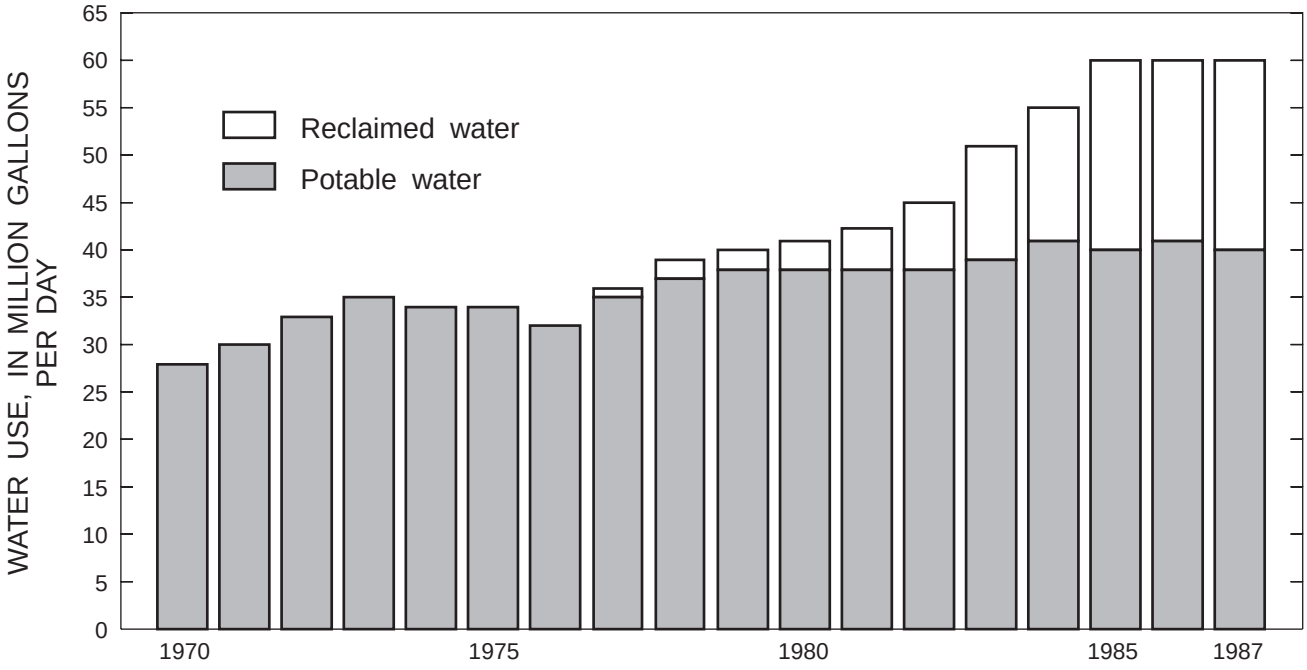

Figure 17. Historical public-supply water use for the city of St. Petersburg, 1970-87 (modified from Johnson, 1989; and Dave Schumister, the city of St. Petersburg, written commun., 1990).

Section on Public-Supply Water-Use Projections for Florida for the Years 2000, 2010 and 2020

PUBLIC-SUPPLY WATER-USE PROJECTIONS FOR FLORIDA TO THE YEAR 2020

In Florida, the need to project future public-supply water use is important, as many areas that have limited freshwater resources also are experiencing extensive development and population growth. The projections made in this report are to provide county-level aggregated estimates of public-supply water use for the period 2000-2020, and are intended as a general planning tool. Evidence of resource shortfalls could be seen throughout Florida during the 1980's as many areas were forced to find alternative freshwater supplies. During 1987, the use of membrane treated water (reverse osmosis and electrodialysis) to supplement freshwater supplies occurred in 16 counties (Dykes and Conlon, 1989), and the transfer of freshwater across county lines occurred in 6 counties. The problem of resource limitations in many areas in Florida is further complicated by competition for the use of available freshwater from other water uses, such as self-supplied commercial and industrial, and agricultural irrigation. In 1985, of the five counties (Broward, Dade, Hillsborough, Orange, and Palm Beach) where more than 100 Mgal/d of freshwater was withdrawn for public-supply use, in four (Dade, Hillsborough, Orange, and Palm Beach) more than 100 Mgal/d of freshwater also was withdrawn for other uses (Marella, 1988, p. 8, 19).

Water-Use Forecasting Methods

Methods to forecast future water use include the use of factual or estimated data and the determination of the relation between data and trends through mathematical functions or judgmental models (Davis and others, 1988). Many of these methods make various assumptions regarding the factors affecting water use and the interaction between these factors (population, climate, socioeconomic conditions, water cost, conservation and alternative sources, and others), and the significance or influence that each variable will have in the future. Different forecasting methods are appropriate for particular needs, therefore, it is important to determine the level of detail needed. Generally, the greater the detail needed for a projection, the more complicated and data-intense the appropriate method becomes. Additionally, many models require a multitude of data derived from various sources, and if the data are not available or are outdated, the projections can lose accuracy.

Single Coefficient Method

For this report, the single coefficient method was used. This method estimates future water use as the product of a single use rate (for example, water used per person, per employee, or per dwelling) and the number of individuals or units in the area. Its value, relation, and rate of change may be obtained or projected from past data using a time or trend extrapolation, or may be assumed. The estimated amount of water used per person served by public-supply water systems or the public supply per capita was used as the single variable for these projections. The use of the public-supply per capita method indirectly accounts for many of these factors. This method was selected for the following reasons:

- recent county-level population forecasts were available,
- historical county-level water-use data were available;
- historical county-level public-supply population data were available;
- historical county-level public-supply per capita data were available;
- the public-supply per capita accounts for nonresident population, commercial, and industrial uses of public-supply water, as well as general climate conditions;
- the general level of detail needed in the projected values was appropriate.

Per Capita Trends

The public-supply per capita values were derived using historical-trend data. The values for public-supply per capita were observed for the years of existing historical data (1965, 1970, 1975, 1977, 1980, 1985, and 1987). For each county, the predicted public-supply per capita use was determined by either using the average value for the seven observations, or by determining a more recent trend that occurred during the 1980's, where a trend was evident. The average for the 1980's was used most often because the recent data (1980, 1985, 1987) better portrayed the current trend in public-supply per capita use. The statewide trend indicates that public-supply per capita use increased substantially during the 1960's and 1970's, but data for the 1980's indicates the public-supply per capita use in Florida may be leveling (fig. 13).

Based on this trend, it was also assumed that public-supply per capita use will remain at or near current levels for most counties through the year 2020 (table 11). Most counties in Florida have experienced the same trend as the State for public-supply per capita use. Most counties had a higher public-supply per capita use for 1980 than for 1970, but also had remained about the same between 1980 and 1987. Several urbanized counties have maintained a high public-supply per capita use. For example, seven counties (Collier, Gilchrist, Indian River, Lake, Martin, Nassau, and Palm Beach) have averaged more than 200 gal/d for public-supply per capita use since 1970, due primarily to large nonresident populations or a high percentage of nonresidential public-supply water use.

