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Water Use Trends and Demand Projections in the Northwest Florida Water Management District

Deer Point Lake and water supply intake for Bay County Public Utilities, by Richard L. Marella

U.S. GEOLOGICAL SURVEY
Open-File Report 98-269

Prepared in cooperation with the Northwest Florida Water Management District

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Tallahassee, Florida
1998

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CONTENTS

Appendixes (on CD-ROM disk located in pocket on inside back cover):

1. Water Conservation and Water Reuse Survey Results
2. Data Collection Questionnaires and Mailing List
3. Technical Memorandum and Projection Flow Chart
4. Water Use and Demand Projections for Planning Region I
5. Water Use and Demand Projections for Planning Region II
6. Water Use and Demand Projections for Planning Region III
7. Water Use and Demand Projectionss for Planning Region IV
8. Water Use and Demand Projections for Planning Region V
9. Water Use and Demand Projections for Planning Region VI
10. Water Use and Demand Projections for Planning Region VII

FIGURES

TABLES

CONVERSION FACTORS, ABBREVIATIONS AND ACRONYMS

Multiply	By	To obtain
acre	4,047	square meter
acre	0.00156	square mile
square mile	2.59	square kilometer
gallons per day (gal/d)	3.785	liters per day
million gallons per day (Mgal/d)	0.003785	million cubic meters per day
acre feet	0.325851	million gallons (Mgal)

AFSIRS = Agricultural Field Scale Irrigation Requirements Simulation
ASC = Areas of Special Concern
BEBR = Bureau of Economic and Business Research
CRV = Coefficient of Relative Variation
FDEP = Florida Department of Environmental Protection
IFAS = Institute of Food and Agricultural Science
MAPE = Mean Absolute Percentage Error
MOR's = Monthly Operating Reports
MSE = Mean Standard Error
NWFWMD = Northwest Florida Water Management District
SEE = Standard Error of the Estimate
USBC = U.S. Bureau of the Census
USGS = U.S. Geological Survey

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Abstract

The Northwest Florida Water Management District is located in the western panhandle of Florida and encompasses about 11,200 square miles. In 1995, the District had an estimated population of 1.13 million, an increase of about 47 percent from the 1975 population of 0.77 million. Over 50 percent of the resident population lives within 10 miles of the coast. In addition, hundreds of thousands of visitors come to the coastal areas of the panhandle during the summer months for recreation or vacation purposes. Water withdrawn to meet demands for public supply, domestic self-supplied, commercial-industrial, agricultural irrigation, and recreational irrigation purposes in the District increased 18 percent (52 million gallons per day) between 1970 and 1995. The greatest increases were for public supply and domestic self-supplied (99 percent increase) and for agricultural irrigation (60 percent increase) between 1970 and 1995. In 1995, approximately 70 percent of the water withdrawn was from ground-water sources, with the majority of this from the Floridan aquifer system. The increasing water demands have affected water levels in the Floridan aquifer system, especially along the coastal areas. The Northwest Florida Water Management District is mandated under the Florida Statutes (Chapter 373) to protect and manage the water resources in this area of the State. The mandate requires that current and future water demands be met, while water resources and water-dependent natural systems are sustained.

For this project, curve fitting and extrapolation were used to project most of the variables (population, population served by public supply, and water use) to the years 2000, 2005, 2010, 2015, and 2020. This mathematical method involves fitting a curve to historical population or water-use data and then extending this curve to arrive at future values. The population within the region is projected to reach 1,596,888 by the year 2020, an increase of 41 percent between 1995 and 2020. Most of the population in this region will continue to reside in the urban areas of Pensacola and Tallahassee, and along the coastal areas. The population served by public water supply is projected to reach 1,353,836 by the year 2020, an increase of nearly 46 percent between 1995 and 2020.

Total water demand for the Northwest Florida Water Management District is projected to reach 940.2 million gallons per day in 2000, 1,003.1 million gallons per day in 2010, and 1,059.1 million gallons per day in 2020. Excluding water withdrawn for power generation from these totals, water demands will increase 34 percent between 1995 and 2020, and 58 percent between 1970 and 2020. Specifically, public supply demands are projected to increase 74.1 million gallons per day (53 percent) and domestic self-supplied and small public supply systems demands are projected to increase 9.1 million gallons per day (28 percent) between 1995 and 2020. Commercial-industrial self-supplied demands are projected to increase about 16.9 million gallons per day (13 percent) between 1995 and 2020. Agricultural and recreational irrigation demands combined are projected to increase 16.8 million gallons per day (48 percent) between 1995 and 2020. Water demands for power generation are

projected to increase about 53.9 million gallons per day (10 percent) between 1995 and 2020. Although power generation water use shows a projected increase during this time, plant capacities are not expected to change dramatically.

INTRODUCTION

The Northwest Florida Water Management District (NWFWMD) is located in the western panhandle of Florida (fig. 1) and encompasses about 11,200 square miles (mi^2) (Fernald and Patton, 1984). In 1995, the District had an estimated population of 1.13 million (Marella, in press), an increase of about 47 percent from the 1975 population of 0.77 million (Marella, 1995). Over 50 percent of the resident population lives within 10 miles of the coast. In addition, hundreds of thousands of visitors come to the coastal areas of the panhandle during the summer months for recreation and vacation (Florida Department of Commerce, 1995). This area of Florida depends on tourism, silviculture (pulp and lumber production), paper and chemical manufacturing, government and military, and some agriculture. Several large chemical plants, paper mills, and military installations, universities, and the Capital City of Tallahassee are located within this area of the State. Water withdrawn to meet demands for public supply, domestic self-supplied, commercial-industrial, agricultural irrigation, and recreational irrigation purposes in the District have increased 18 percent (52 million gallons per day) (Mgal/d) between 1970 and 1995. The greatest increases were for public supply and domestic self-supplied (99 percent increase) and agricultural irrigation (60 percent increase) between 1970 and 1995. Water withdrawn for commercial-industrial purposes decreased 26 percent during this period. In 1995, approximately 70 percent of the water withdrawn for these purposes within the

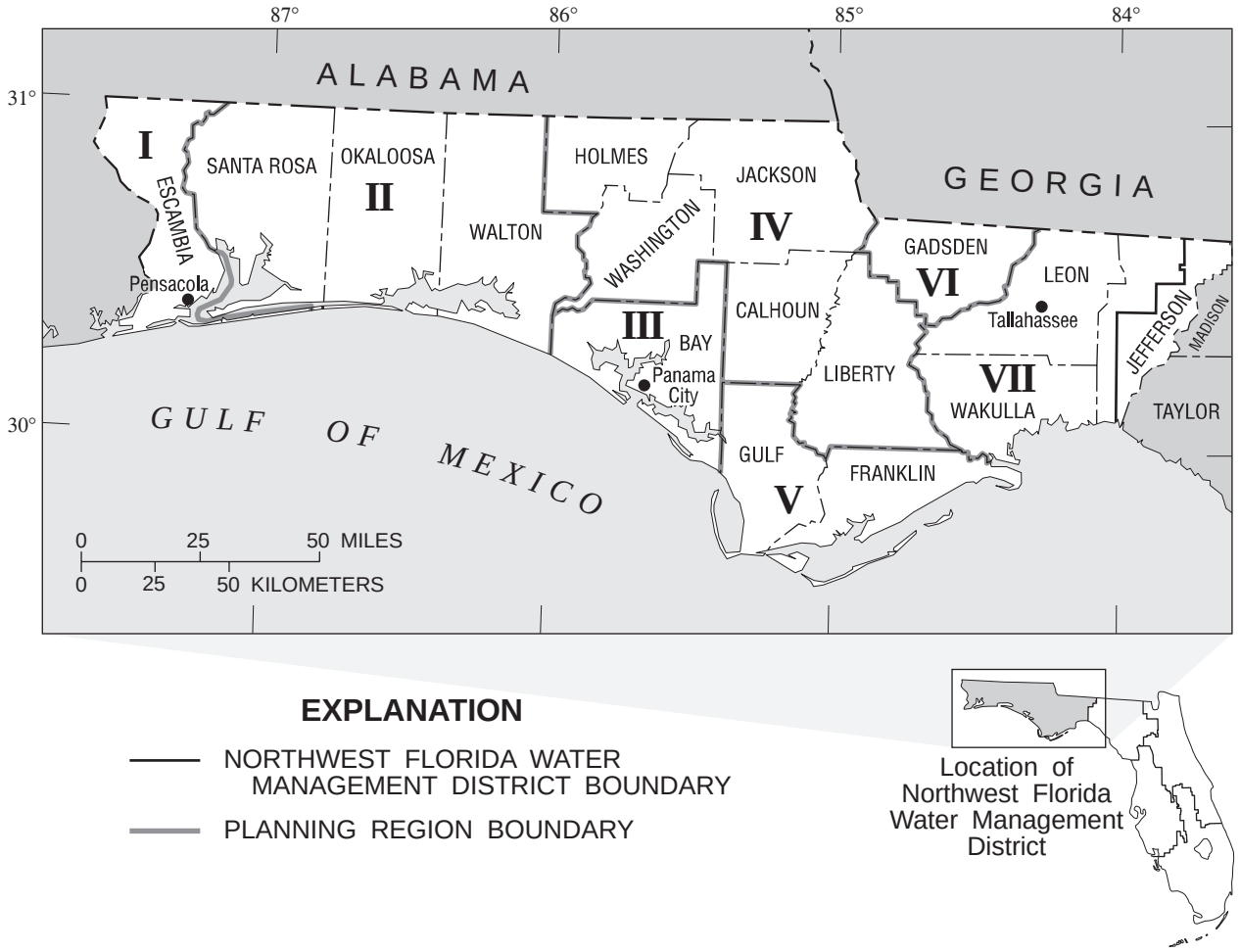


Figure 1. Location of the Northwest Florida Water Management District and the seven designated Planning Regions.

NWFWMD was from ground-water sources, with the majority of this from the Floridan aquifer system (Marella, in press). The increase in water demands has affected water levels in the Floridan aquifer system, especially along the coastal areas (Fernald and Patton, 1984; and Mahon and others, 1997). The NWFWMD is mandated under the Florida Statutes (Chapter 373) to protect and manage water resources in this area of the State. The mandate includes meeting current and future demands while ensuring that adequate amounts of water remain available to sustain water resources and water dependent natural systems. To help accomplish this goal, the U.S. Geological Survey (USGS), in cooperation with the NWFWMD, assessed current water uses and estimated future water needs.

Purpose and Scope

This report documents the methodology and results of a study conducted during 1997 and 1998 for the purpose of projecting water use for 16 counties and seven Planning Regions in Northwest Florida. The objectives of this study were to 1) inventory existing water users, 2) project water demand for public supply, domestic self-supplied use, commercial-industrial self-supplied use, recreational irrigation (golf courses), and power generation for each county in the seven Planning Regions, and 3) project water demand for specific water users within the NWFWMD. Using 1995 as a base year, average annual water-use projections were made for the years 2000, 2005, 2010, 2015, and 2020. Projections of agricultural irrigation water demands were supplied by the University of Florida, Institute of Food and Agricultural Science (IFAS), specifically for this project. Information concerning current and future instream water use (nonwithdrawal), such as navigation, water-based recreation, propagation of fish and wildlife, and dilution and conveyance of liquid or solid wastes, is not included in this report.

The data presented in this report for 1995 were collected and compiled specifically for this project. Data sources include the Florida Department of Environmental Protection (FDEP), NWFWMD, USGS, and individual users. Because of different sources of data and terminology differences between agencies, the water-use data published in this report may differ from the water-use data presented in other reports. Historical water-use values (1970-90) for public supply, domestic self-supplied, commercial-industrial self-supplied and power generation were obtained from Marella (1995). Historical water use values for agricultural irrigation were obtained from Moss and de Bodisco (1998); however, historical water-use values for recreational irrigation were not available. Water-use values for this report do not include estimates for livestock or fish farming or for residential lawn watering. Data presented for Jefferson County represent all of the county, not just the portion within the NWFWMD. Values presented in this report represent all water use, including fresh and saline.

Approach

The project was divided into three tasks. *Task 1* included compiling an inventory of public supply, commercial-industrial self-supplied, recreational irrigation, and power generation water users for 1995. Data were summarized by county for the following water supply Planning Regions: I) Escambia County, II) Okaloosa, Santa Rosa, and Walton Counties; III) Bay County; IV) Calhoun, Holmes, Jackson, Liberty, and Washington Counties; V) Franklin and Gulf Counties; VI) Gadsden County; and VII) Jefferson, Leon, and Wakulla Counties. For each Region, the larger users were inventoried to determine the amount withdrawn, peak day (annual maximum daily flow), peak month, peak three months (consecutive), water source, permitted amount, population served, service connections, and other information (including water purchased, sold, or lost, water sources, and utility interconnections).

A summary of water conservation efforts and reuse efforts by users was compiled for this report and is presented in appendix 1. Service areas for selected public suppliers were obtained from the utility companies and were digitized and provided to the District as an ARC/Info coverage. Historical data (1975-94) were compiled from past and existing data bases, hard copy files, and water use publications and were provided to the District on a CD-ROM disk. A questionnaire for current water uses (1995 or 1996) and projected demands was developed and mailed to selected public supply, commercial-industrial, power generation, and golf course water users (app. 2). Data obtained from the questionnaires and the historical compilation were used as a baseline for the projections presented in this report.

Task 2 included making water-use projections for the years 2000, 2005, 2010, 2015, and 2020 for the seven Planning Regions, based on the categories of public supply, domestic self-supplied (including small public supply systems), commercial-industrial self-

supplied, power generation, and recreational irrigation (golf courses). A methodology was chosen and presented to the District staff for acceptance (app. 3). Water-use projections were totaled and summarized by county and by Planning Region. Agricultural irrigation water use projections were provided by IFAS and were included in the county and Planning Region totals.

Task 3 included providing detailed data for specific users in five designated Areas of Special Concern (ASC). The five designated areas are (in order of priority): 1) southern Okaloosa, Santa Rosa, and Walton Counties, 2) southwestern Gulf County (Port St. Joe/Mexico Beach), 3) southern (coastal) Franklin County, 4) southwestern Bay County (Panama City Beach), and 5) central Gadsden County. Within these areas, detailed projections were made for specified utilities, commercial-industrial facilities, and golf courses. Water-use projections were totaled and summarized by ASC and non-ASC areas.

Previous Investigations

Several reports have been published that identify current water use and projected demands for this area of Florida. Historical water-use inventories for the NWFWMD were published for 1980 (Kranzer, 1983) and 1985 (Bielby, 1987) and data for the District can be found in statewide reports for 1975 (Leach, 1978), 1977 (Leach and Healy, 1980), 1980 (Leach, 1983), 1985 (Marella, 1988), 1990 (Marella, 1992a), and 1995 (Marella, in press). Water-use data on public suppliers have been published for 1970 (Healy, 1972), 1975 (Healy, 1977), 1980 (Northwest Florida Water Management District, 1981), 1987 (Marella, 1990), and 1990 (Marella, 1993), and in other reports such as Wagner and others, 1980; Barrett Daffin and Carlan, Inc., 1982; Richards, 1993; and May and Casella, 1997. Projections of future water demands for individual users and county totals were published in Barrett Daffin and Carlan, Incorporated, 1982; Marella, 1992b; Richards, 1993; and May and others, 1997.

Acknowledgments

The USGS gratefully acknowledges the FDEP, Northwest District Office in Pensacola for its cooperation in providing access to the drinking water Monthly Operating Reports (MOR's) files. Special thanks are extended to the following individuals from the Northwest District Office who provided data or technical assistance: Kimberly Allen, Scott Grubbs, Mary Lou Parker, John Pope, and Anthonette Touart-Rohlke. The USGS also acknowledges the NWFWMD staff for its cooperation in providing data and technical support--specifically, Angela Chelette, Tyler Macmillan, and Patricia Ryan who provided technical advice and support that was critical to the completion and accuracy of this project. Additionally, a special thanks is extended to the many utility operators, plant managers, golf course superintendents, and all of the other individuals who provided time and information vital to the completion of this effort.

Data Categories and Sources

Water-use data discussed in this report were compiled from several sources that include the NWFWMD permit data base (compliance reports), the FDEP, Drinking Water Program, MOR's, the USGS water-use data base, as well as responses to a questionnaire mailed during the project. Water users were divided into six major categories; these categories are uniform across the State and include public supply, domestic self-supplied (including small public supply systems), commercial-industrial self-supplied, power generation, agricultural irrigation, and recreational irrigation.

Public Supply

The public-supply category refers to water supplied by a publicly- or privately- owned water system for public distribution. According to the FDEP, any water system that serves more than 25 people or has 15 year-round service connections is considered to be a public supplier (Florida Department of Environmental Regulation, 1990). In 1995, 211 water systems met these criteria in the NWFWMD (Drinking Water Quick Look Report, Florida Department of Environmental Protection, April 1995, Kenna Study, written commun.).

Water-use data for 1995 were collected for those systems that used 0.05 Mgal/d or more. A list of these systems was obtained from the USGS 1995 State water-use data base. Information was primarily obtained from a public supply questionnaire prepared for the project. Some data were also obtained from the NWFWMD permit data base, the USGS 1995 state water-use data base, or from the FDEP drinking water files. Data included the annual average for 1995, peak

day, peak month, peak three months, service connections, and population served.

Estimates of the population served by individual public suppliers were obtained for all systems that used 0.05 Mgal/d in 1995. These estimates were obtained either from the public supplier through the questionnaire, or from the FDEP MOR's or Sanitary Surveys, or they were calculated by multiplying the total service connections (usually supplied by the public supplier) by the number of people per household by county, which is published by the University of Florida, Bureau of Economic and Business Research (BEBR) (Smith and Cody, 1996).

Domestic Self-Supplied and Small Public Supply Systems

Domestic self-supplied use includes water withdrawn by individual households (domestic wells) and small commercial users (churches, convenience stores, restaurants, and others) that are not served by a public water supplier. For the purpose of this project, this category also includes water withdrawn by the small public supply systems (with a daily average pumpage of less than 0.05 Mgal/d) not inventoried under public supply. No data were collected for this category; water-use estimates were made based on information from the public supply category.

Estimates of domestic self-supplied population were derived by subtracting the population served by public-supplied systems from the total county population, published by BEBR (University of Florida, 1996). Domestic self-supplied withdrawals were calculated by multiplying the public supply per-capita use (in gallons per day) by the self-supplied population served for each county. The public supply per-capita use figures were derived by taking the public-supplied water use for each county and dividing it by the total county population served by public supply.

Commercial-Industrial Self-Supplied

Commercial-industrial self-supplied use includes water withdrawn at commercial, industrial, and mining facilities. Commercial self-supplied use includes water withdrawn at government and military facilities, schools, prisons, hospitals, recreational facilities, and nonmanufacturing establishments. Industrial self-supplied use includes water withdrawn at mining, processing, and manufacturing facilities.

Water-use data for 1995 were collected for the 14 largest self-supplied water users within the District that, combined, accounted for 95 percent of the District's total water use in the commercial-industrial self-supplied category. A list of these systems was obtained from the USGS 1995 State water-use data base. Information was primarily obtained from a commercial-industrial questionnaire prepared for the project. Some data were also obtained from the NWFWMD permit data base and the USGS 1995 State water-use data base. Data included annual average for 1995, peak day, peak month, and peak three months.

Power Generation

Power generation use includes water withdrawn (fresh and saline) at thermoelectric power generation facilities and water used at hydroelectric facilities. All water withdrawn for use at these facilities was considered, including water for domestic purposes, boiler make-up, cooling (including once through), landscape irrigation, and washdown or cleanup.

Water-use data for 1995 were collected for the five thermoelectric power plants and one private generating facility within the District. Information was obtained from a power generation questionnaire and from the NWFWMD permit data base and the USGS 1995 State water-use data base. Data included annual average water use for 1995, peak day, peak month, and peak three months. Information about the amount of water purchased from public supply was obtained from each facility, along with the total gross power generated. Water-use data for the two hydroelectric facilities within the NWFWMD are not included in this report because this is considered an instream use.

Recreational Irrigation

Recreational irrigation use includes the artificial application of water on lands to assist in the growing of turf grass and shrubbery and water used for aesthetic purposes. Turf grass irrigation includes golf courses, athletic fields, parks, playgrounds, nonresidential lawns, and cemeteries. For the purpose of this report, recreational irrigation includes only golf course irrigation. Water-use values for golf course irrigation were estimated based on irrigated acreage multiplied by a coefficient (usually in inches per acre) generated from selected irrigation models for turf grass. The supplemental irrigation coefficient used for this project was estimated from the Agricultural Field Scale Irrigation

Requirements Simulation (AFSIRS) computer model (Smajstrla, 1986).

A master list of golf courses was developed for this project from several sources. These included the NWFWMD water-use permit data base, The Florida Sports Foundation, Fairways in the Sunshine, Official Florida Golf Guide (Florida Sports Foundation, 1994), The Florida Atlas and Gazetteer (DeLorme Publishing Company, 1986), and The National Golf Foundation (National Golf Foundation, 1997). A questionnaire was developed and sent to 52 golf courses from the master list. Information was either obtained from the questionnaire or from the NWFWMD water-use permit data base. Data collected for 1995 included average water use per day, primary and secondary water sources, acres irrigated, and number of golf holes.

Agricultural (Self-Supplied) Irrigation

Agricultural irrigation use consists of water withdrawn for the irrigation of crops and nonirrigation uses associated with farming operations. Irrigation includes the artificial application of water on lands to assist in the growing of crops or to prevent damage to crops due to harsh climatic conditions. This includes water withdrawn for irrigating field, fruit and vegetable crops, ornamental plants, and grasses or pasture. Nonirrigation includes water withdrawn for livestock (washing down dairy and farm equipment), fish farming (water for augmenting ponds), and other uses associated with farm operations. All water-use values (historical and projected) for this category were supplied by the University of Florida, IFAS (Moss and de Bodisco, 1998).

Description of Study Areas

The Florida Water Resource Act of 1972 established authority for management of the State's water resources through five Water Management Districts that encompass the entire State (Fernald and Patton, 1984) and currently operate under the general supervision of the Florida Department of Environmental Protection. The NWFWMD is one of the Districts and is located in the western panhandle of Florida (fig. 1), encompassing approximately 19 percent of the total land area of the State (Fernald and Patton, 1984). Located within the District are all or part of the following 16 Counties: Bay, Calhoun, Escambia, Franklin, Gadsden, Gulf, Holmes, Jackson, Jefferson (part), Leon, Liberty, Okaloosa, Santa Rosa, Wakulla, Walton, and Washington (fig. 1). In 1995, the NWFWMD had an estimated population of 1.13 million residents (Marella, in press), or approximately 8 percent of the total population of Florida. The majority (70 percent) of the District's population in 1995 resided in Escambia,

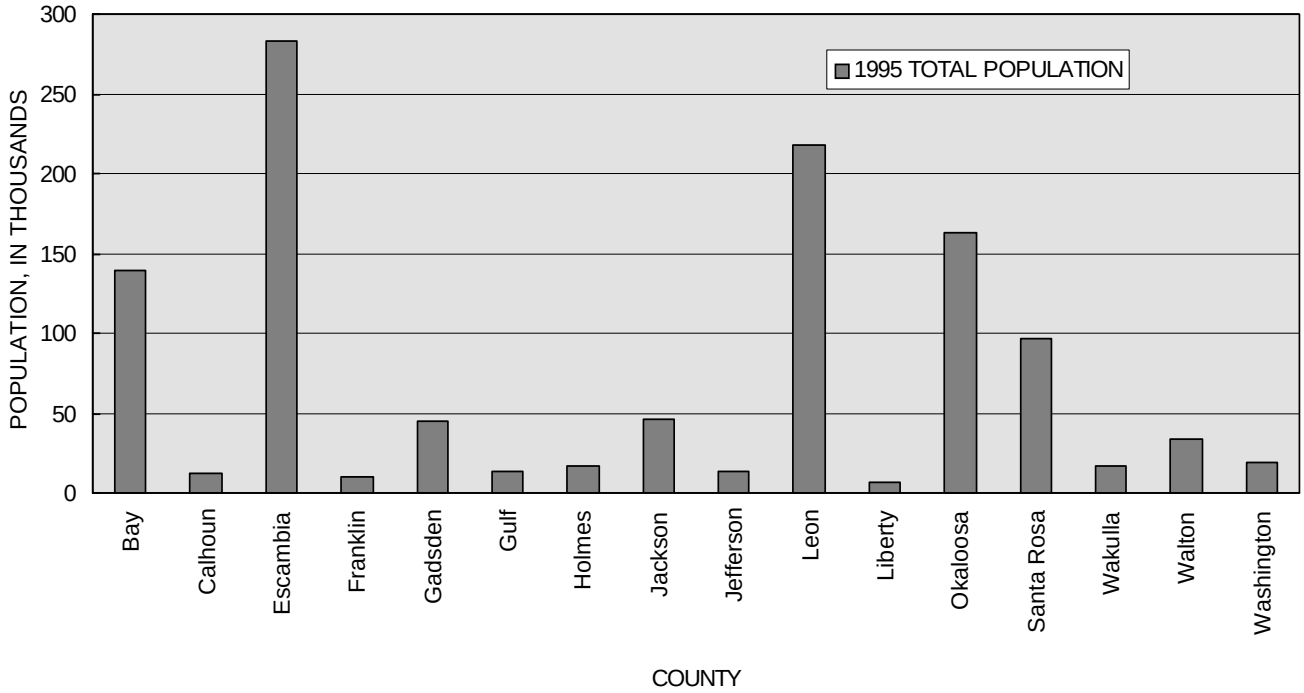


Figure 2. County population for the Northwest Florida Water Management District, 1995. (From University of Florida, 1996)

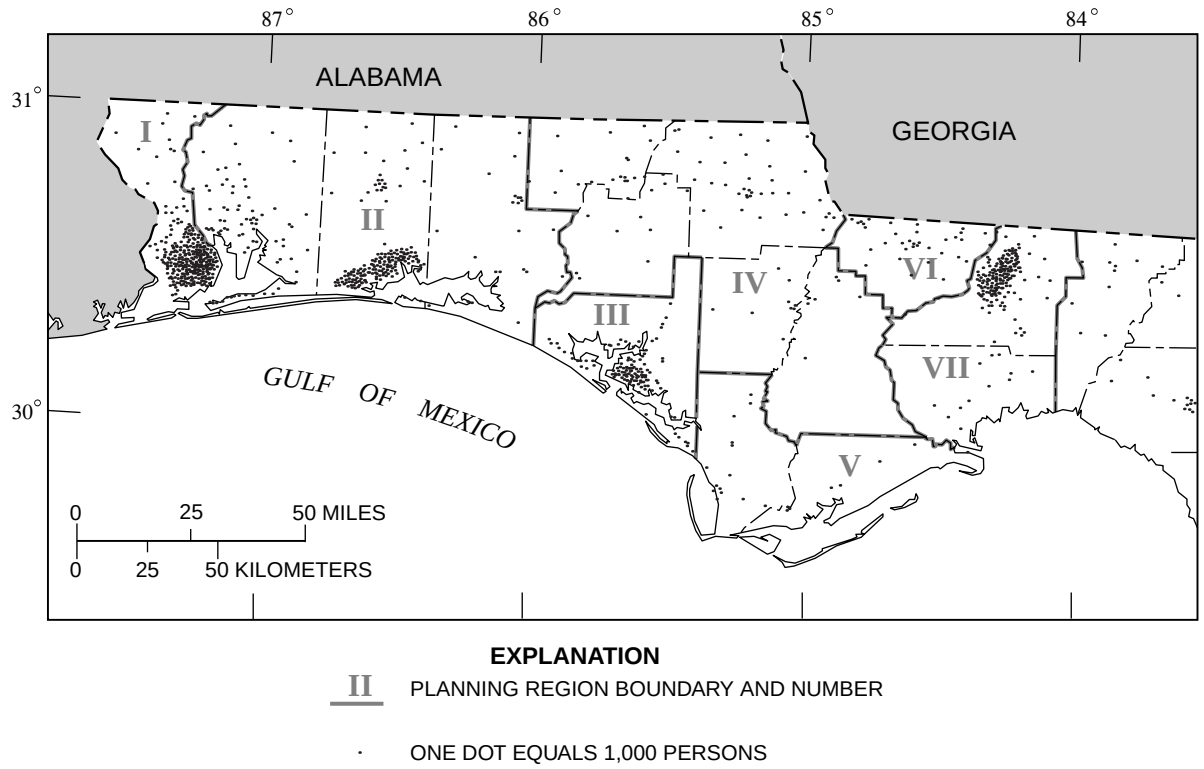


Figure 3. Population distribution for northwest Florida, 1990. (From Fernald and Purdum, 1992)

Leon, Okaloosa, and Bay Counties (fig. 2). Within these four counties, the population is centered around urban areas or along the coast (fig. 3). For the purpose of this report, the District has divided these 16 Counties into seven Planning Regions (PR) (fig. 1), which are described below.

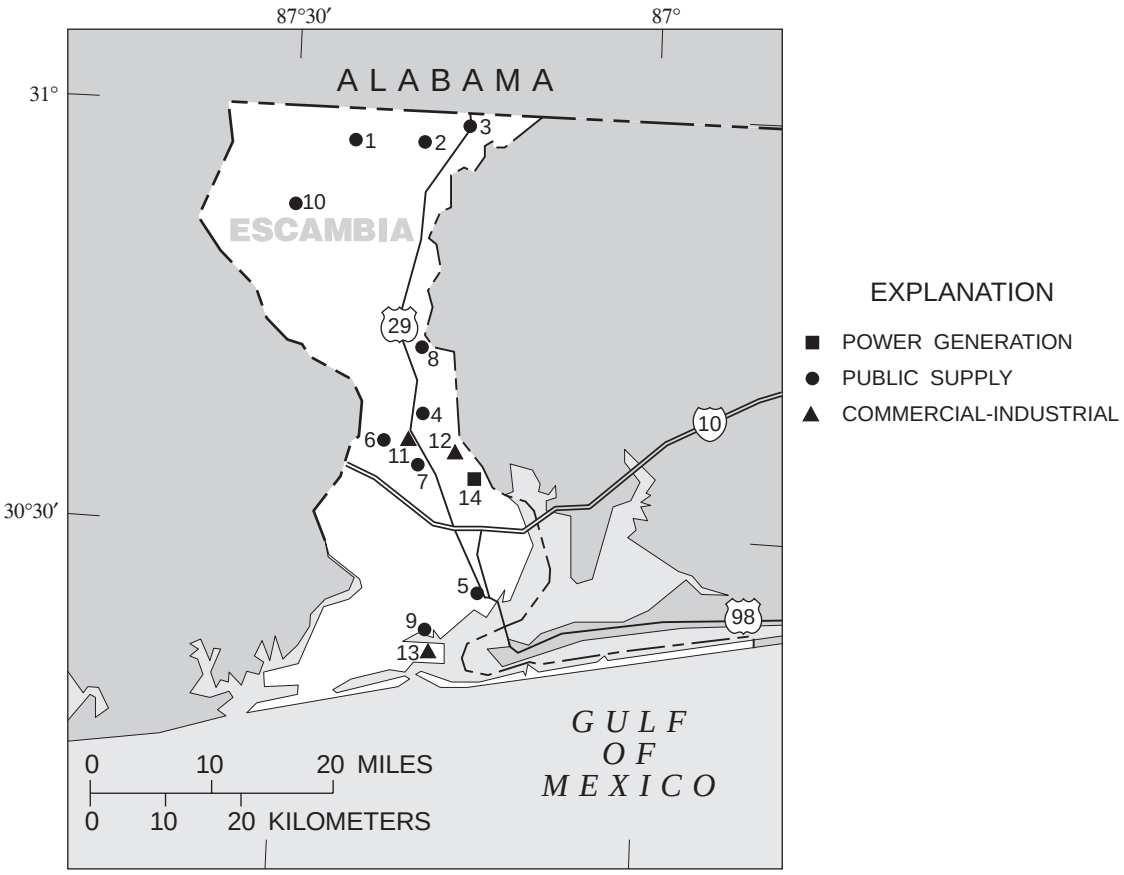
Planning Region I

Planning Region I (PR I) is Escambia County (fig. 4). Pensacola is located within Escambia County, and is one of the District's largest cities and urban areas. In 1995, Escambia County's total population was estimated at 282,742 (University of Florida, 1996). The population of the county increased 38 percent between 1970 and 1995.

For this report, water withdrawn in PR I during 1995 was estimated at about 270.7 Mgal/d (table 1). Water withdrawn for power generation accounted for the largest amount of water used (60 percent), followed by commercial-industrial self-supplied (23 percent), public supply (14 percent), and the remaining 3 percent for domestic self-supplied and small public supply systems, recreational irrigation, and agricultural irrigation (table 1). Most of the water used for power generation (99 percent) was surface water used for cooling purposes, and nearly all of this was returned to its source (Marella, in press). Ground water supplied all of the drinking water for public supply (36.9 Mgal/d), and for domestic self-supplied and small public supply systems (5.4 Mgal/d) during 1995.

Planning Region II

Planning Region II (PR II) includes Okaloosa, Santa Rosa, and Walton Counties (fig. 5). In 1995, the total population of PR II was estimated at 292,213 (University of Florida, 1996). The population of PR II increased 106 percent between 1970 and 1995. The District's largest concentration of coastal population is within PR II; the majority lives within 10 miles of the coast (fig. 3). Seasonal populations and daily visitors in these coastal areas increase substantially during the summer months. Located within PR II is Eglin Air Force Base, which houses a large permanent and temporary population. Within PR II is one of the five Areas of Special Concern (ASC 1), which includes the coastal areas of all three counties (fig. 5) and most of the population and urban centers.



Map number	Utility/Owner	Plant/facility	County
1	Bratt-Davisville Water System		Escambia
2	Central Water Works		Escambia
3	Century Utilities		Escambia
4	Cottage Hill Utilities		Escambia
5	Escambia County Utility Authority		Escambia
6	Farm Hill Utilities		Escambia
7	Gonzalez Utilities		Escambia
8	Molino Utilities		Escambia
9	Peoples Water System		Escambia
10	Walnut Hill Water Works		Escambia
11	Champion International Corp.		Escambia
12	Monsanto Corp.		Escambia
13	U.S. Navy: Pensacola NAS		Escambia
14	Gulf Power Company	Crist Plant	Escambia

Figure 4. General location of projected water users in Planning Region I.