Table 11. Historical public-supply per capita water use in Florida by county

[Modified from Pride, 1973; Leach, 1978; Leach and Healy, 1980; Leach, 1983; Marella, 1988;Marella, in press. All values, except "Percent change," are shown in gallons per day]

County	Public Supply Per Capita Water Use							Percent change			Average		Values used for projections
	1965	1970	1975	1977	1980	1985	1987	1965-87	1970-87	1980-87	1965-87	1980-87	
Alachua	118	282	164	181	179	167	161	36	-43	-10	179	169	170
Baker	92	192	132	137	120	142	145	58	-24	21	137	136	135
Bay	102	134	109	154	146	180	233	128	74	60	151	186	185
Bradford	88	121	100	174	178	170	172	95	42	-3	143	173	175
Brevard	166	130	121	133	118	150	149	-10	15	26	138	139	140
Broward	165	188	172	177	189	170	180	9	-4	-5	177	180	180
Calhoun	67	62	93	103	114	138	149	122	140	31	104	134	135
Charlotte	90	169	128	118	96	118	110	22	-35	15	118	108	110
Citrus	113	80	107	120	123	199	162	43	103	32	129	161	160
Clay	90	126	169	157	105	130	142	58	13	35	131	126	125
Collier	262	200	228	234	270	117	299	14	50	11	230	229	230
Columbia	120	102	107	146	216	174	189	58	85	-13	151	193	190
Dade	176	149	171	168	203	194	203	15	36	0	181	200	200
De Soto	110	83	109	106	101	108	102	-7	23	1	103	104	105
Dixie	160	200	111	141	110	141	154	-4	-23	40	145	135	135
Duval	202	197	182	178	145	161	168	-17	-15	16	176	158	160
Escambia	133	128	145	162	159	157	159	20	24	0	149	158	160
Flagler	88	107	103	103	96	157	146	66	36	52	114	133	135
Franklin	112	125	148	176	185	160	198	77	58	7	158	181	180
Gadsden	101	118	110	150	136	112	145	44	23	7	125	131	130
Gilchrist	106	117	253	353	300	215	272	157	132	-9	231	262	260
Glades	140	63	167	110	175	117	115	-18	83	-34	127	136	135
Gulf	70	83	114	160	152	153	161	130	94	6	128	155	155
Hamilton	67	116	102	165	145	137	155	131	34	7	127	146	145
Hardee	120	108	174	148	169	148	151	26	40	-11	145	156	155
Hendry	106	215	203	141	152	143	176	66	-18	16	162	157	160
Hernando	100	120	150	174	173	124	135	35	13	-22	139	144	145
Highlands	267	201	175	153	191	184	155	-42	-23	-19	189	177	180
Hillsborough	138	140	148	135	144	160	159	15	14	10	146	154	155
Holmes	91	100	50	162	164	183	200	120	100	22	136	182	180
Indian River	120	148	241	310	191	211	243	103	64	27	209	215	215
Jackson	99	107	106	123	154	160	157	59	47	2	129	157	155
Jefferson	120	148	147	190	163	149	214	78	45	31	162	175	175
Lafayette	100	111	140	189	133	162	171	71	54	29	144	155	155
Lake	208	237	195	235	191	192	193	-7	-19	1	207	192	195
Lee	100	91	114	122	179	153	144	44	58	-20	129	159	160
Leon	150	154	156	182	145	157	167	11	8	15	159	156	155
Levy	75	122	140	140	139	145	170	127	39	22	133	151	150
Liberty	100	125	60	69	81	120	154	54	23	90	101	118	115
Madison	111	94	156	170	157	197	213	92	127	36	157	189	190
Manatee	93	153	236	269	168	124	140	51	-8	-17	169	144	145
Marion	177	137	166	160	138	174	160	-10	17	16	159	157	160
Martin	162	133	240	232	234	208	195	20	47	-17	201	212	210
Monroe	91	106	138	131	60	160	176	93	66	193	123	132	130
Nassau	128	225	414	227	217	176	171	34	-24	-21	223	188	190
Okaloosa	164	130	117	165	170	143	158	-4	22	-7	150	157	160
Okeechobee	257	66	127	163	163	143	131	-49	98	-20	150	146	145
Orange	188	140	187	198	185	192	198	5	41	7	184	192	190
Osceola	254	186	192	208	170	140	138	-46	-26	-19	184	149	150
Palm Beach	184	213	241	231	245	213	222	21	4	-9	221	227	225
Pasco	87	82	113	133	87	130	117	34	43	34	107	111	110
Pinellas	99	145	127	135	147	143	140	41	-3	-5	134	143	140
Polk	152	163	171	163	194	200	192	26	18	-1	176	195	195
Putnam	143	193	173	211	181	164	157	10	-19	-13	175	167	170
St. Johns	136	147	126	136	116	133	131	-4	-11	13	132	127	130
St. Lucie	108	127	144	156	174	148	151	40	19	-13	144	158	160
Santa Rosa	109	162	90	108	115	132	153	40	-6	33	124	133	130
Sarasota	83	107	115	105	102	119	152	83	42	49	112	124	125
Seminole	127	107	166	195	148	167	176	39	64	19	155	164	165
Sumter	125	166	84	126	189	156	116	-7	-30	-39	137	154	155
Suwannee	86	77	124	160	154	149	153	78	99	-1	129	152	150
Taylor	105	114	132	182	175	152	151	44	32	-14	144	159	160
Union	100	62	324	90	108	129	153	53	147	42	138	130	130
Volusia	103	135	170	170	120	136	138	34	2	15	139	131	130
Wakulla	67	83	58	73	119	94	109	63	31	-8	86	107	105
Walton	173	76	102	101	126	135	127	-27	67	1	120	129	130
Washington	79	105	87	124	156	146	148	87	41	-5	121	150	150
State values	147	163	168	171	174	172	175	19	7	1	167	174	

Conversely, several counties have maintained a low public-supply per capita water use. For example, Charlotte, De Soto, Liberty, Pasco, and Wakulla Counties had a per capita of less than 120 gal/d during the 1980's, due primarily to the rural nature or lack of growth of the counties and the high percentage of fixed-income households. Although the county public-supply per capita use data is fairly consistent for the years 1965, 1970, 1975, 1977, 1980, 1985 and 1987, (table 11), several anomalies do exist, and these anomalies generally can be attributed to changes in data-collection procedures, or misinformation gathered or tabulated for a given year.

Population Trends

Population projections are vital to the accuracy and the validity of a water-use forecast. Resident population projections were supplied by the University of Florida, Bureau of Economics and Business Research (Smith and Bayya, 1989). Smith and Bayya (1989) compiled low, medium, and high projections of population, by county, based on different growth scenarios. These projections are done annually in Florida, and, due to the large population influx during the 1980's, projections have changed dramatically since the early 1980's. Population projections estimated in 1983 showed that medium projections for Florida's population in the year 2000 would be 14.8 million (Smith and Sincich, 1983); those made in 1988 showed medium projection for the year 2000 at nearly 16.0 million (Smith and Bayya, 1989). The difference between the 1983 and 1988 projections on the State level is approximately 1.2 million (7 percent). This difference in population projections affects the accuracy of past water-use forecasts that used earlier (1983) estimates (Leach, 1984). The same problem can occur with this report, as the accuracy of the water-use forecast again will depend upon the accuracy of current (1988) population projections. Therefore, water-use projections were calculated using low, medium, and high population projections (table 12).

Percentage of Population Served by Public Supply

Population served by public-supply was determined by using past trends in each county. The percentage of population served by public supply was observed for the years of existing historical data (1965, 1970, 1975, 1977, 1980, 1985, and 1987). For each county, the predicted percentage of public-supply population was determined by either using the average percentage over the 7 years of data, or by determining a more recent trend that occurred during the 1980's where a trend was evident. The average for the 1980's was used most often because the recent data (1980, 1985, 1987) better portrayed the current trend in public-supply populations. The statewide trend indicates that public-supply population served increased substantially during the 1960's and 1970's, but data for the 1980's indicate that the percentage of public-supply population in Florida may be leveling (fig. 4).

Based on the overall statewide trend, it also was assumed that the percentage of population served by public supply will remain at or near its current rate for most counties through the year 2020 (table 13). Primarily because of the urban growth and water-utility consolidation within the counties, many counties have maintained a high percentage, or have increased substantially, their percentage of population served by public supply. For example, Brevard, Broward, Dade, and Pinellas have had a relatively high percentage (above 85 percent) of public-supply population since 1970. For the same reason, several counties that are experiencing population growth are also experiencing increases in the percentage of population served by public supply. For example, Citrus, Hernando, Pasco, and Santa Rosa Counties all have experienced large increases in the percentage (increased more than 100 percent) of population served by public supply since 1970. Conversely, several rural counties have a decreasing percentage of population served by public-supply. For example, Columbia, Lafayette, Liberty, and Levy Counties have all experienced decreases in the percentage (decreased more than 40 percent) of population served by public supply since 1970 due primarily to the rural nature of these counties and the growth occurring outside of the water-systems service areas. Although the data for the percentage of county public-supply population served is fairly consistent for the years 1965, 1970, 1975, 1977, 1980, 1985, and 1987 (table 13), several anomalies do exist, and these anomalies generally can be attributed to changes in data-collection procedures, or misinformation gathered or tabulated for a given year.

Projection Results

Water demand options, such as conservation, restrictions, education programs, leak detection and repair programs, and more realistic pricing practices can reduce the demand for freshwater. Increased use of alternative sources of water, such as reclaimed wastewater and desalinated seawater also can reduce the deman for freshwater. Because the water demand projections in this report are based primarily on population projections, they should represent an upper limit of actual future demand if the population projections prove sound. Any additional water demand options implemented in the future at the State, county, or public-supply facility level may significantly reduce per capita use and result in public-supply use less than projected in this report.

Using medium projections, Florida's population is expected to increase to nearly 16.0 million in the year 2000, to 18.0 million in the year 2010, and to nearly 20.0 million in the year 2020 (Smith and Bayya, 1989).

Table 12. Low, medium, and high population projections in Florida, by county, for the years 2000, 2010, and 2020

[Population in thousands; from Smith and Bayya, 1989]

County	Low projections			Medium projections			High projections		
	2000	2010	2020	2000	2010	2020	2000	2010	2020
Alachua	199.7	193.9	188.0	221.9	242.4	268.6	244.1	290.9	349.1
Baker	19.5	17.7	15.4	23.0	25.2	27.9	26.4	32.8	40.5
Bay	160.0	160.4	155.5	177.8	200.5	222.2	195.6	240.6	288.8
Bradford	23.3	20.7	18.0	27.4	29.6	32.7	31.6	38.4	47.5
Brevard	453.7	439.8	382.9	533.8	628.2	696.1	613.9	816.7	1,009.3
Broward	1,326.8	1,307.5	1,267.7	1,474.2	1,634.4	1,811.0	1,621.7	1,961.3	2,354.2
Calhoun	9.9	7.9	5.8	12.4	13.1	14.5	14.9	18.4	23.2
Charlotte	121.1	122.6	106.8	142.5	175.2	194.1	163.8	227.7	281.4
Citrus	111.4	113.1	98.4	131.1	161.5	179.0	150.7	210.0	259.5
Clay	125.4	125.3	109.1	147.6	179.0	198.3	169.7	232.7	287.6
Collier	171.1	172.6	150.2	201.3	246.5	273.1	231.5	320.5	396.0
Columbia	45.2	44.2	42.8	50.2	55.2	61.2	55.3	66.2	79.5
Dade	1,874.7	1,791.5	1,736.9	2,083.0	2,239.4	2,481.3	2,291.3	2,687.3	3,225.6
De Soto	24.0	21.5	18.7	28.3	30.7	34.0	32.5	39.9	49.3
Dixie	10.4	8.9	6.5	13.0	14.8	16.4	15.7	20.7	26.2
Duval	745.1	719.1	697.2	827.9	898.9	996.0	910.7	1,078.7	1,294.8
Escambia	300.7	283.6	275.0	334.1	354.5	392.8	367.6	425.4	510.6
Flagler	29.6	27.9	20.6	37.0	46.5	51.5	44.4	65.1	82.4
Franklin	7.6	5.9	4.3	9.4	9.8	10.8	11.3	13.7	17.3
Gadsden	46.4	43.3	42.0	51.5	54.1	60.0	56.7	65.0	78.0
Gilchrist	7.4	6.3	4.7	9.2	10.5	11.7	11.1	14.7	18.7
Glades	7.4	6.1	4.5	9.2	10.2	11.3	11.1	14.2	18.0
Gulf	11.1	8.5	6.3	13.8	14.2	15.8	16.6	19.9	25.2
Hamilton	8.7	6.7	5.0	10.8	11.2	12.5	13.0	15.7	19.9
Hardee	21.9	19.1	16.6	25.7	27.3	30.2	29.6	35.4	43.8
Hendry	28.1	26.0	22.7	33.0	37.2	41.2	38.0	48.3	59.7
Hernando	124.4	128.5	111.8	146.4	183.5	203.3	168.4	238.6	294.8
Highlands	81.3	84.5	81.9	90.4	105.7	117.1	99.4	126.8	152.2
Hillsborough	941.4	926.2	897.9	1,046.0	1,157.7	1,282.7	1,150.6	1,389.2	1,667.5
Holmes	17.1	15.1	13.2	20.1	21.6	24.0	23.2	28.1	34.8
Indian River	105.9	105.1	91.5	124.6	150.1	166.3	143.3	195.1	241.2
Jackson	44.3	41.5	40.3	49.3	51.9	57.5	54.2	62.3	74.8
Jefferson	11.1	8.9	6.6	13.9	14.9	16.5	16.7	20.9	26.4
Lafayette	4.8	3.8	2.8	6.0	6.3	7.0	7.1	8.8	11.2
Lake	168.6	172.9	167.7	187.3	216.2	239.5	206.0	259.4	311.4
Lee	383.9	385.0	335.2	451.7	550.0	609.5	519.4	715.1	883.7
Leon	198.3	191.0	185.2	220.3	238.7	264.5	242.3	286.5	343.9
Levy	25.8	23.7	20.6	30.4	33.9	37.5	35.0	44.0	54.4
Liberty	4.3	3.4	2.5	5.3	5.6	6.2	6.4	7.9	10.0
Madison	14.1	11.9	10.4	16.6	17.1	18.9	19.0	22.2	27.4
Manatee	212.7	208.0	201.6	236.3	260.0	288.1	259.9	312.0	374.5
Marion	225.0	225.6	196.4	264.6	322.2	357.0	304.3	418.9	517.7
Martin	109.9	107.6	93.7	129.3	153.8	170.4	148.7	199.9	247.0
Monroe	82.3	77.8	75.4	91.4	97.2	107.7	100.5	116.7	140.0
Nassau	55.8	56.2	54.4	62.0	70.2	77.8	68.2	84.2	101.1
Okaloosa	175.5	164.0	142.8	206.4	234.3	259.6	237.4	304.5	376.4
Okeechobee	31.8	27.8	20.5	39.7	46.3	51.3	47.7	64.8	82.1
Orange	739.4	735.8	713.4	821.5	919.8	1,019.1	903.7	1,103.7	1,324.8
Osceola	133.5	136.8	119.1	157.0	195.4	216.5	180.6	254.1	314.0
Palm Beach	1,006.4	998.9	869.6	1,184.0	1,426.9	1,581.1	1,361.6	1,855.0	2,292.5
Pasco	334.6	351.6	340.9	371.8	439.5	487.0	408.9	527.5	633.1
Pinellas	866.3	832.7	807.4	962.6	1,040.9	1,153.4	1,058.8	1,249.1	1,499.4
Polk	447.3	432.3	419.1	497.0	540.4	598.7	546.7	648.4	778.3
Putnam	65.2	63.4	61.5	72.4	79.2	87.8	79.6	95.1	114.1
St. Johns	102.3	102.9	89.6	120.3	147.1	162.9	138.4	191.2	236.3
St. Lucie	168.3	168.4	146.6	198.0	240.5	266.5	227.7	312.7	386.4
Santa Rosa	71.3	68.3	66.2	79.2	85.3	94.5	87.1	102.4	122.9
Sarasota	298.8	303.3	294.0	332.0	379.1	420.0	365.2	454.9	546.1
Seminole	335.7	336.7	293.1	395.0	481.0	532.9	454.2	625.2	772.7
Sumter	34.5	34.5	33.4	38.3	43.1	47.7	42.1	51.7	62.1
Suwannee	27.4	24.9	21.7	32.3	35.5	39.4	37.1	46.2	57.1
Taylor	18.2	16.1	14.0	21.4	23.0	25.5	24.6	29.9	37.0
Union	9.2	7.2	5.3	11.5	12.0	13.3	13.8	16.8	21.3
Volusia	417.1	431.6	418.4	463.4	539.5	597.8	509.8	647.4	777.1
Wakulla	15.0	12.7	9.4	18.8	21.2	23.5	15.0	29.6	37.5
Walton	32.1	29.8	25.9	37.7	42.5	47.1	32.1	55.3	68.3
Washington	15.2	13.3	11.6	17.9	19.1	21.1	15.2	24.8	30.6
Totals[1]	14,046.3	13,769.8	12,914.2	15,899.2	17,998.3	19,942.4	17,728.7	22,227.1	26,970.2