Table 1. Total water use by Planning Region and county in the Northwest Florida Water Management District, 1995

[All values in million gallons per day; agricultural irrigation data from Moss and de Bodisco, 1998]

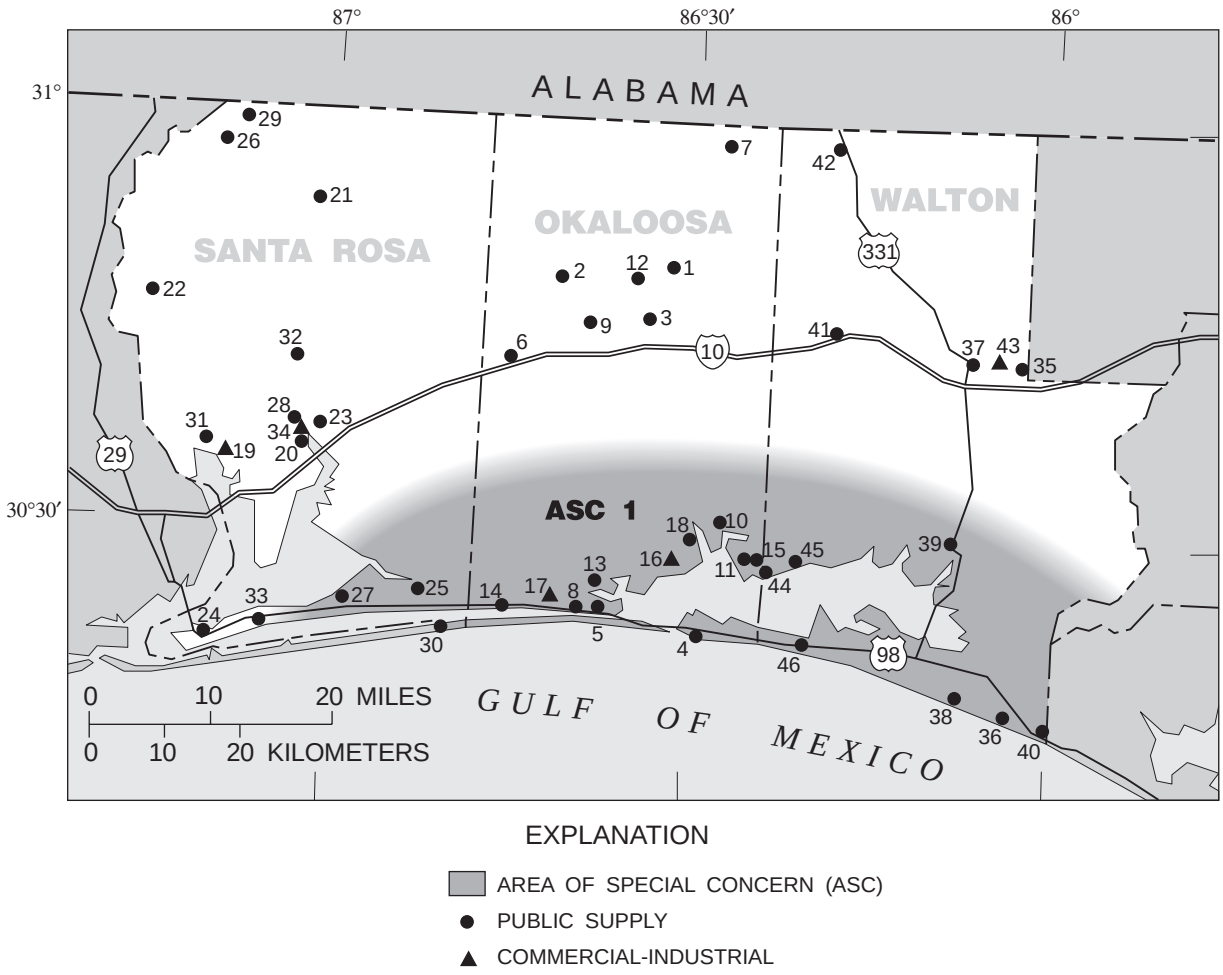
	Public supply	Domestic self-supplied and small public supply systems	Commercial-industrial self-supplied	Recreational irrigation (golf courses)	Agricultural irrigation	Power generation	1995 total water use
Planning Region I	**36.94**	**5.37**	**62.33**	**1.81**	**0.14**	**164.10**	**270.69**
Escambia	36.94	5.37	62.33	1.81	0.14	164.10	270.69
Planning Region II	**38.04**	**3.27**	**11.77**	**5.43**	**1.49**	**0.00**	**60.00**
Okaloosa	21.18	1.86	3.97	2.62	1.23	0.00	30.86
Santa Rosa	12.51	0.89	6.20	1.54	0.21	0.00	21.35
Walton	4.35	0.52	1.60	1.27	0.05	0.00	7.79
Planning Region III	**24.32**	**2.23**	**27.69**	**1.90**	**0.00**	**259.25**	**315.39**
Bay	24.32	2.23	27.69	1.90	0.00	259.25	315.39
Planning Region IV	**5.28**	**12.00**	**1.90**	**0.69**	**11.28**	**50.70**	**81.85**
Calhoun	0.68	1.15	0.00	0.00	2.09	0.00	3.92
Holmes	1.01	3.52	0.00	0.25	0.00	0.00	4.78
Jackson	2.19	4.68	1.55	0.25	8.30	50.31	67.28
Liberty	0.29	0.70	0.24	0.00	0.00	0.39	1.62
Washington	1.11	1.95	0.11	0.19	0.89	0.00	4.25
Planning Region V	**3.02**	**0.37**	**28.70**	**0.18**	**0.00**	**0.00**	**32.27**
Franklin	1.74	0.03	0.00	0.00	0.00	0.00	1.77
Gulf	1.28	0.34	28.70	0.18	0.00	0.00	30.50
Planning Region VI	**3.79**	**2.20**	**1.02**	**0.25**	**5.24**	**0.00**	**12.50**
Gadsden	3.79	2.20	1.02	0.25	5.24	0.00	12.50
Planning Region VII	**29.41**	**6.82**	**1.09**	**1.24**	**5.25**	**71.77**	**115.58**
Jefferson	0.70	1.28	0.23	0.19	4.24	0.00	6.64
Leon	27.66	4.61	0.23	0.95	1.01	2.64	37.10
Wakulla	1.05	0.93	0.63	0.10	0.00	69.13	71.84
Totals	140.80	32.26	134.50	11.50	23.40	545.82	888.28

For this report, water withdrawn in PR II during 1995 was estimated at about 60.0 Mgal/d (table 1). The largest amount of water withdrawn in 1995 was for public supply (63 percent), followed by commercial-industrial self-supplied (20 percent), recreational irrigation (9 percent), domestic self-supplied and small public supply systems (5.5 percent), and agricultural irrigation (2.5 percent) (table 1). Ground water supplied all of the drinking water for public supply (38.0 Mgal/d), and for domestic self-supplied and small public supply systems (3.3 Mgal/d).

Planning Region III

Planning Region III (PR III) is Bay County (fig. 6). Within Bay County is the coastal urban areas associated with Panama City and Panama City Beach. In 1995, Bay County's total population was estimated at 139,173 (University of Florida, 1996). The population of PR III increased 85 percent between 1970 and 1995. Within PR III is ASC 4, which encompasses the western coastal area of the county (fig. 6) and includes a large portion of the tourist and seasonal population centers within PR III (fig. 3).

For this report, water withdrawn in PR III during 1995 was estimated at 315.4 Mgal/d (table 1). The largest amount of water withdrawn was for power generation (82 percent), followed by commercial-industrial self-supplied (9 percent), public supply (8 percent), and the remaining 1 percent for domestic self-supplied and small public supply systems and recreational irrigation (table 1). Most of the water used for power generation (99.7 percent) was saline surface water used for cooling purposes, and all of this was returned to its source (Marella, in press). During 1995, surface water supplied 79 percent of the drinking water for public supply (19.2 Mgal/d); ground water supplied the remaining



EXPLANATION

AREA OF SPECIAL CONCERN (ASC)

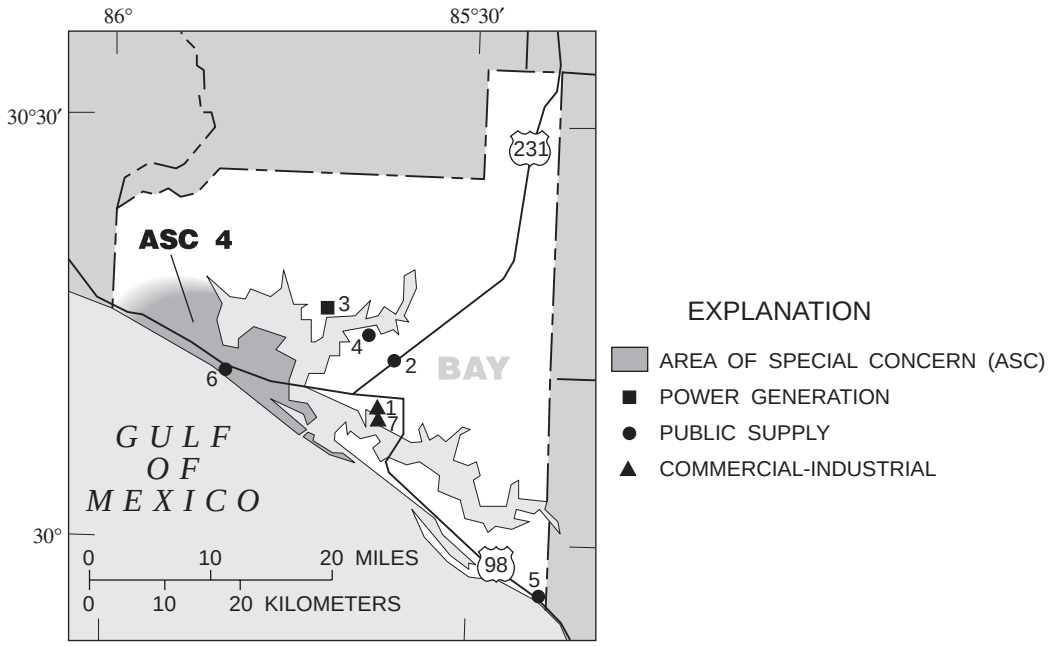
PUBLIC SUPPLY

COMMERCIAL-INDUSTRIAL

Map number	Utility/Owner	Plant/facility	County
1	Auburn Water System		Okaloosa
2	Baker Water System		Okaloosa
3	Crestview, City of		Okaloosa
4	Destin Water Users		Okaloosa
5	Fort Walton Beach, City of		Okaloosa
6	Holt Water System		Okaloosa
7	Laurel Hill, City of		Okaloosa
8	Mary Ester, City of		Okaloosa
9	Milligan Water System		Okaloosa
10	Niceville, town of		Okaloosa
11	Okaloosa County Water/Sewer	Bluewater Bay	Okaloosa
12	Okaloosa County Water/Sewer	Mid County-Del Cerro	Okaloosa
13	Okaloosa County Water/Sewer	Main (Garnier)	Okaloosa
14	Okaloosa County Water/Sewer	County West-Seashore	Okaloosa
15	Seminole Community Water System		Okaloosa
16	US Air Force: Eglin AFB	Main System	Okaloosa
17	US Air Force: Hulbert Field		Okaloosa
18	Valparaiso, City of		Okaloosa
19	Air Products and Chemicals, Inc.		Santa Rosa
20	Bagdad/Garron Water System		Santa Rosa
21	Berrydale Water System		Santa Rosa
22	Chumuckla, town of		Santa Rosa
23	East Milton Water System		Santa Rosa

Map number	Utility/Owner	Plant/facility	County
24	Gulf Breeze, City of		Santa Rosa
25	Holly/Navarre Water System		Santa Rosa
26	Jay, town of		Santa Rosa
27	Midway Water System		Santa Rosa
28	Milton, City of		Santa Rosa
29	Moore Creek/Mt. Carmel		Santa Rosa
30	Navarre Beach		Santa Rosa
31	Pace, City of		Santa Rosa
32	Point Baker Water System		Santa Rosa
33	South Santa Rosa Utilities		Santa Rosa
34	Sterling Fibers (Cytec), Inc.	Santa Rosa Plant	Santa Rosa
35	Argyle Water System		Walton
36	Camp Creek Water System		Walton
37	DeFuniak Springs, City of		Walton
38	Florida Community Service Company	Seagrove Beach	Walton
39	Freeport, town of		Walton
40	Inlet Beach Water System		Walton
41	Mossy Head Water System		Walton
42	Paxton, town of		Walton
43	Purdue Farms, Inc.		Walton
44	Smith Water Company	Villa Tasso	Walton
45	Smith Water Company	Choctaw Beach	Walton
46	South Walton Utilities		Walton

Figure 5. General location of projected water users in Planning Region II.



Map number	Utility/Owner	Plant/facility	County
1	Arizona Chemical Company	Bay County Plant	Bay
2	Bay County Public Utilities	Potable Water System	Bay
3	Gulf Power Company	Smith Plant	Bay
4	Lynn Haven, City of		Bay
5	Mexico Beach, City of		Bay
6	Panama City Beach		Bay
7	Stone Container Corporation		Bay

Figure 6. General location of projected water users in Planning Region III.

10 percent (5.1 Mgal/d) of the public supply water, and all of the domestic self-supplied and small public supply systems (2.2 Mgal/d). An additional 25.2 Mgal/d of surface water was withdrawn by public supply and delivered directly for commercial-industrial use. This water was accounted for under the commercial-industrial self-supplied category for projection purposes.

Planning Region IV

Planning Region IV (PR IV) includes Calhoun, Holmes, Jackson, Liberty, and Washington Counties (fig. 7). In 1995, the total population of PR IV was estimated at 101,833 (University of Florida, 1996). The population of PR IV increased 51 percent between 1970 and 1995. The majority of the population in PR IV live in rural areas throughout the five counties (fig. 3). The District's largest concentration of agricultural lands is within Jackson County.

For this report, water withdrawn in PR IV for 1995 was estimated at 81.9 Mgal/d (table 1). The largest amount of water withdrawn was for power generation (62 percent), followed by domestic self-supplied and small public supply systems (15 percent), agricultural irrigation (14 percent), public supply (6.5 percent), and the remaining 2.5 percent for commercial-industrial self-supplied and recreational irrigation (table 1). Ground water supplied all of the drinking water for public supply (5.3 Mgal/d) and domestic self-supplied and small public supply systems (12.0 Mgal/d). Nearly all of the water used for power generation (99.2 percent) was surface water used for cooling purposes, and nearly all of this was returned to its source (Marella, in press). Most of the water withdrawn for agricultural irrigation was ground water.

EXPLANATION

■ POWER GENERATION

● PUBLIC SUPPLY

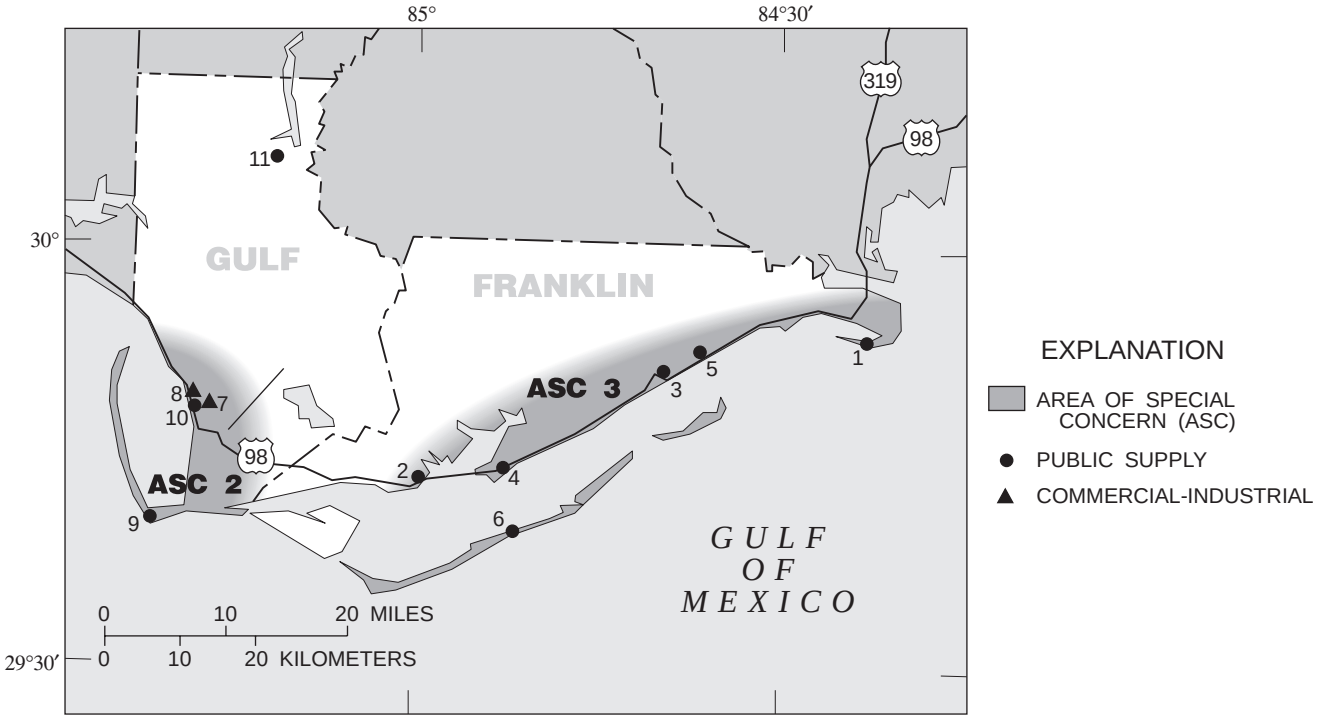
Map number	Utility/Owner	Plant/facility	County
1	Altha, town of		Calhoun
2	Blountstown, City of		Calhoun
3	Bonifay, City of		Holmes
4	Ponce DeLeon, town of		Holmes
5	Cottondale, town of		Jackson
6	Graceville, City of		Jackson
7	Grandridge, City of		Jackson
8	Greenwood, town of		Jackson
9	Gulf Power Company	Scholz Plant	Jackson
10	Malone, town of		Jackson
11	Marianna, City of		Jackson
12	Sneads, town of		Jackson
13	Bristol, City of		Liberty
14	Hosford-Telogia Water System		Liberty
15	Timber Energy Inc.		Liberty
16	Carryville, town of		Washington
17	Chipley, City of		Washington
18	Southern States Utilities	Sunny Hills/Deltona	Washington
19	Vernon Water System		Washington

Figure 7. General location of projected water users in Planning Region IV.

Planning Region V

Planning Region V (PR V) includes Franklin and Gulf Counties (fig. 8). Most of this Planning Region is forest or wetlands with several small coastal communities. In 1995, the total population of PR V was estimated at 23,507 (University of Florida, 1996). The population of PR V increased 37 percent between 1970 and 1995. The majority of the population live in or near the coastal communities (fig. 3), where seasonal populations increase substantially during the summer months. Within PR V are two ASC's - ASC 2 covers the coastal area of western Gulf County, whereas ASC 3 covers the coastal area of Franklin County, including the barrier islands of the county (fig. 8).

For this study, water withdrawn during PR V for 1995 was estimated at 32.3 Mgal/d (table 1). The largest amount of water withdrawn was for commercial-industrial self-supplied (89 percent), followed by public supply (9 percent), while the remaining 2 percent was withdrawn by domestic self-supplied and small public supply systems, and recreational irrigation (table 1). Ground water supplied all of the drinking water for public supply (3.0 Mgal/d), and for domestic self-supplied and small public supply systems (0.4 Mgal/d).



Map number	Utility/Owner	Plant/facility	County
1	Alligator Point Water System		Franklin
2	Apalachicola, City of		Franklin
3	Carrabelle, town of		Franklin
4	East Point Water System		Franklin
5	Lanark Village		Franklin
6	St. George Island Utilities		Franklin
7	Arizona Chemical Company	Gulf County Plant	Gulf
8	Florida Coast Paper Company		Gulf
9	Lighthouse Utilities	Cape San Blas	Gulf
10	Port St. Joe, City of		Gulf
11	Wewahitchka, town of		Gulf

Figure 8. General location of projected water users in Planning Region V.

Planning Region VI

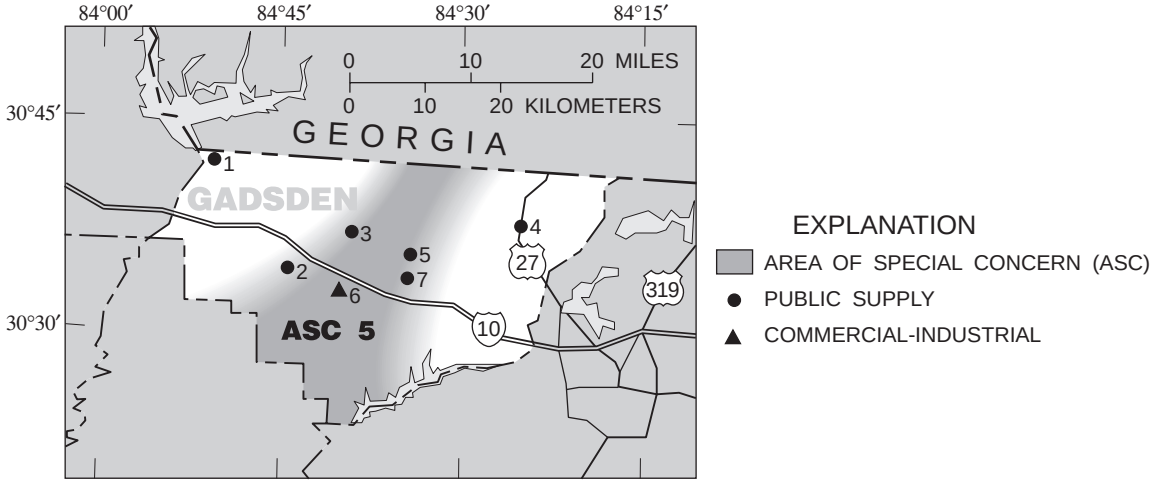
Planning Region VI (PR VI) is Gadsden County (fig. 9). In 1995, Gadsden County's total population was estimated at 44,734 (University of Florida, 1996). The population of PR VI increased 14 percent between 1970 and 1995. Within PR VI is ASC 5, which encompasses the central part of Gadsden County (fig. 9).

For this study, water withdrawn in PR VI during 1995 was estimated at 12.5 Mgal/d (table 1). The largest amount of water withdrawn was for agricultural irrigation (42 percent), followed by public supply (30 percent), domestic self-supplied and small public supply systems (18 percent), commercial-industrial self-supplied (8 percent), and recreational irrigation (2 percent) (table 1). Ground water supplied 64 percent of the drinking water for public supply (2.4 Mgal/d) and all of the domestic self-supplied and small public supply systems (2.2 Mgal/d), whereas surface water supplied 34 percent (1.4 Mgal/d) of the public supply water.

Planning Region VII

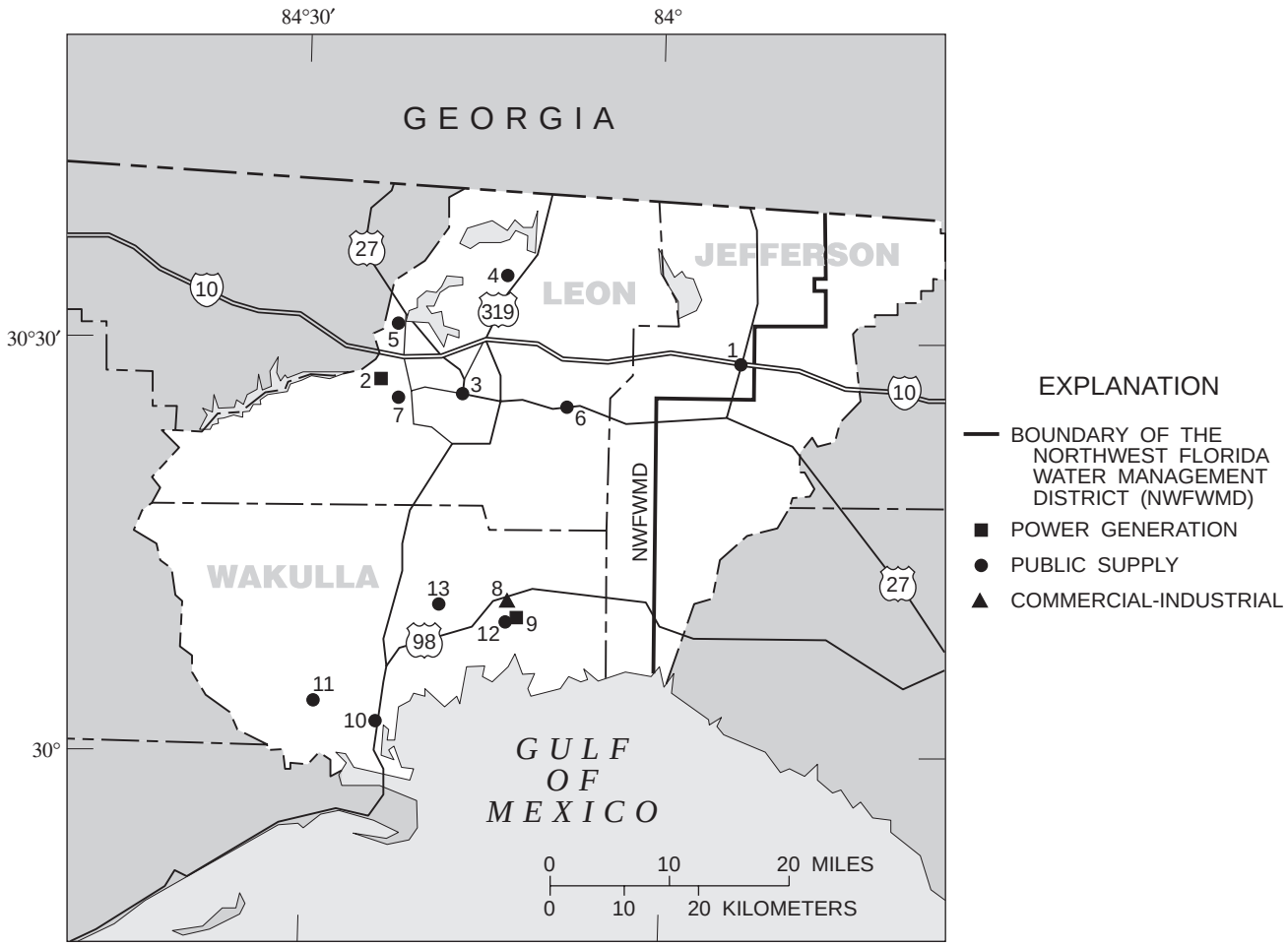
Planning Region VII (PR VII) includes Jefferson, Leon, and Wakulla Counties (fig. 10). In 1995, the total population of PR VII was estimated at 248,047 (University of Florida, 1996). The population of PR VII increased 110 percent between 1970 and 1995. Tallahassee is located within Leon County, and is one of the District's largest cities and urban areas. The majority of the population in this Planning Region live in the urban area associated with Tallahassee (fig. 3). Data for this PR VII include all of Jefferson County, even though the eastern part of the county is not located within the NWFWMD (fig. 10).

For this study, water withdrawn in PR VII during 1995 was estimated at 115.6 Mgal/d (table 1). The largest amount of water withdrawn was for power generation (62 percent), followed by public supply (25 percent), agricultural irrigation (5 percent), domestic self-supplied and small public supply systems (6 percent), and the remaining 2 percent for recreational irrigation and commercial-



Map number	Utility/Owner	Plant/facility	County
1	Chattahochee, City of		Gadsden
2	Greensboro, town of		Gadsden
3	Gretna, town of		Gadsden
4	Havana, town of		Gadsden
5	Quincy, City of		Gadsden
6	Quincy Farms, Inc.		Gadsden
7	Talquin Electric Cooperative	Gadsden Regional	Gadsden

Figure 9. General location of projected water users in Planning Region VI.



Map number	Utility/Owner	Plant/facility	County
1	Monticello, City of		Jefferson
2	Tallahassee, City of	Hopkins Power Plant	Leon
3	Tallahassee, City of	Main System	Leon
4	Talquin Electric Cooperative	Bradfordville Regional	Leon
5	Talquin Electric Cooperative	Lake Jackson Regional	Leon
6	Talquin Electric Cooperative	East Regional	Leon
7	Talquin Electric Cooperative	South Regional	Leon
8	Primex Technologies, Inc.		Wakulla
9	Tallahassee, City of	Purdom Plant	Wakulla
10	Panacea Water System		Wakulla
11	Sopchoppy, town of		Wakulla
12	St. Marks, town of		Wakulla
13	Talquin Electric Cooperative	Gulf Coast	Wakulla

Figure 10. General location of projected water users in Planning Region VII.

industrial self-supplied (table 1). Nearly all of the water used for power generation (96 percent) was surface water used for cooling purposes, and nearly all of this was returned to its source (Marella, in press).

Ground water supplied all of the drinking water for public supply (29.4 Mgal/d), and for domestic self-supplied and small public supply systems (6.8 Mgal/d).

1995 Base Data

Total water withdrawn (fresh and saline) in 1995 within the NWFWMD was estimated at 888.3 Mgal/d (table 1) for this study. This estimate differs somewhat from the 925.1 Mgal/d value published in Marella (in press). The difference is a result of 1) higher water use thresholds used to inventory users for this study, 2) different agricultural irrigation estimates, and 3) the inclusion of data for all of Jefferson County (including the area outside the District) in this report. According to Marella (in press) about 71 percent of the water withdrawn in the NWFWMD in 1995 was freshwater, while the remaining 29 percent was saline water. Of the freshwater withdrawn, 60 percent was surface water and the remaining 40 percent was ground water. The largest amount of fresh surface water was withdrawn from the Escambia River (41 percent), followed by the St. Marks River (18 percent), the Apalachicola River (13 percent), and Deer Point Lake (11 percent). All of the surface water withdrawn from the Apalachicola, Escambia, and St. Marks Rivers is used for once-through cooling for power generation and is returned to its source. The Floridan aquifer system supplied nearly 60 percent of the ground water withdrawn, and the sand-and-gravel aquifer supplied the remaining 40 percent.

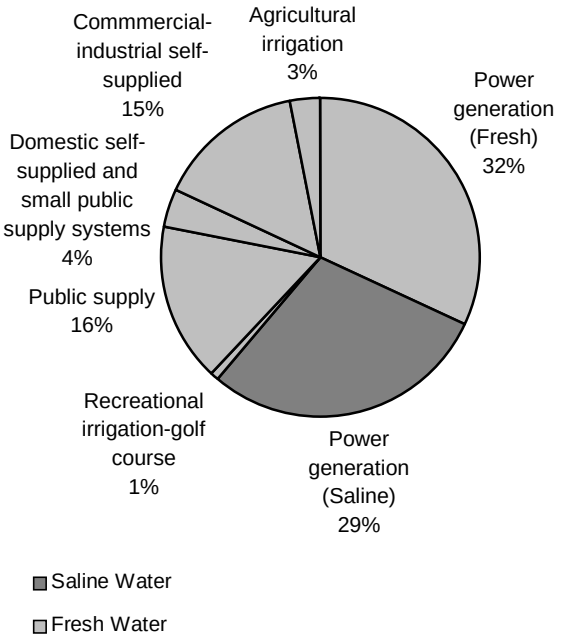


Figure 11. Total water withdrawn in the Northwest Florida Water Management District by category, 1995.

Of the 888.3 Mgal/d of water use accounted for in this report, power generation accounted for the largest amount of water withdrawn (545.8 Mgal/d), followed by public supply (140.8 Mgal/d), commercial-industrial self-supplied (134.5 Mgal/d), domestic self-supplied and small public supply systems (32.3 Mgal/d), agricultural irrigation (23.4 Mgal/d), and recreational irrigation (11.5 Mgal/d) (table 1 and fig. 11). Ground water supplied all of the water used for domestic self-supplied and small public supply systems, 85 percent of the water used for public supply, and 80 percent of the water used for agricultural irrigation. Surface water supplied more than 99 percent of the water used for power generation and 60 percent of the water used for commercial-industrial self-supplied. Water used for recreational irrigation was supplied by ground, surface, and reclaimed water.

Planning Region III (Bay County) accounted for the largest amount of water withdrawn in the NWFWMD in 1995. Water withdrawn in PR III was estimated at 315.4 Mgal/d (table 1 and fig. 12). About 83 percent of the water withdrawn in PR III was saline. Planning Region I (Escambia County) was the next largest user of water (270.7 Mgal/d), followed by PR VII (Jefferson, Leon, and Wakulla Counties) (115.6 Mgal/d). These three Planning Regions (III, I, and VII) accounted for 79 percent of the District's total water use.

PROJECTION METHODOLOGY

Several methods were used to project water use for each of the five water use categories: public supply, domestic self-supplied and small public supply systems, commercial-industrial self-supplied, power generation, and recreational irrigation (golf courses). Methods varied from category to category, and were chosen based on the level of detail needed and the availability of historical and current data. For some categories, water-use projections were made by the water users. No projections were made for small water use categories such as livestock, fish farming, and residential lawn watering. The methodology and variables used for each category are detailed below.

For this project, curve fitting and extrapolation were used to project most of the variables (population, population served by public supply, and water use). This mathematical method is based on the fitting of a curve to historical population or water-use data and then extending this curve to arrive at future values. Six

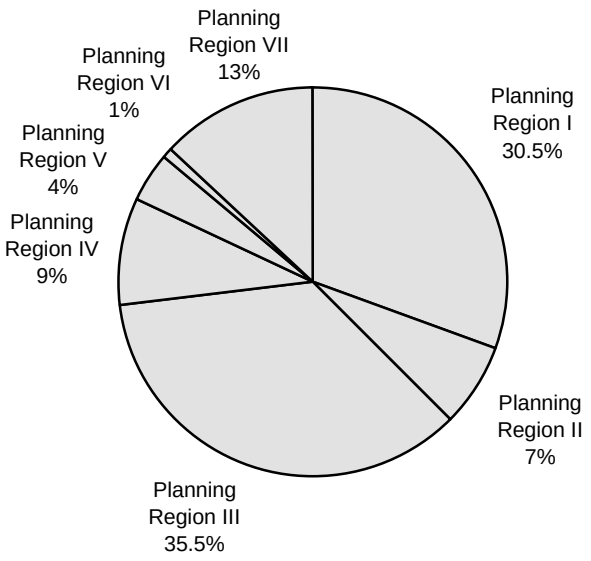


Figure 12. Total water withdrawn in the Northwest Florida Water Management District by Planning Region, 1995.

of the most widely used curves of this type are: linear, geometric, parabolic, modified exponential, Gompertz, and logistic (Klosterman, 1990). These curves all rely on the assumption that the particular variable (population or water use) is related to time in some manner. Linear, geometric, and parabolic curves are based on assumptions about the growth or growth rate of the variable. The linear curve assumes a constant increase in the variable, the geometric curve assumes a constant growth rate over time, and the parabolic curve assumes a constant change in the growth rate over time. Modified exponential, Gompertz, and logistic curves are asymptotic, in that they all change in relation to a fixed value that they either do not exceed or do not fall below, yet the curve gets ever closer to the fixed value. The assumption inherent in these asymptotic curves is that there is a resource limit which confines the variable's growth above a particular number or that there is a lower limit to the variable. All six curves were generated for each population (county and utility) and water-use projection.

Several techniques were used to determine which of the six curves best fit the historical trend. These techniques include: 1) visual examination, 2) evaluative statistics, and 3) other data or known limitations. The first step was to visually examine the graphs produced. Generally, only a few of the curves looked reasonable and fit the past trends well, and those curves that produce extreme or unrealistic results were eliminated (fig. 13). The next step was to analyze the evaluative statistics of the remaining curves. The evaluative statistics include the Coefficient of Relative Variation (CRV), Mean Standard Error (MSE), Standard Error of the Estimate (SEE) and the Mean Absolute Percentage Error (MAPE) which are calculated for each curve (table 2). Input criteria measure how closely the assumptions made in the curve's changes correspond to changes in the actual historical data. For this study, the CRV was chosen as the input statistic. This coefficient is the standard deviation of the input evaluation values divided by the mean of these values (Klosterman, 1990). In this manner, the CRV is standardized without regard to units so that varying data can be compared. While input criteria measure discrepancies between the changes in the predicted values, output criteria measure discrepancies between the actual values and the predicted values. Output statistics include the MSE, SEE, and MAPE. The MSE and SEE are measures of how well the predicted values correlate to the actual values. The MAPE is devoid of units and allows comparison between varying data (Klosterman, 1990). Generally, the curves with the best CRV or MAPE values were chosen (table 2). The third step was used if the first or second steps did not produce a clear choice. This step involved comparing the data from the curves to information provided by the water user, published information, or other sources to compare and select an appropriate curve. In some cases, none of the curves produced statistically significant results, and in these instances, projections were made using information from the water user or other sources.