[1]Totals may not equal due to round-off.

Table 13. Historical percentage of county population served by public supply in Florida, by county

[Modified from Pride, 1973; Leach, 1978; Leach and Healy, 1980; Leach, 1983; Marella, 1988, 1990. All values are shown in percent]

County	Percent Served by Public Supply							Percent change			Average		Values used for projections
	1965	1970	1975	1977	1980	1985	1987	1965-87	1970-87	1980-87	1965-87	1980-87	
Alachua	78.8	75.5	69.3	68.2	67.1	73.2	75.4	-4	0	12	72.5	71.9	72
Baker	41.7	28.1	33.3	32.3	32.7	24.5	23.5	-44	-16	-28	30.9	26.9	30
Bay	71.3	51.5	90.3	82.9	89.6	74.1	74.7	5	45	-17	76.3	79.5	80
Bradford	24.3	39.7	50.9	36.7	29.5	33.7	35.9	48	-10	22	35.8	33.0	35
Brevard	80.8	88.7	89.2	88.8	89.2	88.9	88.9	10	0	0	87.8	89.0	90
Broward	86.2	88.7	92.7	97.7	96.3	98.5	97.8	13	10	2	94.0	97.5	97
Calhoun	39.5	42.0	36.1	35.2	31.2	29.7	27.6	-30	-34	-12	34.5	29.5	30
Charlotte	86.2	58.1	75.8	75.8	86.9	65.1	81.8	-5	41	-6	75.7	77.9	80
Citrus	42.5	13.0	15.6	14.2	13.5	45.5	58.7	38	352	335	29.0	39.2	60
Clay	48.1	39.6	62.3	63.2	26.0	75.6	73.0	52	84	181	55.4	58.2	70
Collier	49.0	77.5	83.6	87.7	83.2	75.4	77.3	58	0	-7	76.2	78.6	80
Columbia	43.1	65.7	55.2	42.9	26.3	29.0	28.4	-34	-57	8	41.5	27.9	30
Dade	95.0	93.4	94.4	93.1	92.8	96.1	96.1	1	3	4	94.4	95.0	95
De Soto	49.2	45.9	38.5	38.9	36.8	29.1	34.6	-30	-25	-6	39.0	33.5	35
Dixie	49.0	36.5	57.6	48.6	64.5	48.9	39.4	-20	8	-39	49.2	50.9	40
Duval	58.2	65.3	90.6	91.5	71.7	84.6	84.5	45	29	18	78.1	80.3	80
Escambia	67.5	77.1	85.4	81.8	82.0	88.7	83.4	24	8	2	80.8	84.7	85
Flagler	59.6	62.9	90.9	75.9	73.3	88.1	91.2	53	45	24	77.4	84.2	90
Franklin	67.1	56.6	84.8	77.8	70.5	89.2	90.2	34	59	28	76.6	83.3	85
Gadsden	43.0	43.4	49.6	45.8	39.7	58.5	49.9	16	15	26	47.1	49.4	50
Gilchrist	37.5	33.8	29.4	26.3	20.8	22.9	20.7	-45	-39	0	27.3	21.5	21
Glades	27.8	37.5	23.5	37.7	20.0	30.7	30.4	9	-19	52	29.7	27.0	30
Gulf	66.0	59.4	60.6	50.0	60.0	56.8	53.3	-19	-10	-11	58.0	56.7	60
Hamilton	32.1	55.2	68.6	56.3	53.6	57.7	57.1	78	3	7	54.4	56.1	60
Hardee	51.1	43.7	37.3	39.7	38.7	42.1	40.5	-21	-7	5	41.9	40.4	40
Hendry	42.0	54.8	63.5	67.9	71.0	75.9	73.1	74	33	3	64.0	73.3	75
Hernando	34.2	29.4	17.5	16.5	14.8	89.2	97.1	184	230	556	42.7	67.0	90
Highlands	70.6	79.3	57.0	59.4	54.5	74.1	79.5	13	0	46	67.8	69.4	70
Hillsborough	70.9	75.5	66.6	86.3	90.9	95.0	82.0	16	9	-10	81.0	89.3	90
Holmes	19.8	28.0	32.0	26.2	26.5	28.8	27.4	38	-2	3	27.0	27.6	30
Indian River	39.6	58.3	40.2	37.8	54.3	54.8	58.9	49	1	8	49.1	56.0	60
Jackson	43.6	43.6	40.8	42.0	35.8	37.3	36.0	-17	-17	1	39.9	36.4	40
Jefferson	26.9	30.8	31.9	31.3	28.0	25.0	24.4	-9	-21	-13	28.3	25.8	25
Lafayette	34.5	31.1	32.3	23.7	22.3	20.7	18.4	-47	-41	-17	26.1	20.5	20
Lake	62.6	60.9	58.2	45.9	56.8	64.3	66.7	7	10	17	59.3	62.6	65
Lee	53.8	87.0	94.4	90.5	81.1	78.2	79.3	47	-9	-2	80.6	79.5	80
Leon	69.7	75.4	76.3	69.3	79.6	83.3	78.3	12	4	-2	76.0	80.4	80
Levy	47.7	58.0	45.6	47.2	39.8	33.6	32.6	-32	-44	-18	43.5	35.3	35
Liberty	31.3	47.4	38.5	32.5	37.6	26.0	27.4	-12	-42	-27	34.4	30.3	30