County Population Projections

The accuracy of using a curve fitting and extrapolation method are dependent upon the availability of reliable historical data. For this report, it was necessary to use population data in 5-year increments beginning with 1970. Generally, the U.S. Bureau of the Census (USBC) has the most reliable and comprehensive source of data available; it was the primary source for these population projections, but it is only available every 10 years.

The mid-decade population numbers are derived from BEBR. For all mid-decade population figures collected, the most recent data available are used. With the exception of 1995, only mid-census estimates that were calculated after the 1975 and 1985 censuses are

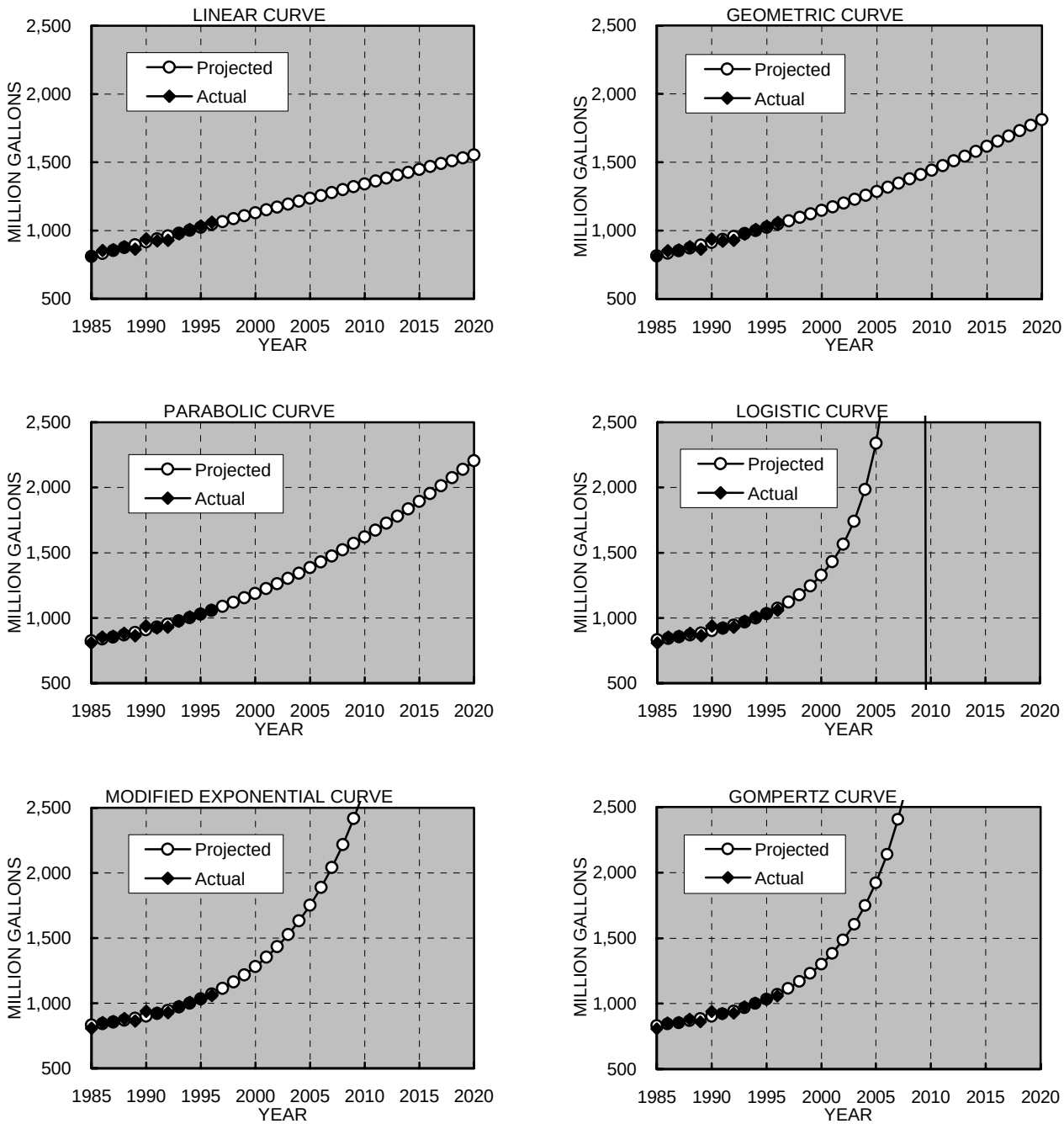


Figure 13. Water use projections for Destin Water Users by curve. (Geometric curve was the projection selected.)

used. Thus, the 1975 and 1985 population data are from the 1981 and 1991 Florida Statistical Abstract (University of Florida, 1981 and 1991). Although these estimates are rounded to the nearest hundred, they represent substantial differences from the estimates made within several years of the mid-census year. It is better to have numbers that differ slightly from the actual population due to rounding, rather than numbers that are specific, yet represent estimates made from less complete data. The 1995 county population figures were derived from BEBR (University of Florida, 1996 and 1997).

The future population for each county was estimated by fitting a curve to the historical data from the USBC and BEBR, and extrapolating these data into the future in 5-year increments. The six curves mentioned

Table 2. Water use projections for Destin Water Users, Inc.

[All values in million gallons; Mod Exp, Modified Exponential; Geometric curve (grey column) was the projection selected; () values are negative]

		Computed Values					
Year	Actual	Linear	Geometric	Parabolic	Mod Exp	Gompertz	Logistic
1985	808.10	810.42	815.15	824.34	832.76	832.17	831.59
1986	852.20	831.64	833.95	837.96	843.28	842.93	842.58
1987	858.60	852.85	853.19	853.11	855.24	855.05	854.85
1988	881.20	874.07	872.88	869.77	868.83	868.72	868.61
1989	863.20	895.29	893.01	887.95	884.27	884.18	884.07
1990	937.50	916.51	913.62	907.65	901.82	901.67	901.51
1991	923.20	937.73	934.69	928.87	921.77	921.53	921.27
1992	928.40	958.95	956.26	951.61	944.44	944.10	943.74
1993	974.90	980.17	978.32	975.86	970.20	969.84	969.45
1994	1,007.10	1,001.38	1,000.89	1,001.64	999.48	999.26	999.03
1995	1,031.60	1,022.60	1,023.98	1,028.93	1,032.76	1,033.01	1,033.29
1996	1,059.43	1,043.82	1,047.61	1,057.74	1,070.58	1,071.85	1,073.31
1997	--	1,065.04	1,071.77	1,088.07	1,113.56	1,116.74	1,120.46
1998	--	1,086.26	1,096.50	1,119.92	1,162.41	1,168.83	1,176.65
1999	--	1,107.48	1,121.80	1,153.29	1,217.92	1,229.57	1,244.49
2000	--	1,128.70	1,147.68	1,188.17	1,281.01	1,300.78	1,327.68
2001	--	1,149.91	1,174.16	1,224.58	1,352.72	1,384.78	1,431.70
2002	--	1,171.13	1,201.24	1,262.50	1,434.21	1,484.49	1,564.97
2003	--	1,192.35	1,228.96	1,301.94	1,526.82	1,603.76	1,741.13
2004	--	1,213.57	1,257.31	1,342.91	1,632.07	1,747.57	1,983.84
2005	--	1,234.79	1,286.32	1,385.38	1,751.69	1,922.57	2,338.09
2006	--	1,256.01	1,315.99	1,429.38	1,887.63	2,137.69	2,901.14
2007	--	1,277.23	1,346.35	1,474.90	2,042.13	2,405.10	3,929.74
2008	--	1,298.45	1,377.42	1,521.93	2,217.71	2,741.70	6,393.55
2009	--	1,319.66	1,409.19	1,570.49	2,417.26	3,171.32	20,070.38
2010	--	1,340.88	1,441.70	1,620.56	2,644.05	3,728.17	(15,146.93)
2011	--	1,362.10	1,474.96	1,672.15	2,901.79	4,462.45	(5,210.20)
2012	--	1,383.32	1,508.99	1,725.26	3,194.70	5,449.31	(3,041.52)
2013	--	1,404.54	1,543.81	1,779.89	3,527.60	6,804.06	(2,094.12)
2014	--	1,425.76	1,579.42	1,836.03	3,905.93	8,708.21	(1,564.46)
2015	--	1,446.98	1,615.86	1,893.70	4,335.90	11,455.61	(1,227.12)
2016	--	1,468.19	1,653.14	1,952.88	4,824.56	15,536.87	(994.13)
2017	--	1,489.41	1,691.28	2,013.59	5,379.91	21,799.23	(824.07)
2018	--	1,510.63	1,730.30	2,075.81	6,011.06	31,760.73	(694.88)
2019	--	1,531.85	1,770.22	2,139.55	6,728.36	48,254.09	(593.71)
2020	--	1,553.07	1,811.06	2,204.80	7,543.55	76,806.40	(512.59)
Evaluative Statistics							
CRV		1.14	1.17	28.85	3.30	3.30	3.30
MSE		351.17	309.68	274.22	303.40	304.97	307.71
SEE		18.74	17.60	16.56	17.42	17.46	17.54
MAPE		1.54	1.47	1.32	1.37	1.39	1.40
ASYM					756	741	723

above were all fit to the historical data. The appropriate curve was initially selected based on statistical analysis and past trends, and the resulting projection was compared against those either published by BEBR, in the county comprehensive plans, or from other sources. After further scrutiny, the projection was either accepted, or rejected. If rejected, the process would begin again, this time excluding the first curve used. Estimates of the population within the ASC portion of the county were made by comparing the public supply population served within the ASC to the total population served within the county.

Public Supply Population Served Projections

Population served projections were made using historical population served data in 5-year increments. Either five (1975, 1980, 1985, 1990, and 1995) or six (1970, 1975, 1980, 1985, 1990, and 1995) data points were used, depending on available data. For utilities that did not supply water before 1975, all available data points were used to estimate the future population served. Data came primarily from the USGS water-use data base (5-year assessments), but were also derived from service connections multiplied by people per household, and from FDEP Sanitary Surveys, BEBR, the NWFWMD water-use permit data base, and other sources. If the historical population served data were missing for one of the five or six data points (years), missing values were estimated based on the mean of the surrounding years.

From these data, each utility's population served was projected for the years 2000, 2005, 2010, 2015 and 2020 by selecting the most statistically viable projection curve. The population served for these years was then divided into the projected water use to calculate a utility per capita value. If the per capita value appeared to be appropriate for a particular utility based on historical data and trends, then the water-use projection was considered acceptable. If not, the utility's projected water-use calculations and historical population estimates were re-examined and adjustments were made as to the projection chosen.

Public Supply Water Use Projections

Projections for public supply water use were made using historical water-use values for a 6-year (1991- 96), 9-year (1988-96), or 12-year (1985-96) period between 1985 and 1996. The period selected was based on the reliability of the data and the pattern of water use for the utility. Water-use projections were made by fitting a curve to the historical data and extrapolating. The appropriate curve was selected by statistical analysis and past trends, and was compared against projections provided by the utility (if the utility did supply projections).

Projections were calculated for all utilities that used more than 0.10 Mgal/d in 1995 or that were projected to reach 0.10 Mgal/d by 2020. Projections were made with the assumption that the future trend for each utility is the same as the past trend (unless build out or expansion is noted through contact with the utility). Water-use projections for each utility were then checked against the projected population served as described above, and a per capita value was generated per utility. The per capita value was used to help verify the population served and the water use projection by utility. If the estimated per capita value was less than 100 gal/d or more than 200 gal/d, then the projection variables were reexamined, and recalculated if needed.

Peak day, peak month, and peak three-month values were projected using a calculated ratio between the annual daily average water use and the actual peak value per utility for each (peak day, peak month, and peak three-month), and multiplying it by the projected annual daily average. The peak day, peak month, and peak three-month values were obtained from the historical records of the utilities contacted through the public supply questionnaire or from the FDEP MOR files, and for the smaller utilities where data were not available, the county average was applied.

The ratio used for each peak day, peak month, and peak three-month period was the highest ratio of the particular peak to that year's annual daily average since 1985. Using the peak month and the peak three-month values helped accommodate for seasonality of public supply water use. Water demand increases from May through September because of lawn watering, seasonal population, and daily visitors. It is not possible to differentiate the demand for each use (lawn watering, seasonal population, or daily visitors) out of the total. The assumption was made that the ratio between the annual average daily use and peak day, peak month, and peak three-month values will remain about the same between 1995 and 2020, and that all peak events will occur at approximately the same time of year. To verify these peak values, the trend in ratios was examined and anomalies were omitted using information obtained from the utilities.

Domestic Self-Supplied and Small Public Supply Systems Water-Use Projections

Projections for domestic self-supplied and small public supply systems populations were made by subtracting the population served by public supply from the total county population. This assumes the remaining population to be self-supplied or served by small public supply systems that use less than 0.10 Mgal/d (systems not accounted for under public supply). For estimating the domestic self-supplied and small public supply systems populations in each ASC, the same percentage of population for the ASC portion of the county was used, and it was assumed that this percentage would not change through 2020.

The water use for domestic self-supplied and small public supply systems was then calculated by assuming that the population not on public supply used the same amount of water (per capita) as the portion of the population on public supply in a county. The per capita value was then multiplied by the domestic self-supplied and small public supply systems population to estimate the water demand for this category on a county level. The per capita value was calculated by taking the projected public supply water use per year and dividing it by the projected public supply population served per year for each county.

Commercial-Industrial Self-Supplied Water-Use Projections

Projections for the 14 major self-supplied commercial-industrial facilities were provided directly by the users. Peak day, peak month, and peak three-month values were projected using a calculated ratio between the actual peak value per facility for each period and then multiplying that value by the projected annual daily average. The 14 commercial-industrial self-supplied systems inventoried and projected individually include: Arizona Chemical Company (Bay County), Stone Container Corporation (Bay County), Champion International Corporation (Escambia County), Monsanto Corporation (Escambia County), U.S. Navy; Pensacola Naval Air Station (Escambia County), Quincy Farms (Gadsden County), Arizona Chemical Company (Gulf County), Florida Coast Paper Company (Gulf County), U.S. Air Force; Eglin Air Force Base (Okaloosa County), U.S. Air Force; Hulbert Field (Okaloosa County), Sterling Fibers Incorporated (Santa Rosa County), Air Products and Chemicals Incorporated (Santa Rosa County), Purdue Farms Incorporated (Walton County), and Primex Technologies Incorporated (Wakulla County). Water-use values for the remaining users in this category were assumed to stay at the current (1995) demand level.

Power Generation Water-Use Projections

Projections for the five major power plants were provided directly by the users. This includes the Crist (Escambia County), Scholz (Jackson County), and Smith (Bay County) plants of Gulf Power Company and the Hopkins (Leon County) and Purdom (Wakulla County) Plants of the City of Tallahassee. Projections were also provided by a small private power generating facility, Timber Energy Incorporated (Liberty County). According to Gulf Power Company and the City of Tallahassee, no new power plants are planned over the next 10 years. No information was available beyond then. The Purdom Plant is in line to be expanded over the next 5 years, and projections by the City of Tallahassee for this facility reflect this change. Projections provided for each facility include demands for both fresh and saline water. Most of the freshwater used as well as all of the saline water used for power generation is used for once-through cooling, and nearly all of this water is returned to its source.

Recreational Irrigation (Golf Course) Water-Use Projections

Projections for golf course irrigation water use were made by applying a fixed application rate per acre based on geographic location to the number of acres irrigated per county. The application rate was determined using one of two permitted rates—coastal or inland. For golf courses in coastal Counties (Bay, Escambia, Franklin, Gulf, Okaloosa, Santa Rosa, and Walton) 30 inches per acre was used as the application rate, and for golf courses in inland Counties (Calhoun, Gadsden, Holmes, Jackson, Jefferson, Leon, Liberty, Wakulla, and Washington), 21 inches per acre was used as the application rate (Angela Chelette, Northwest Florida Water Management District, April 1998, written commun.). These rates are generated from the AFSIRS computer model (Smajstrla, 1986) and are estimated to be for the average year.

Golf course acreage was estimated by multiplying the number of golf course holes per county by a statewide average of 4.5 acres per hole (Fernald and Purdum, 1998). The number of golf course holes was

obtained from the master list of golf courses compiled for this project from several sources. These sources included the NWFWMD water-use permit data base, and the Florida Sports Foundation, Fairways in the Sunshine, Official Florida Golf Guide (Florida Sports Foundation, 1994), the Florida Atlas and Gazetteer (DeLorme Publishing Company, 1986), and the National Golf Foundation (National Golf Foundation, 1997). This method was used because the acreage information obtained from the golf course surveys was incomplete.

In addition to existing golf courses, a projection of additional golf course holes per county was made. A ratio of people per golf course hole was developed for 1995 by dividing a county's total population by the total number of golf course holes in that county. This ratio was then multiplied by the projected population to estimate the future number of golf course holes per county. The number of holes was rounded to increments of nine to reflect potential golf course development. The projected number of holes was then multiplied by 4.5 acres per hole to obtain future acreage. The projected acreage was then multiplied by the appropriate application rate (21 or 30 inches per acre) to project water use.