Madison	45.0	47.5	48.6	44.8	41.1	38.4	40.3	-10	-15	-2	43.7	39.9	40
Manatee	81.4	66.7	64.8	64.2	83.7	98.1	98.2	21	47	17	79.6	93.3	95
Marion	33.5	41.1	40.2	37.6	40.2	44.4	47.3	41	15	18	40.6	44.0	50
Martin	48.5	42.8	49.9	47.3	41.1	55.4	58.4	20	36	42	49.1	51.6	60
Monroe	100.0	100.0	100.0	100.0	100.0	100.0	98.7	-1	-1	-1	99.8	99.6	100
Nassau	49.5	43.1	19.9	43.4	13.7	43.4	47.1	-5	9	244	37.2	34.7	45
Okaloosa	61.9	68.9	78.2	72.8	69.1	88.8	78.9	27	15	14	74.1	78.9	80
Okeechobee	36.8	40.1	48.2	45.3	46.9	55.0	55.0	49	37	17	46.8	52.3	55
Orange	84.2	84.2	79.9	79.7	79.5	94.3	97.3	16	16	22	85.6	90.4	95
Osceola	58.8	57.4	51.8	50.1	49.9	55.9	62.1	6	8	24	55.1	56.0	60
Palm Beach	71.4	74.5	82.0	82.5	88.1	96.3	96.2	35	29	9	84.4	93.5	95
Pasco	44.9	32.0	20.2	18.8	70.4	71.9	76.0	69	138	8	47.7	72.8	75
Pinellas	80.4	79.1	90.7	95.9	96.3	96.9	98.6	23	25	2	91.1	97.3	97
Polk	81.3	74.4	66.3	66.8	57.0	75.2	80.4	-1	8	41	71.6	70.9	75
Putnam	40.7	38.4	34.3	33.3	31.3	31.9	33.3	-18	-13	6	34.7	32.2	32
St. Johns	71.7	54.8	52.7	49.5	50.3	76.8	77.4	8	41	54	61.9	68.2	75
St. Lucie	62.5	66.9	61.5	57.7	63.8	62.8	63.5	2	-5	0	62.7	63.4	65
Santa Rosa	29.7	39.2	80.8	81.4	90.2	90.1	97.6	229	149	8	72.7	92.6	95
Sarasota	85.9	86.6	55.1	60.7	94.7	89.4	79.3	-8	-8	-16	78.8	87.8	85
Seminole	45.3	70.4	46.3	45.4	52.5	90.6	90.9	101	29	73	63.1	78.0	90
Sumter	28.4	32.3	35.4	33.8	22.2	35.3	33.1	17	2	49	31.5	30.2	35
Suwannee	43.5	50.1	48.1	37.9	31.0	35.1	33.2	-24	-34	7	39.8	33.1	33
Taylor	69.9	76.2	71.2	63.9	51.4	58.1	56.0	-20	-27	9	63.8	55.2	55
Union	20.8	19.7	16.3	60.8	52.1	37.4	37.4	80	90	-28	34.9	42.3	40
Volusia	81.4	84.0	69.5	71.2	85.9	87.3	87.9	8	5	2	81.0	87.0	87
Wakulla	5.0	38.0	51.1	53.8	43.2	47.4	44.9	798	18	4	40.5	45.2	45
Walton	33.5	57.2	58.9	51.6	60.6	85.9	89.6	167	57	48	62.5	78.7	85
Washington	33.0	33.2	48.2	43.2	40.7	47.6	43.4	32	31	7	41.3	43.9	42
State values	74.3	76.7	78.4	79.6	79.9	85.9	86.3	16	13	8	80.1	84.0	

Based on these projections, an estimated 13.5 million people are expected to be supplied water from public-supply water systems in the year 2000, 15.3 million in 2010, and nearly 17.0 million by the year 2020. Public-supply water use is expected to increase from 1,811 Mgal/d in 1987 to nearly 2,310 Mgal/d in the year 2000, to 2,610 Mgal/d in the year 2010, and to almost 2,890 Mgal/d in the year 2020 (medium projections) (fig. 18). If the population exceeds the medium projections, high projections estimate public-supply water use could reach nearly 2,570 Mgal/d in 2000, 3,210 Mgal/d in 2010, and 3,900 Mgal/d in 2020 (fig. 18).

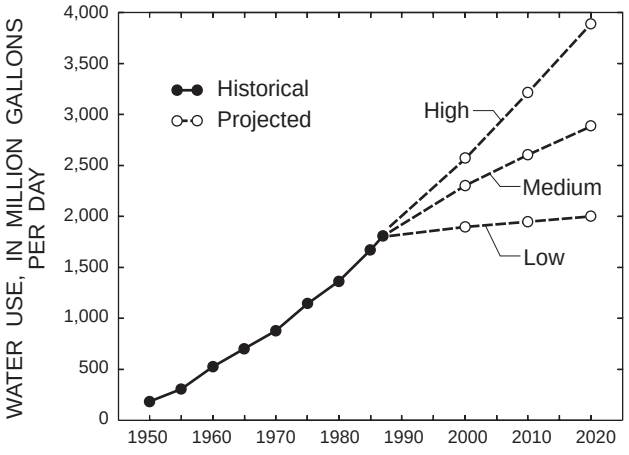

Figure 18. Historical and projected public-supply water use in Florida, 1950-2020 (modified from Marella, 1990).

County Projections

By the year 2000, seven counties are projected to have public-supply water use that will exceed 100 Mgal/d (table 14). Furthermore, these seven counties (Broward, Dade, Duval, Hillsborough, Orange, Palm Beach, and Pinellas) will account for 53 percent of the State's total population and 62 percent of the State's public-supply water use.