WATER-USE PROJECTION FOR THE NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

The projected population for the NWFWMD was made using the methods described previously. Population for the NWFWMD is projected to reach 1,596,888 by the year 2020 (table 3 and fig. 14). This is an increase of 41 percent (464,639) between 1995 and 2020. These estimates compare favorably to the 1,595,900 estimated by BEBR in their medium population projection for the 16 counties within the NWFWMD for the year 2020 (Smith and Nogle, 1997); there was a difference of less than 1 percent between the two projections. The population served by public supply for the NWFWMD is projected to reach 1,353,836 by the year 2020 (table 3 and fig. 14)—an increase of nearly 46 percent (427,707) between 1995 and 2020.

Total water demand for the NWFWMD is projected to reach 940.2 Mgal/d in 2000, 1,003.1 Mgal/d in 2010, and 1,059.1 Mgal/d in 2020 (table 4). This represents a 19 percent increase between 1995 and 2020, but a 1.5 percent decrease between 1970 and 2020. The decrease between 1970 and 2020 is a result of high water usage at several power plants during the 1970's, which decreased substantially by 1995 and will remain at this level through 2020. Excluding water withdrawn for power generation needs from these totals, water demands will increase 34 percent between 1995 and 2020, and 58 percent between 1970 and 2020. Specifically, public supply demands are projected to increase 74.1 Mgal/d (53 percent), and demands by domestic self-supplied and small public supply systems are projected to increase 9.1 Mgal/d (28 percent) between 1995 and 2020. Combined, projected water needs for drinking water purposes in the NWFWMD will increase about 83.2 Mgal/d (48 percent) between 1995 and 2020 (fig. 15). Commercial-industrial self-supplied demands are projected to increase about 16.9 Mgal/d (13 percent) between 1995 and 2020 (fig. 15). Agricultural and recreational irrigation demands, combined, are projected to increase 16.8 Mgal/d (48 percent) between 1995 and 2020 (fig. 15). Water demands for power generation are projected to increase about 53.9 Mgal/d (10 percent) between 1995 and 2020. Although power generation water use shows an increase during this time, plant capacities are not projected to change dramatically. The increase is actually a result of several plants not operating at capacity during 1995, and projecting that they will by 2020. Additionally, nearly all (99 percent) of the water withdrawn for power generation purposes in 1995 was returned to its source.

Population and Water-Use Projections by Planning Region

Population projections indicate that PR II will account for the largest population by the year 2020, followed by PR VII, and PR I (table 3). Combined, these three PRs will account for 75 percent of the District's total population by the year 2020. Planning Region II will account for the largest population served by public supply by the year 2020, followed by PR I, and PR VII (table 3). Combined, these three PRs will account for 80 percent of the District's population served by public supply in the year 2020.

Water use projections indicate that the demands will increase in most of the seven Planning Regions over the next 25 years (fig. 16). Planning Region III will continue to be the largest user of water, but the largest increase will occur in PR II and VII. Between

Table 3. Projected population and population served by public supply by Planning Region and county in the Northwest Florida Water Mangement District, 1970-2020

[All values in million gallons per day; modified from Marella 1995; and Moss and de Bodisco, 1998]

	1995		2000		2005		2010		2015		2020	
	Total Population	Population Served	Total Population	Population Served	Total Population	Population Served	Total Population	Population Served	Total Population	Population Served	Total Population	Population Served
Planning Region I	**282,742**	**246,878**	**300,372**	**273,287**	**316,471**	**292,060**	**332,570**	**311,195**	**348,669**	**330,788**	**364,768**	**350,965**
Escambia	282,742	246,878	300,372	273,287	316,471	292,060	332,570	311,195	348,669	330,788	364,768	350,965
Planning Region II	**292,213**	**269,711**	**326,914**	**301,075**	**351,743**	**325,892**	**378,640**	**352,485**	**409,918**	**378,980**	**442,351**	**403,574**
Okaloosa	162,707	149,665	172,982	158,482	187,128	172,701	201,275	184,220	215,421	195,747	229,567	205,438
Santa Rosa	96,091	90,247	118,412	110,805	126,164	118,511	135,770	130,912	149,300	143,353	162,475	155,826
Walton	33,415	29,799	35,520	31,788	38,451	34,680	41,595	37,353	45,197	39,880	50,309	42,310
Planning Region III	**139,173**	**127,562**	**145,364**	**135,829**	**155,763**	**143,456**	**166,162**	**151,192**	**176,561**	**159,046**	**186,960**	**167,039**
Bay	139,173	127,562	145,364	135,829	155,763	143,456	166,162	151,192	176,561	159,046	186,960	167,039
Planning Region IV	**101,833**	**32,084**	**100,236**	**33,360**	**105,023**	**35,131**	**110,633**	**37,138**	**116,270**	**39,387**	**122,227**	**41,864**
Calhoun	11,988	4,455	11,916	4,382	12,641	4,689	13,410	5,003	14,225	5,324	15,090	5,637
Holmes	17,385	3,864	17,574	3,997	18,572	4,056	19,627	4,110	20,742	4,161	21,920	4,212
Jackson	46,577	14,870	44,727	15,487	45,696	16,081	47,211	16,796	48,454	17,632	49,696	18,589
Liberty	6,873	2,020	6,767	1,971	7,507	2,057	8,327	2,152	9,238	2,255	10,248	2,370
Washington	19,010	6,875	19,252	7,523	20,607	8,248	22,058	9,077	23,611	10,015	25,273	11,056
Planning Region V	**23,507**	**20,034**	**24,539**	**21,112**	**27,020**	**23,478**	**30,177**	**26,057**	**34,241**	**29,248**	**39,558**	**32,279**
Franklin	10,236	9,926	11,251	10,680	12,738	12,060	14,634	13,626	17,048	15,796	20,126	17,777
Gulf	13,271	10,108	13,288	10,432	14,282	11,418	15,543	12,431	17,193	13,452	19,432	14,502
Planning Region VI	**44,734**	**29,619**	**44,982**	**29,227**	**46,557**	**29,933**	**48,372**	**30,340**	**50,426**	**30,604**	**52,719**	**30,810**
Gadsden	44,734	29,619	44,982	29,227	46,557	29,933	48,372	30,340	50,426	30,604	52,719	30,810
Planning Region VII	**248,047**	**200,241**	**275,013**	**217,353**	**303,985**	**243,041**	**332,746**	**268,582**	**360,931**	**297,659**	**388,305**	**327,305**
Jefferson	13,509	4,788	13,718	5,132	14,534	5,773	15,349	6,494	16,165	7,304	16,980	8,216
Leon	217,533	186,440	241,272	202,032	265,840	225,270	289,555	248,008	311,934	273,832	332,610	299,654
Wakulla	17,005	9,013	20,023	10,189	23,611	11,998	27,842	14,080	32,832	16,523	38,715	19,435
Totals	1,132,249	926,129	1,217,420	1,011,243	1,306,562	1,092,991	1,399,300	1,176,989	1,497,016	1,265,712	1,596,888	1,353,836

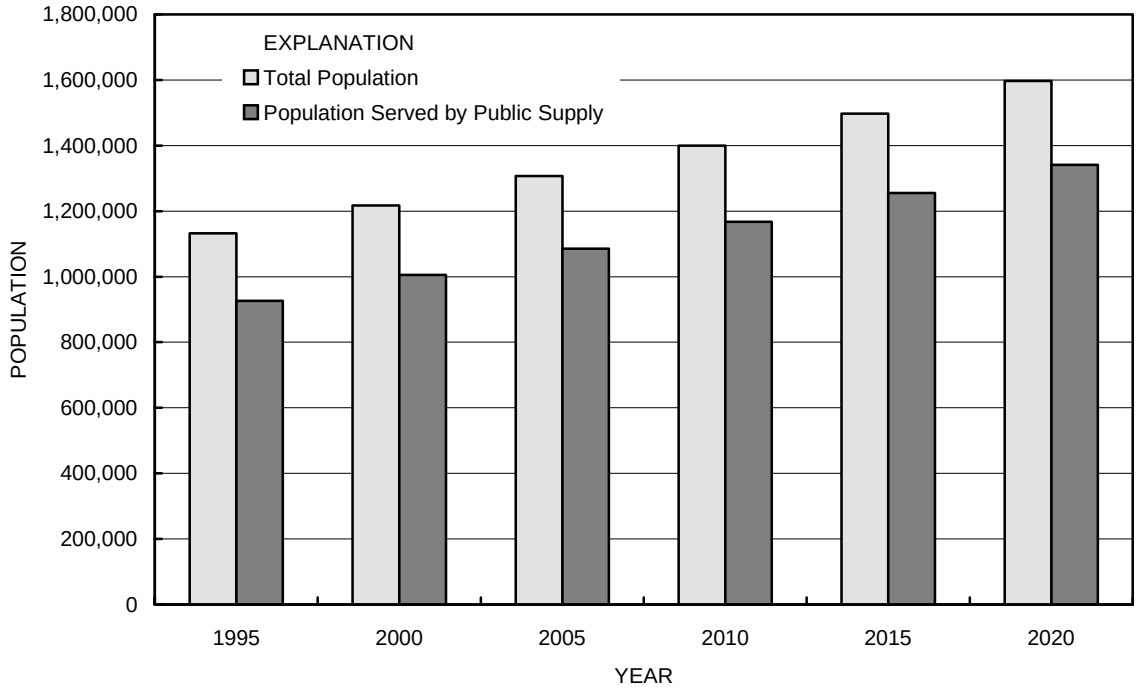


Figure 14. Projected population and population served by public supply in the Northwest Florida Water Management District, 1995-2020. (1995 total population from University of Florida, 1996)

1970 and 1990, water use trends were influenced by fluctuations in power generation usage or extreme climatic conditions (primarily rainfall) that increased or decreased public supply and irrigation demands. Although projections for each Planning Region is consistent through 2020, extreme climate conditions can dramatically affect water demands for a given year.

Planning Region I

The population of PR I is projected to increase from 282,742 in 1995 to 364,768 in 2020 (table 3). This is an increase of 29 percent between 1995 and 2020. The population served by public supply is projected to reach 350,965 by 2020 (table 3), which is an increase of 32 percent between 1995 and 2020.

Total water demand for PR I is projected to increase to 300.1 Mgal/d by the year 2020, an 11 percent increase from 1995 (table 4). Excluding water withdrawn for power generation needs, water use will increase 19 percent between 1995 and 2020. Specifically, public supply demands are projected to increase 10.8 Mgal/d while demands from domestic self-supplied and small public supply systems are projected to decrease by about 3.5 Mgal/d between 1995 and 2020. Combined, projected water needs for drinking water purposes in PR I will increase 7.3 Mgal/d (17 percent) between 1995 and 2000 (fig. 17). Commercial-industrial self-supplied demands are projected to increase about 12 Mgal/d (19 percent) between 1995 and 2020 (fig. 17). Agricultural and recreational irrigation demands combined are projected to increase 0.9 Mgal/d (44 percent) between 1995 and 2020 (fig. 17). Water demands for power generation are projected to remain between 165 and 175 Mgal/d through 2020. Water use and population projections for the individual water users within PR I are detailed in Appendix 4.

Planning Region II

The population of PR II is projected to increase from 292,213 in 1995 to 442,351 in 2020 (table 3). This is an increase of 51 percent between 1995 and 2020. The population served by public supply is projected to reach 403,574 by 2020 (table 3), an increase of 50 percent between 1995 and 2020. Planning Region II includes Okaloosa, Santa Rosa, and Walton Counties, in which populations are projected to reach 229,567, 162,475, and 50,309, respectively, by the year 2020 (table 3). The majority of the population (65 percent) in

Table 4. Historical and projected water use by Planning Region and county in the Northwest Florida Water Management District, 1970-2020

[All values in million gallons per day; modified from Marella 1995; and Moss and de Bodisco, 1998]

	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2020
Planning Region I	**322.54**	**375.88**	**427.79**	**337.88**	**285.91**	**270.69**	**277.39**	**282.69**	**288.34**	**294.12**	**300.14**
Escambia	322.54	375.88	427.79	337.88	285.91	270.69	277.39	282.69	288.34	294.12	300.14
Planning Region II	**34.03**	**42.16**	**49.87**	**45.06**	**53.28**	**60.00**	**66.57**	**72.74**	**79.25**	**86.68**	**94.65**
Okaloosa	15.66	17.61	21.41	25.46	30.40	30.86	33.95	36.51	39.67	42.98	46.67
Santa Rosa	15.60	22.28	25.20	15.23	17.85	21.35	23.92	26.70	29.17	32.16	34.98
Walton	2.77	2.27	3.26	4.37	5.03	7.79	8.70	9.53	10.41	11.54	13.00
Planning Region III	**319.10**	**266.18**	**446.10**	**312.74**	**283.62**	**315.39**	**319.34**	**326.19**	**333.88**	**338.15**	**343.32**
Bay	319.10	266.18	446.10	312.74	283.62	315.39	319.34	326.19	333.88	338.15	343.32
Planning Region IV	**168.02**	**143.04**	**140.07**	**124.31**	**133.64**	**81.85**	**119.17**	**124.49**	**132.43**	**134.68**	**138.37**
Calhoun	2.04	2.71	3.42	3.14	3.74	3.92	5.27	5.76	6.37	6.95	7.63
Holmes	1.23	1.08	1.98	2.84	3.39	4.78	4.97	5.44	5.92	6.28	6.63
Jackson	161.23	136.65	131.44	114.83	121.47	67.28	102.37	106.30	112.68	113.47	115.57
Liberty	1.72	0.66	0.73	0.65	1.40	1.62	1.78	2.02	2.28	2.57	2.88
Washington	1.80	1.94	2.50	2.85	3.64	4.25	4.78	4.97	5.18	5.41	5.66
Planning Region V	**37.79**	**36.02**	**36.72**	**35.17**	**36.89**	**32.27**	**32.54**	**32.85**	**33.19**	**33.78**	**34.44**
Franklin	0.87	1.12	1.30	1.35	1.82	1.77	2.03	2.26	2.51	2.81	3.23
Gulf	36.92	34.90	35.42	33.82	35.07	30.50	30.51	30.59	30.68	30.97	31.21
Planning Region VI	**11.02**	**10.53**	**11.54**	**11.91**	**13.79**	**12.50**	**13.32**	**13.01**	**14.29**	**14.89**	**15.78**
Gadsden	11.02	10.53	11.54	11.91	13.79	12.50	13.32	13.01	14.29	14.89	15.78
Planning Region VII	**183.07**	**135.02**	**123.10**	**66.81**	**96.73**	**115.58**	**111.83**	**116.42**	**121.76**	**127.06**	**132.41**
Jefferson	6.03	7.11	7.45	4.52	6.41	6.64	6.83	6.88	7.40	7.71	8.08
Leon	15.27	20.56	26.90	31.44	35.84	37.10	41.82	45.75	50.00	54.39	58.79
Wakulla	161.77	107.35	88.75	30.85	54.48	71.84	63.18	63.79	64.36	64.96	65.54
Totals	1,075.57	1,008.83	1,235.19	933.88	903.86	888.28	940.16	968.39	1,003.14	1,029.36	1,059.11

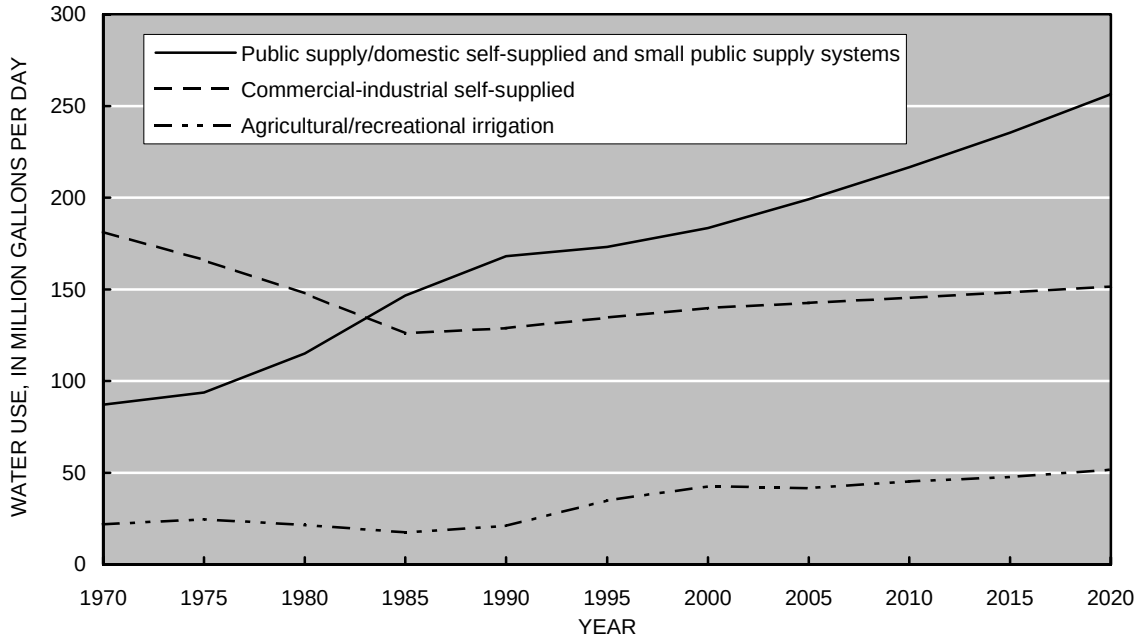


Figure 15. Historical and projected water use for the Northwest Florida Water Management District by major category, 1970-2020. (Values do not include power generation water use; modified from Marella, 1995; and Moss and de Bodisco, 1998)