The biggest change in population and public-supply water use is projected for Palm Beach and Dade Counties. Palm Beach County shows the largest increase in public-supply water use, increasing from 168.5 Mgal/d in 1987 (table 3) to a medium projected 338.0 Mgal/d for 2020 (table 14). Dade County's medium public-supply water use is projected to increase to nearly 471.0 Mgal/d and withdrawals may even exceed 485.0 Mgal/d, as Dade County also supplies Monroe County with its public-supply water. Dade and Palm Beach Counties are expected to continue to use the greatest amount of public-supply water for each of the years 2000, 2010, and 2020. Along with Dade and Palm Beach Counties, the highly urbanized counties of Broward, Hillsborough, and Orange are expected to increase in projected public-supply water use from 1987 by more than 30.0 Mgal/d by the year 2000. By the year 2020 these five counties are each projected to increase public-supply water use by more than 65.0 Mgal/d each over 1987.

If the population exceeds the medium projections for Dade and Palm Beach Counties, then public-supply water use could reach more than 612.0 Mgal/d and 490.0 Mgal/d, respectively, by the year 2020 (table 14). Additionally, using high projection, six counties (Broward, Dade, Hillsborough, Orange, Palm Beach, and Pinellas) could surpass 200 Mgal/d by the year 2020 and five more (Brevard, Duval, Lee, Polk, and Seminole) could surpass 100 Mgal/d. Combined, these 11 counties could account for 72 percent of the Florida's future public-supply water use.

Several counties can experience increases in public-supply water use as a direct result of suburban or coastal growth. For example, population growth in Orlando (Orange County) also can be felt in Osceola and Seminole Counties; growth in Jacksonville (Duval County) can affect Clay and St. Johns Counties. Osceola County's public-supply water use is projected to increase 88 percent by the year 2000, and 160 percent by the year 2020; Seminole County is projected to increase 43 percent by the year 2000, and 93 percent by the year 2020 over their 1987 use; Clay County's public-supply water use is projected to increase 31 percent by the year 2000, and 77 percent by the year 2020; and St. Johns is projected to increase 51 percent by the year 2000, and 109 percent by the year 2020 over their 1987 use.

Public-supply water use in many coastal counties also may be affected by population growth. For example, in southwest Florida, Charlotte, Collier, and Lee Counties are projected to increase by the year 2020 in public-supply water use by 63, 71, and 131 percent, respectively, over 1987 values. Total public-supply water use for these three counties in 1987 equaled 73.0 Mgal/d, and is projected to reach nearly 107.0 Mgal/d by the year 2000, and 145.0 Mgal/d by 2020. Along the coastal counties of east-central Florida, Brevard, Indian River, Martin, and St. Lucie Counties are projected to increase by the year 2020 in public-supply water use by 77, 79, 115, and 123 percent, respectively, over 1987 values. Total public-supply water use for these four counties in 1987 equaled 83.6 Mgal/d, and is projected to reach 120.0 Mgal/d by the year 2000, and 158.0 Mgal/d in 2020.

Other counties that are projected to have a large percentage increase (more than 100 percent) in public-supply water use from 1987 by the year 2020 are Hernando (152 percent), Flagler (142 percent), Sumter (136 percent), Citrus (121 percent), and Palm Beach (101 percent). Three counties (Lafayette, Liberty, and Madison) project little or no increase in public-supply water use between 1987 and 2020, whereas Monroe (7 percent), Franklin (13 percent), and Gadsden (15 percent) Counties projected increases of 15 percent or less in public-supply water use during this timeframe. Using the current growth patterns, no county in Florida is projected to have a decline in public-supply water use between 1987 and 2020.

Table 14. Projected range of public-supply water use in Florida, by county, for the years 2000, 2010, and 2020

[Projected for each county by using the public supply per capita water use (table 11), estimated percentage of population served by public supply (table 13), and the population projections in table 12]

	Projected water use in million gallons per day								
	2000			2010			2020		
County	Low	Medium	High	Low	Medium	High	Low	Medium	High
Alachua	24.4	27.2	29.9	23.7	29.7	35.6	23.0	32.9	42.7
Baker	0.8	0.9	1.1	0.7	1.0	1.3	0.6	1.1	1.6
Bay	23.7	26.3	28.9	23.7	29.7	35.6	23.0	32.9	42.7
Bradford	1.4	1.7	1.9	1.3	1.8	2.4	1.1	2.0	2.9
Brevard	57.2	67.3	77.4	55.4	79.2	102.9	48.2	87.7	127.2
Broward	231.7	257.4	283.1	228.3	285.4	342.4	221.3	316.2	411.0
Calhoun	0.4	0.5	0.6	0.3	0.5	0.7	0.2	0.6	0.9
Charlotte	10.7	12.5	14.4	10.8	15.4	20.0	9.4	17.1	24.8
Citrus	10.7	12.6	14.5	10.9	15.5	20.2	9.4	17.2	24.9
Clay	11.0	12.9	14.8	11.0	15.7	20.4	9.5	17.4	25.2
Collier	31.5	37.0	42.6	31.8	45.4	59.0	27.6	50.3	72.9
Columbia	2.6	2.9	3.2	2.5	3.1	3.8	2.4	3.5	4.5
Dade	356.2	395.8	435.3	340.4	425.5	510.6	330.0	471.4	612.9
De Soto	0.9	1.0	1.2	0.8	1.1	1.5	0.7	1.2	1.8
Dixie	0.6	0.7	0.8	0.5	0.8	1.1	0.4	0.9	1.4
Duval	95.4	106.0	116.6	92.0	115.1	138.1	89.2	127.5	165.7
Escambia	40.9	45.4	50.0	38.6	48.2	57.9	37.4	53.4	69.4
Flagler	3.6	4.5	5.4	3.4	5.6	7.9	2.5	6.3	10.0
Franklin	1.2	1.4	1.7	0.9	1.5	2.1	0.7	1.7	2.6
Gadsden	3.0	3.3	3.7	2.8	3.5	4.2	2.7	3.9	5.1
Gilchrist	0.4	0.5	0.6	0.3	0.6	0.8	0.3	0.6	1.0
Glades	0.3	0.4	0.4	0.2	0.4	0.6	0.2	0.5	0.7
Gulf	1.0	1.3	1.5	0.8	1.3	1.9	0.6	1.5	2.3
Hamilton	0.8	0.9	1.1	0.6	1.0	1.4	0.4	1.1	1.7
Hardee	1.4	1.6	1.8	1.2	1.7	2.2	1.0	1.9	2.7
Hendry	3.4	4.0	4.6	3.1	4.5	5.8	2.7	4.9	7.2
Hernando	16.2	19.1	22.0	16.8	23.9	31.1	14.6	26.5	38.5
Highlands	10.2	11.4	12.5	10.6	13.3	16.0	10.3	14.8	19.2
Hillsborough	131.3	145.9	160.5	129.2	161.5	193.8	125.3	178.9	232.6
Holmes	0.9	1.1	1.3	0.8	1.2	1.5	0.7	1.3	1.9
Indian River	13.7	16.1	18.5	13.6	19.4	25.2	11.8	21.5	31.1
Jackson	2.7	3.1	3.4	2.6	3.2	3.9	2.5	3.6	4.6
Jefferson	0.5	0.6	0.7	0.4	0.7	0.9	0.3	0.7	1.2
Lafayette	0.1	0.2	0.2	0.1	0.2	0.3	0.1	0.2	0.3
Lake	21.4	23.7	26.1	21.9	27.4	32.9	21.3	30.4	39.5
Lee	49.1	57.8	66.5	49.3	70.4	91.5	42.9	78.0	113.1
Leon	24.6	27.3	30.0	23.7	29.6	35.5	23.0	32.8	42.6
Levy	1.4	1.6	1.8	1.2	1.8	2.3	1.1	2.0	2.9
Liberty	0.1	0.2	0.2	0.1	0.2	0.3	0.1	0.2	0.3
Madison	1.1	1.3	1.4	0.9	1.3	1.7	0.8	1.4	2.1
Manatee	29.3	32.6	35.8	28.7	35.8	43.0	27.8	39.7	51.6
Marion	18.0	21.2	24.3	18.0	25.8	33.5	15.7	28.6	41.4
Martin	13.8	16.3	18.7	13.6	19.4	25.2	11.8	21.5	31.1
Monroe	10.7	11.9	13.1	10.1	12.6	15.2	9.8	14.0	18.2
Nassau	4.8	5.3	5.8	4.8	6.0	7.2	4.7	6.7	8.6
Okaloosa	22.5	26.4	30.4	21.0	30.0	39.0	18.3	33.2	48.2
Okeechobee	2.5	3.2	3.8	2.2	3.7	5.2	1.6	4.1	6.5
Orange	133.5	148.3	163.1	132.8	166.0	199.2	128.8	183.9	239.1
Osceola	12.0	14.1	16.3	12.3	17.6	22.9	10.7	19.5	28.3
Palm Beach	215.1	253.1	291.0	213.5	305.0	396.5	185.9	338.0	490.0
Pasco	27.6	30.7	33.7	29.0	36.3	43.5	28.1	40.2	52.2
Pinellas	117.6	130.7	143.8	113.1	141.4	169.6	109.6	156.6	203.6
Polk	65.4	72.7	80.0	63.2	79.0	94.8	61.3	87.6	113.8
Putnam	3.5	3.9	4.3	3.4	4.3	5.2	3.3	4.8	6.2
St. Johns	10.0	11.7	13.5	10.0	14.3	18.6	8.7	15.9	23.0
St. Lucie	17.5	20.6	23.7	17.5	25.0	32.5	15.2	27.7	40.2
Santa Rosa	8.8	9.8	10.8	8.4	10.5	12.6	8.2	11.7	15.2
Sarasota	31.7	35.3	38.8	32.2	40.3	48.3	31.2	44.6	58.0
Seminole	49.9	58.7	67.4	50.0	71.4	92.8	43.5	79.1	114.7
Sumter	1.9	2.1	2.3	1.9	2.3	2.8	1.8	2.6	3.4
Suwannee	1.4	1.6	1.8	1.2	1.8	2.3	1.1	2.0	2.8
Taylor	1.6	1.9	2.2	1.4	2.0	2.6	1.2	2.2	3.3
Union	0.5	0.6	0.7	0.4	0.6	0.9	0.3	0.7	1.1
Volusia	47.2	52.4	57.7	48.8	61.0	73.2	47.3	67.6	87.9
Wakulla	0.7	0.9	0.7	0.6	1.0	1.4	0.4	1.1	1.8
Walton	3.5	4.2	3.5	3.3	4.7	6.1	2.9	5.2	7.5
Washington	1.0	1.1	1.0	0.8	1.2	1.6	0.7	1.3	1.9
State values	2,040.3	2,306.4	2,570.7	1,999.7	2,606.2	3,212.9	1,879.6	2,887.8	3,895.9

Several counties in Florida already are experiencing water quantity and quality problems caused by increasing demands and competition for freshwater. In 1987, 16 counties used reverse osmosis and 6 counties imported water for public-supply use (Marella, 1990). Sarasota and Lee Counties used reverse osmosis to treat 60 percent and 44 percent, respectively, of their public-supply water use in 1987. These two counties are projected to need an additional 59.0 Mgal/d (Sarasota, 14.0 Mgal/d, and Lee, 45.0 Mgal/d) by the year 2020, and much of this water also may come from reverse osmosis treated water. Monroe, Pinellas, and Brevard Counties imported a large percentage of their public-supply water in 1987. Monroe County imported 100 percent of its public-supply water from Dade County, Pinellas County imported 66 percent of its public-supply water from Hillsborough and Pasco Counties, and Brevard County imported 48 percent of its public-supply water from Orange County during 1987. By the year 2020, Pinellas and Brevard Counties are projected to need an additional 77.0 Mgal/d (Pinellas, 38.0 Mgal/d, and Brevard, 39.0 Mgal/d), and much of this water may need to be imported from adjacent areas.

Overall Setting

Public-supply water use along with domestic self-supplied water use has increased steadily between 1960 and 1987 and is projected to continue increasing through the year 2020. Combined, potable water needed for public-supply and domestic self-supplied purposes increased from 616.0 Mgal/d (530.0 Mgal/d public supply) in 1960 (MacKichan and Kammerer, 1961, p. 5, 9) to nearly 2,100 Mgal/d (1,811 Mgal/d public supply) in 1987 (Marella, 1990), and could reach nearly 3,400 Mgal/d (2,890 Mgal/d public supply) using medium projections by the year 2020. These increases have and will continue to occur because of the increase in population, housing units, tourism, and the increase in public-supply water deliveries to nonresidential users in Florida. Based on these values, it is projected that, sometime between the years 2010 and 2020, the demands for potable water for public-supply and domestic self-supplied purposes could exceed all other uses of freshwater in Florida (fig. 19).

SUMMARY

Public-supply water use in Florida increased 242 percent between 1960 and 1987. Water withdrawn for public supply use in 1960 was 530 Mgal/d and in 1987 totaled 1,811 Mgal/d. Ground water is the primary source of water for public-supply use in Florida because it is readily available and is of good quality in most areas of the State. In 1987, ground water supplied 90 percent of the public-supply water withdrawn in Florida. Dade County withdrew the largest amount of water for public supply use in 1987 (365.2 Mgal/d).

Public-supply utilities provide water to a variety of users. In 1985, 71 percent of the water used for public supply was delivered for residential uses, 15 percent for commercial, 9 percent for industrial, and the remaining 5 percent for miscellaneous or utility uses. Florida had a higher percentage of residential water deliveries than the South Atlantic-Gulf Region (63 percent) and the nationwide average (57.5 percent) for 1985. Total residential use of public-supply water increased from 916 Mgal/d in 1975 to 1,196 Mgal/d in 1985; however, the proportion of the total deliveries decreased from 80 percent to 71 percent.

Factors that influence public-supply water use in Florida include population, climate, socioeconomic conditions, water cost, and water conservation and alternative sources. Changes in the resident population has had a substantial influence on public-supply water use in Florida. The population of Florida increased from 4.95 million in 1960 to 12 million in 1987 and reliance on public-supply water increased from 68 percent in 1960 to 86 percent in 1987. Florida's nonresident population increased from 18.8 million visitors in 1977 to 34.1 million visitors in 1987. Climate affects public-supply water use in Florida. Precipitation has a substantial effect on use because of the high percentage of residential water used for lawn and garden watering and the duration of the growing seasons in Florida. The effects of socioeconomic conditions (including income, household size, and type of housing unit), water costs, water conservation, and alternative supply sources on the use of public-water supply are difficult to determine. The significance of each is unknown, but combined, these factors influence Florida's increased public-supply water use.