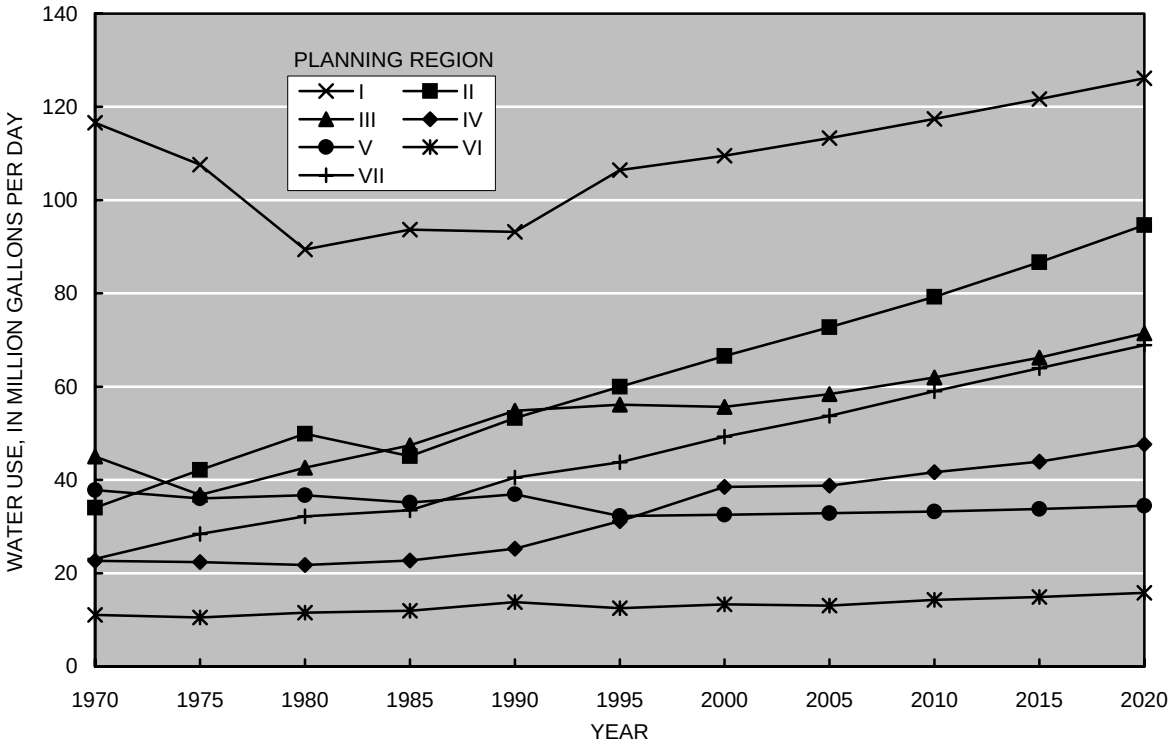


Figure 16. Historical and projected water use for the Northwest Florida Water Management District by Planning Region, 1970-2020. (Values do not include power generation water use; modified from Marella, 1995; and Moss and de Bodisco, 1998)

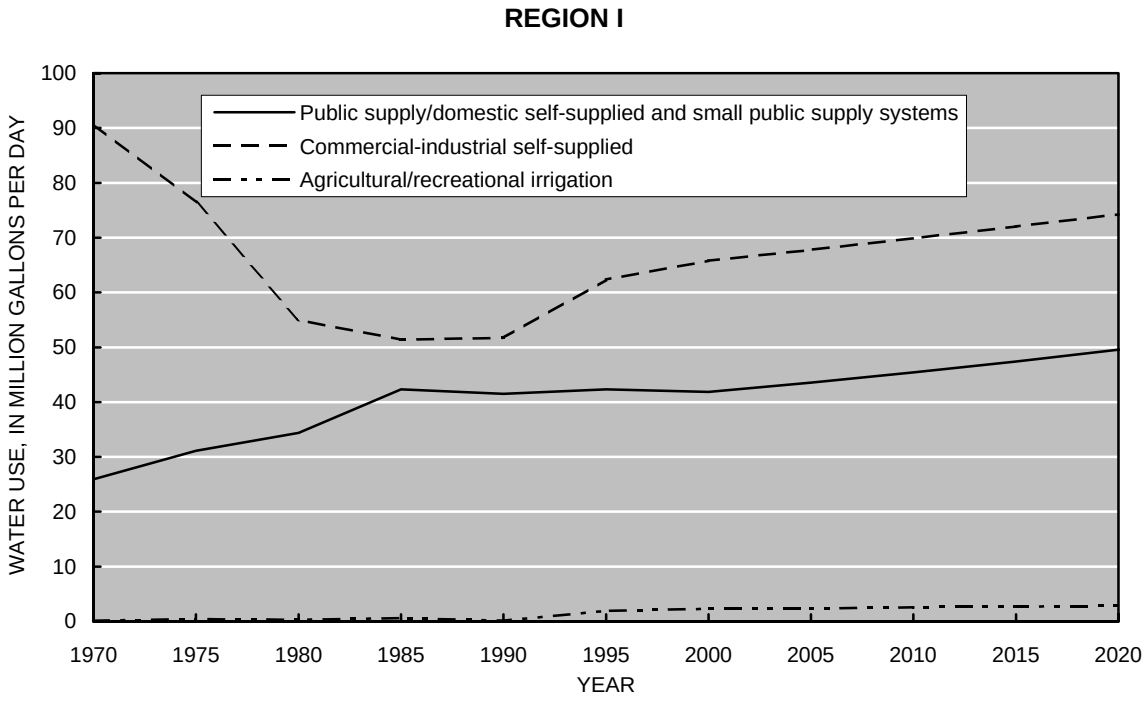


Figure 17. Historical and projected water use for Planning Region I by major category, 1970-2020. (Values do not include power generation water use; modified from Marella, 1995; and Moss and de Bodisco, 1998)

PR II is expected to continue to live within ASC 1 (figs. 3 and 5), as the population of this ASC is projected to reach 287,665 by 2020. In addition to permanent residents, seasonal populations and daily visitors will continue to be a large part of ACS 1, especially during the summer months.

Total water demand for PR II is projected to increase to 94.7 Mgal/d by the year 2020, a 58 percent increase from 1995 (table 4). Specifically, public supply demands are projected to increase 25.2 Mgal/d while demands from domestic self-supplied and small public supply systems are projected to increase by about 2.9 Mgal/d between 1995 and 2020. Combined, projected water needs for drinking water purposes in PR II will increase 28.1 Mgal/d (68 percent) between 1995 and 2000 (fig. 18). Commercial-industrial self-supplied demands are projected to increase about 4.5 Mgal/d (38 percent) between 1995 and 2020 (fig. 18). Agricultural and recreational irrigation demands combined are projected to increase 2.1 Mgal/d (31 percent) between 1995 and 2020 (fig. 18). Water-use and population projections for the individual water users within PR II are detailed in Appendix 5.

Planning Region III

The population of PR III is projected to increase from 139,173 in 1995 to 186,960 in 2020 (table 3). This is an increase of 34 percent between 1995 and 2020. The population served by public supply is projected to reach 167,039 by 2020 (table 3), an increase of 31 percent between 1995 and 2020. A large portion of the population in PR III lives along the coast or in the urban area within ASC 4 (figs. 3 and 6). The population of this ASC for the year 2020 is projected to reach 52,349 or 28 percent of the total population of PR III. In addition to permanent residents, seasonal populations and daily visitors will continue to be a large part of PR III and ASC 4, especially during the summer months.

Total water demand for PR III is projected to increase to 343.3 Mgal/d by the year 2020, a 9 percent increase from 1995 (table 4). Excluding water withdrawn for power generation needs, water use will increase 27 percent between 1995 and 2020. Specifically, public supply demands are projected to increase 12.6 Mgal/d while demands from domestic self-supplied and small public supply systems are projected to increase by about 2.1 Mgal/d between 1995 and 2020. Combined, projected water needs for drinking water

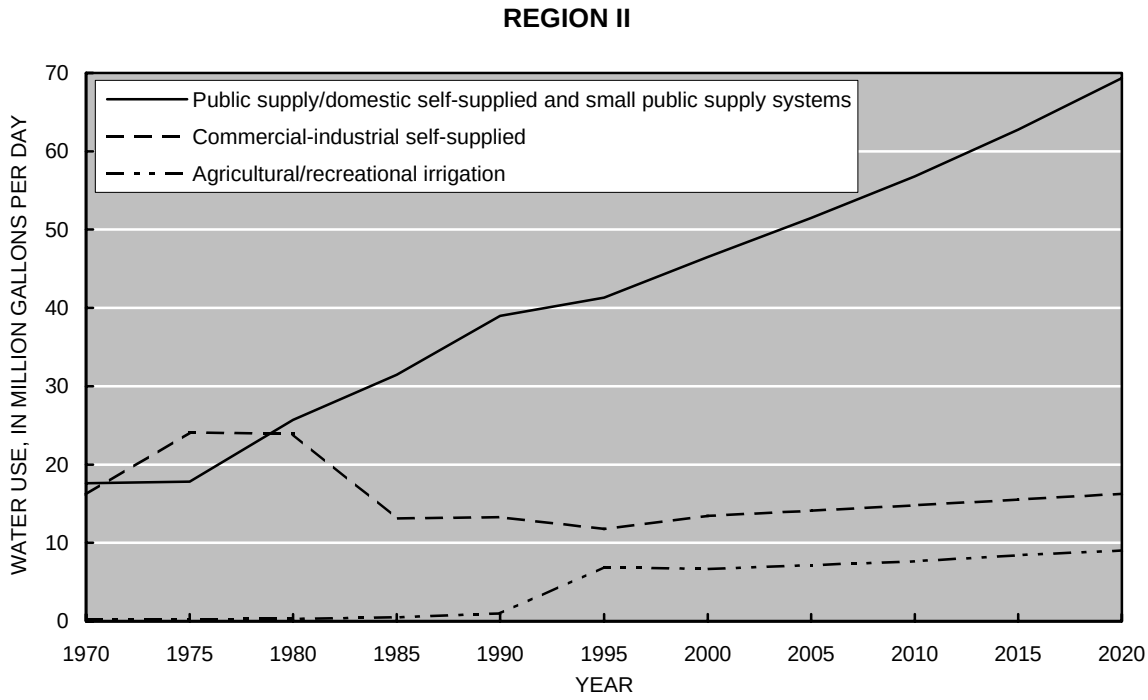


Figure 18. Historical and projected water use for Planning Region II by major category, 1970-2020. (Modified from Marella, 1995; and Moss and de Bodisco, 1998)

purposes in PR III will increase 14.6 Mgal/d (55 percent) between 1995 and 2000 (fig. 19). Commercial-industrial self-supplied demands are projected to remain between 27 and 28 Mgal/d through 2020 (fig. 19). Most of the water used for commercial-industrial will be provided by public supply, but for projection purposes it was included under the commercial-industrial self-supplied category. Agricultural and recreational irrigation demands combined are projected to increase 0.6 Mgal/d (32 percent) between 1995 and 2020 (fig. 19). Water demands for power generation are projected to remain between 260 and 275 Mgal/d through 2020. Water-use and population projections for the individual water users within PR III are detailed in Appendix 6.

Planning Region IV

The population of PR IV is projected to increase from 101,833 in 1995 to 122,227 in 2020 (table 3). This is an increase of 20 percent between 1995 and 2020. The population served by public supply is projected to reach 41,864 by 2020 (table 3), an increase of 30 percent between 1995 and 2020. Planning Region IV includes Calhoun, Holmes, Jackson, Liberty, and Washington Counties, in which populations are projected to reach 15,090, 21,920, 49,696, 10,248, and 25,273, respectively, by the year 2020 (table 3). The majority of the population in PR IV will continue to live in rural areas throughout these five counties.

Total water demand for PR IV is projected to increase to 138.4 Mgal/d by the year 2020, a 69 percent increase from 1995 (table 4). Excluding water withdrawn for power generation needs, water use will increase 53 percent between 1995 and 2020. Specifically, public supply demands are projected to increase 2.6 Mgal/d while demands from domestic self-supplied and small public supply systems are projected to increase by about 4.4 Mgal/d between 1995 and 2020. Combined, projected water needs for drinking water purposes in PR IV will increase 6.9 Mgal/d (40 percent) between 1995 and 2000 (fig. 20). Commercial-industrial self-supplied demands are projected to remain at about 2.0 Mgal/d between 1995 and 2020 (fig. 20). Agricultural and recreational irrigation demands combined are projected to increase 9.5 Mgal/d (79 percent) between 1995 and 2020 (fig. 20). Water demands for power generation are projected to remain between 80 and 90 Mgal/d through 2020. Water-use and population projections for the individual water users within PR IV are detailed in Appendix 7.

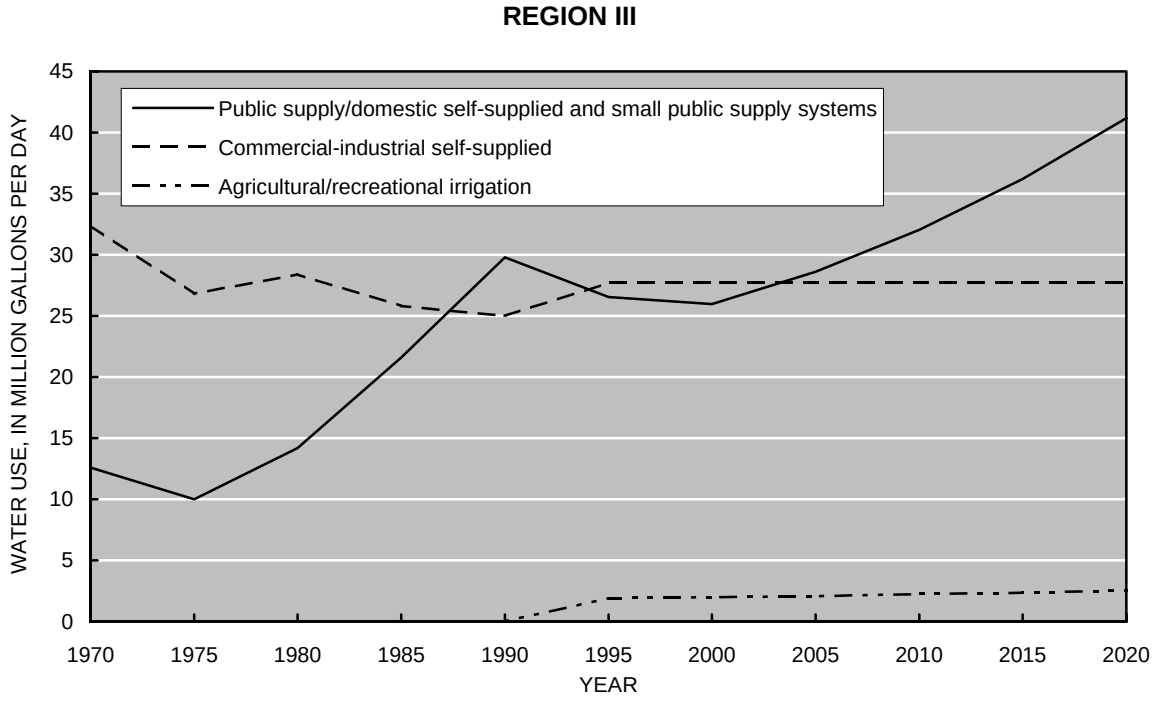


Figure 19. Historical and projected water use for Planning Region III by major category, 1970-2020. (Values do not include power generation water use; modified from Marella, 1995; and Moss and de Bodisco, 1998.)

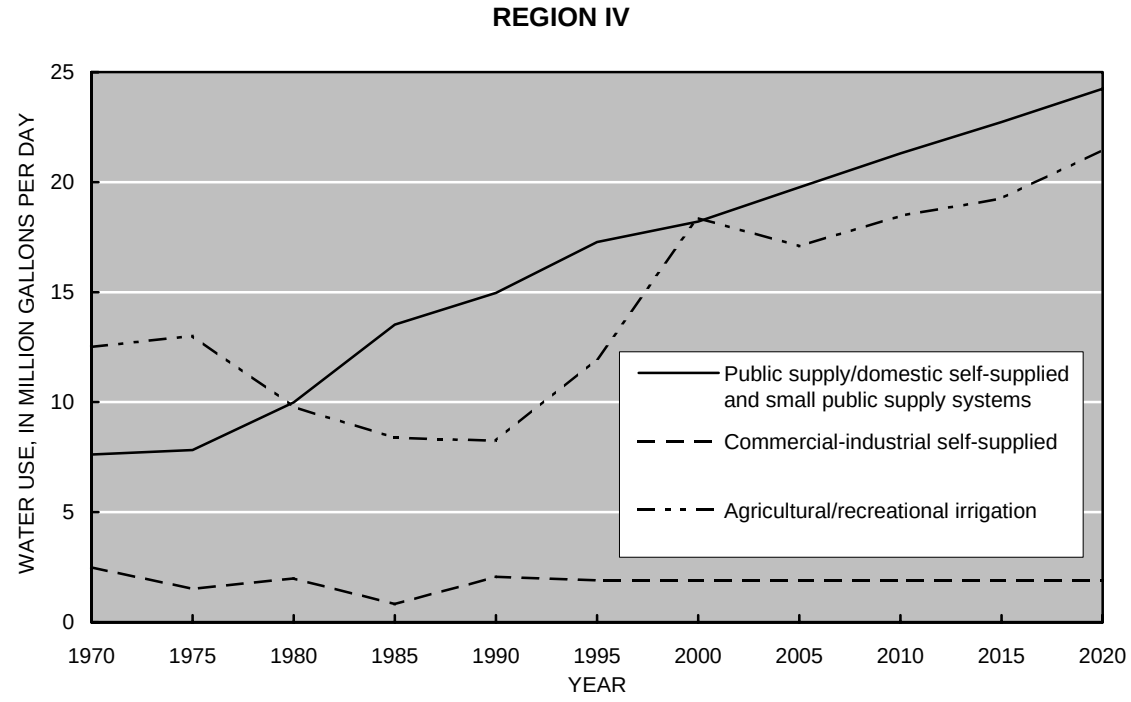


Figure 20. Historical and projected water use for Planning Region IV by major category, 1970-2020. (Values do not include power generation water use; modified from Marella, 1995; and Moss and de Bodisco, 1998.)