Many different methods can be used to forecast future water use, but for this report, the single coefficient method was used. The variable used was the public-supply per capita, which is the amount of water used per person served by public supply. This method was selected for a variety of reasons, including the availability of good historical public-supply water-use data, successful accuracy in the past, and sufficient results for the level of detail desired.

Future public-supply water-use projections were compiled for each county for the years 2000, 2010, 2020. Using medium projections, Florida's population is expected to increase to nearly 16.0 million in the year 2000, to 18.0 million in the year 2010, and to nearly 20.0 million in the year 2020, and based on these projections, an estimated 13.5 million people will be supplied water from public-supply water systems in the year 2000, 15.3 million in 2010, and will increase to nearly 17.0 million by the year 2020. Public-supply water demand is projected (medium) to increase from its rate of 1,811 Mgal/d in 1987, to 2,310 Mgal/d in the year 2000, 2,610 Mgal/d in the year 2010, and 2,890 Mgal/d in the year 2020. However, if the population exceeds the medium projections, high

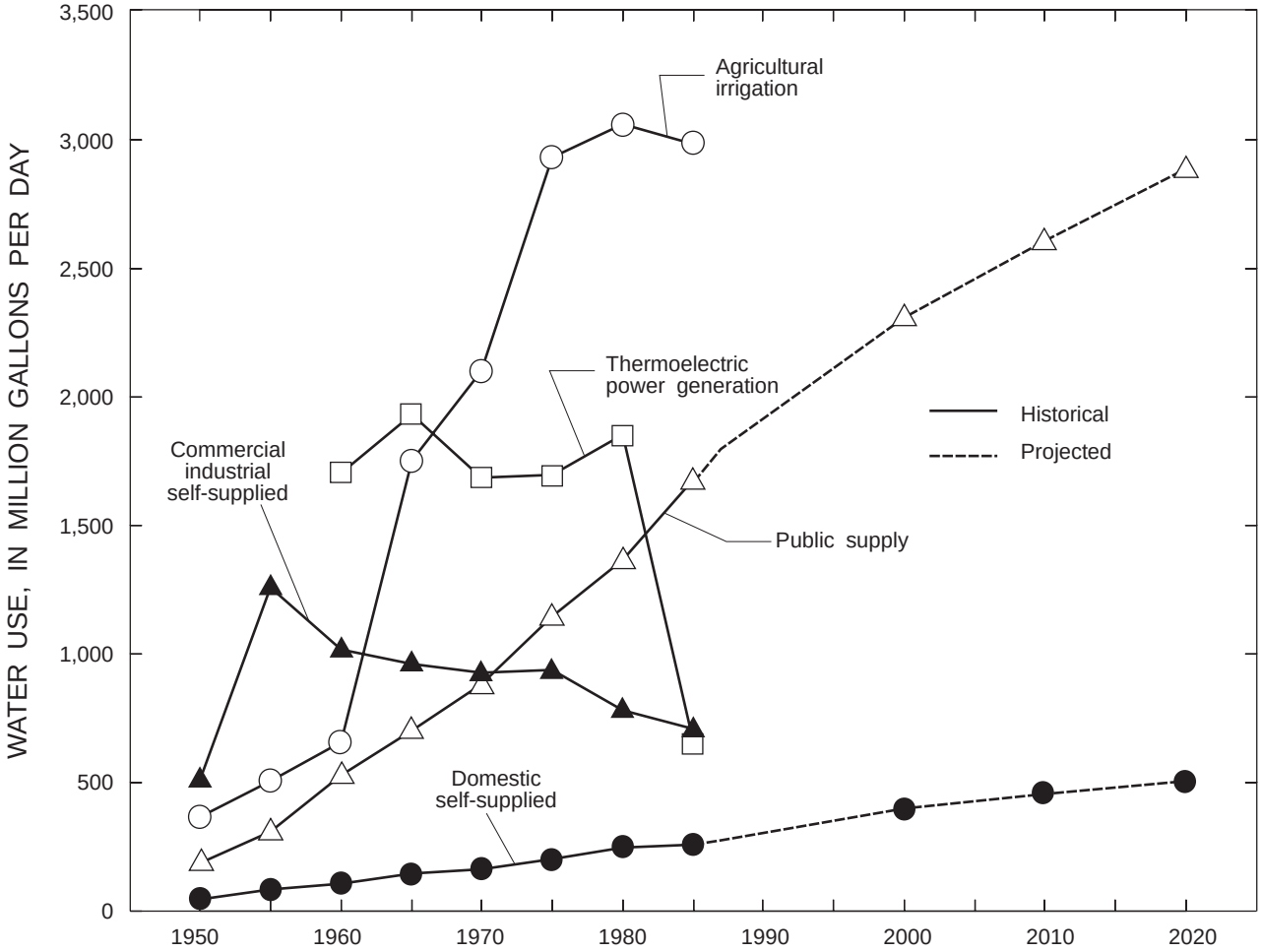

Figure 19. Historical freshwater use by category and projected public-supply and domestic self-supplied water use in Florida, 1950-2020 (modified from Leach, 1983; Marella, 1988; and the Governor's Water Resource Commission, 1989).

projections estimate public-supply water demands could reach 2,570 Mgal/d in 2000, 3,210 Mgal/d in 2010, and 3,900 Mgal/d in 2020.

Broward, Dade, Duval, Hillsborough, Orange, Palm Beach, and Pinellas Counties are projected to have public-supply water demands that could exceed 100 Mgal/d by the year 2000. These seven counties could account for 53 percent of the State's total population and 62 percent of the State's public-supply water use. Dade County is expected to continue to use the greatest amount of public-supply water for each of the years 2000, 2010, and 2020. The biggest change in public-supply water use is projected for Palm Beach and Dade Counties. Palm Beach County shows the largest increase in public-supply water use, increasing from 168.5 Mgal/d in 1987 to a projected 338.0 Mgal/d for 2020. Dade County's public-supply water use is projected to increase to nearly 471 Mgal/d and withdrawals may even exceed 485 Mgal/d, as Dade County also supplies Monroe County with its public-supply water. Twelve counties (Citrus, Flagler, Hernando, Lee, Marion, Martin, Okeechobee, Osceola, Palm Beach, St. Johns, St. Lucie, and Seminole) are projected to increase in public-supply water use by more than 100 percent from 1987 to 2020. Three counties (Lafayette, Liberty, and Madison) are projected to increase less than 1 percent in public-supply use between 1987 and 2020; however, based on current growth patterns, no county in Florida is projected to decline in public-supply water use by the year 2020.

Water demand options, such as conservation, restrictions, education programs, leak detection and repair programs, and more realistic pricing practices can reduce the demand for freshwater. Increased use of alternative sources of water, such as reclaimed wastewater and desalinated seawater also can reduce the demand for freshwater. Because the water demand projections in this report are based primarily on population projections, they should represent an upper limit of actual future demand if the population projections prove sound. Any additional water demand options implemented in the future at the State, county, or public-supply facility level may significantly reduce per capita use and result in public-supply use less than projected in this report.

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