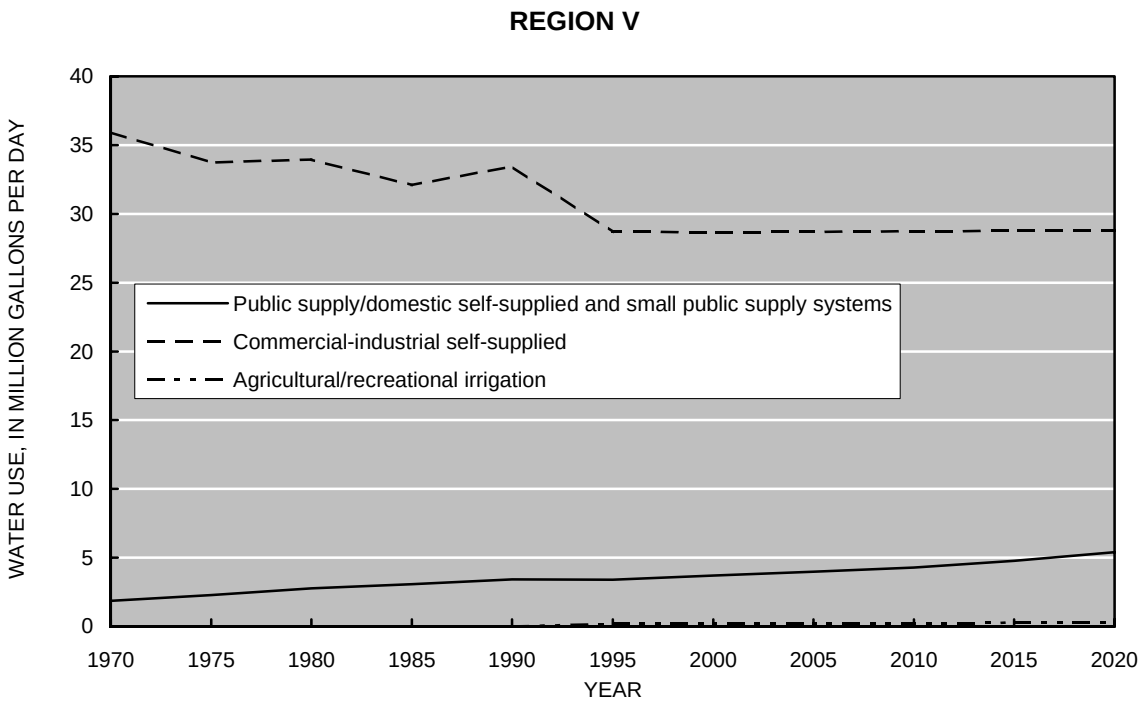


Figure 21. Historical and projected water use for Planning Region V by major category, 1970-2020. (Modified from Marella, 1995; and Moss and de Bodisco, 1998)

Planning Region V

The population of PR V is projected to increase from 23,507 in 1995 to 39,558 in 2020 (table 3). This is an increase of 68 percent between 1995 and 2020. The population served by public supply is projected to reach 32,279 by 2020 (table 3), an increase of 61 percent between 1995 and 2020. Planning Region V includes Franklin and Gulf Counties, in which populations are projected to reach 20,126 and 19,432, respectively, by the year 2020 (table 3). The majority of the population (86 percent) in PR V lives along the coast in ASC 2 and ASC 3 (figs. 3 and 8). The population of ASC 2 for the year 2020 is projected to reach 14,574 while the population of ACS 3 is projected to reach 19,522 by the year 2020. In addition to the permanent population in PR V, seasonal populations increase substantially during the summer months in the coastal communities and is expected to continue.

Total water demand for PR V is projected to increase to 34.4 Mgal/d by the year 2020, a 7 percent increase from 1995 (table 4). Specifically, public supply demands are projected to increase 1.5 Mgal/d, while demands from domestic self-supplied and small public supply systems are projected to increase by about 0.5 Mgal/d between 1995 and 2020. Combined, projected water needs for drinking water purposes in PR V will increase 2.0 Mgal/d (59 percent) between 1995 and 2000 (fig. 21). Commercial-industrial self-supplied demands are projected to remain between 28 and 29 Mgal/d between 1995 and 2020 (fig. 21). Agricultural and recreational irrigation demands combined are projected to increase 0.1 Mgal/d (50 percent) between 1995 and 2020 (fig. 21). Water-use and population projections for the individual water users within PR V are detailed in Appendix 8.

Planning Region VI

The population of PR VI is projected to increase from 44,734 in 1995 to 52,719 in 2020 (table 3). This is an increase of 18 percent between 1995 and 2020. The population served by public supply is projected to reach 30,810 by 2020 (table 3), an increase of 4 percent between 1995 and 2020. Within PR VI is ASC 5, which covers the central part of Gadsden County (fig. 9). The population of this ASC for the year 2020 is projected to reach 39,539 or 75 percent of the total population of PR VI.

Total water demand for PR VI is projected to increase to 15.8 Mgal/d by the year 2020, a 26 percent increase from 1995 (table 4). Specifically, public supply demands are projected to increase 0.6 Mgal/d,

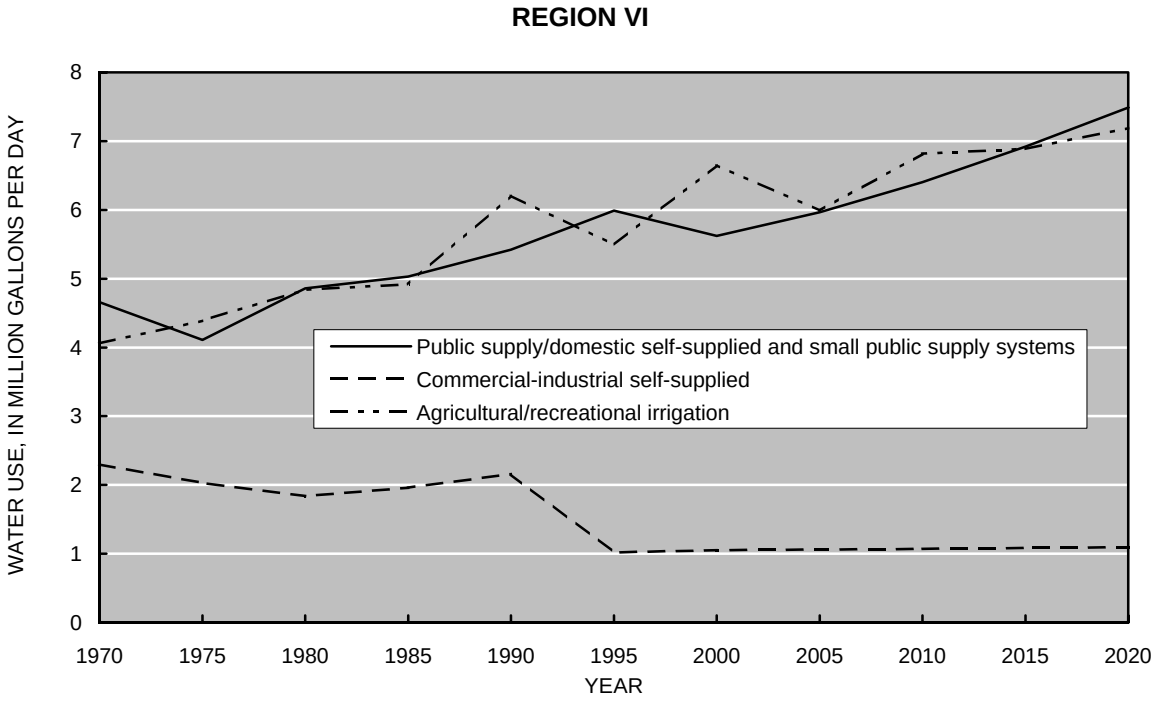


Figure 22. Historical and projected water use for Planning Region VI by major category, 1970-2020. (Modified from Marella, 1995; and Moss and de Bodisco, 1998)

while demands from domestic self-supplied and small public supply systems demands are projected to increase by about 0.9 Mgal/d between 1995 and 2020. Combined, projected water needs for drinking water purposes in PR VI will increase 1.5 Mgal/d (25 percent) between 1995 and 2000 (fig. 22). Commercial-industrial self-supplied demands are projected to remain near 1 Mgal/d between 1995 and 2020 (fig. 22). Agricultural and recreational irrigation demands combined are projected to increase 1.7 Mgal/d (31 percent) between 1995 and 2020 (fig. 22). Water-use and population projections for the individual water users within PR VI are detailed in Appendix 9.

Planning Region VII

The population of PR VII is projected to increase from 248,047 in 1995 to 388,305 in 2020 (table 3). This is an increase of nearly 57 percent between 1995 and 2020. The population served by public supply is projected to reach 327,305 by 2020 (table 3), an increase of 63 percent between 1995 and 2020. Planning Region VII includes all of Jefferson, Leon, and Wakulla Counties, in which populations are projected to reach 16,980, 332,610, and 38,715 by the year 2020 respectively (table 3). The majority of the population in PR VII will continue to reside in the urban area associated with the City of Tallahassee.

Total water demand for PR VII is projected to increase to 132.4 Mgal/d by the year 2020, a 15 percent increase from 1995 (table 4). Excluding water withdrawn for power generation needs, water use will increase 57 percent between 1995 and 2020. Specifically, public supply systems demands are projected to increase 21.1 Mgal/d, while demands from domestic self-supplied and small public supply systems are projected to increase by about 1.8 Mgal/d between 1995 and 2020. Combined, projected water needs for drinking water purposes in PR VII will increase 22.9 Mgal/d (63 percent) between 1995 and 2000 (fig. 23). Commercial-industrial self-supplied demands are projected to remain between 1.0 and 1.5 Mgal/d through 2020 (fig. 23). Agricultural and recreational irrigation demands combined are projected to increase 1.9 Mgal/d (30 percent) between 1995 and 2020 (fig. 23). Water demands for power generation are projected to remain between 60 and 70 Mgal/d through 2020. Water-use and population projections for the individual water users within PR VII are detailed in Appendix 10.

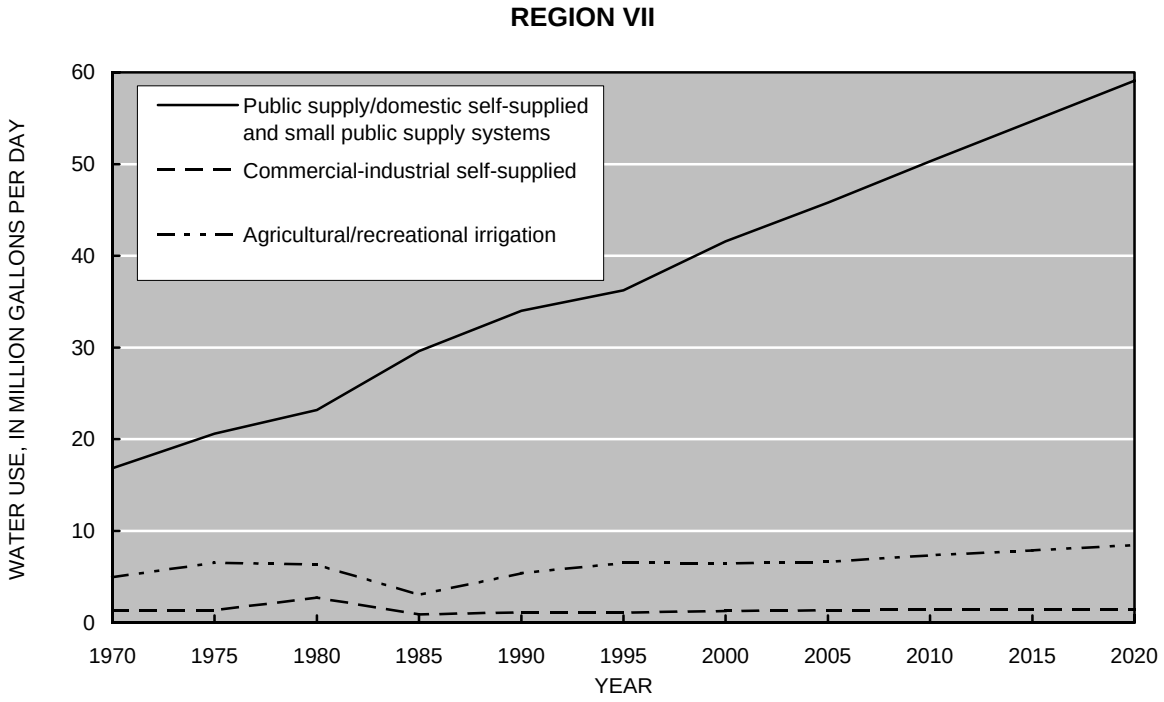


Figure 23. Historical and projected water use for Planning Region VII by major category, 1970-2020. (Values do not include power generation water use; modified from Marella, 1995; and Moss and de Bodisco, 1998)

SUMMARY

The Northwest Florida Water Management District is located in the western panhandle of Florida and encompasses about 11,200 square miles. In 1995, the District had an estimated population of 1.13 million, an increase of about 47 percent from the 1975 population of 0.77 million. Over 50 percent of the resident population lives within 10 miles of the coast. In addition, hundreds of thousands of visitors come to the coastal areas of the panhandle during the summer months for recreation and vacation purposes. Water withdrawn to meet demands for public supply, domestic self-supplied, commercial-industrial, agricultural irrigation, and recreational irrigation purposes in the District has increased 18 percent (52 Mgal/d) between 1970 and 1995. The greatest increases were for public supply and domestic self-supplied (99 percent increase) and agricultural irrigation (60 percent increase) between 1970 and 1995. In 1995, approximately 70 percent of the water withdrawn for these purposes was from ground-water sources, with the majority of this from the Floridan aquifer system. The increase in water demands has affected water levels in the Floridan aquifer system, especially along the coastal areas. The NWFWMD is mandated under the Florida Statutes (Chapter 373) to protect and manage the water resources in this area of the State. The mandate includes meeting current and future demands while ensuring that adequate amounts of water remain available to sustain water resources and water dependent natural systems.

For this project, curve fitting and extrapolation were used to project most of the variables (population, population served by public supply, and water use) for the years 2000, 2005, 2010, 2015, and 2020. This mathematical method is based on the fitting of a curve to historical population or water-use data and then extending this curve to arrive at future values. Six of the most widely used curves for this type of process are linear, geometric, parabolic, modified exponential, Gompertz, and logistic. Several techniques were used to determine which of the six curves best fit the historical trend. These techniques include 1) visual examination, 2) evaluative statistics, and 3) other data or known limitations.

The public-supply category refers to water supplied by a publicly or privately owned water system for public distribution. Projections were calculated for all utilities that used more than 0.10 Mgal/d in 1995 or that were projected to reach 0.10 Mgal/d by 2020

within each county and ASC. Projections for public supply water use were made by using historical water-use values for a 6-year (1991-96), 9-year (1988-96), or 12-year (1985-96) period between 1985 and 1996. The period selected was based on the reliability of the data and the pattern of water use for each utility or user.

Domestic self-supplied use includes water withdrawn by individual households and water withdrawn by the small public supply systems not inventoried under public supply. Water-use projections for domestic self-supplied and small public supply systems water use were made by multiplying the population of the county not served by public supply by per capita use value.

Commercial-industrial self-supplied use includes water withdrawn at commercial, industrial, and mining facilities. Projections for the 14 major self-supplied commercial-industrial facilities were made based upon information provided directly from the users, which included the annual daily average water use. Values for the remaining users in this category were assumed to stay at current (1995) levels.

Power generation use includes water withdrawn at thermoelectric power generation facilities and includes fresh and saline water withdrawn for all uses at these facilities. Projections for five power plants and the one small power provider in the District were made based on information provided by the owners or facility.

Recreational irrigation use includes the artificial application of water on lands to assist in the growing of golf course turf grass. Projections for golf course irrigation were made by applying a fixed application rate per acre based on geographic location (30 inches per acre in coastal areas or 21 inches per acre for inland areas) to each golf course and multiplied by the number of acres irrigated. A ratio of people per golf course hole was developed and applied to project future water use. This ratio was then multiplied by the projected population to determine the additional number of golf course holes per county or Planning Region (rounded in nine hole increments). The projected number of holes was multiplied by the number of acres per hole and then by the appropriate application rate.

The population for the NWFWMD is projected to reach 1,596,888 by the year 2020 - an increase of 41 percent between 1995 and 2020. Most of the population in the District will continue to reside in the urban areas of Pensacola and Tallahassee, and along the coastal areas. Population projections indicate that PR II will account for the largest population by the year 2020, followed by PR VII, and PR I. Combined, these three Planning Regions will account for 75 percent of the District's total population by the year 2020. The population served by public supply for the NWFWMD is projected to reach 1,353,836 by the year 2020 - an increase of nearly 46 percent between 1995 and 2020.

Total water demand for the NWFWMD is projected to reach 940.2 Mgal/d in 2000, 1,003.1 Mgal/d in 2010, and 1,059.1 Mgal/d in 2020. Excluding water withdrawn for power generation needs from these totals, water demands will increase 34 percent between 1995 and 2020 and 58 percent between 1970 and 2020. Specifically, public supply demands are projected to increase 74.1 Mgal/d (53 percent), and demands from domestic self-supplied and small public supply systems are projected to increase 9.1 Mgal/d (28 percent) between 1995 and 2020. Combined, projected water needs for drinking water purposes in the NWFWMD will increase about 83.2 Mgal/d (48 percent) between 1995 and 2020. Commercial-industrial self-supplied demands are projected to increase about 16.9 Mgal/d (13 percent) between 1995 and 2020. Agricultural and recreational irrigation demands, combined, are projected to increase 16.8 Mgal/d (48 percent) between 1995 and 2020. Water demands for power generation are projected to increase about 53.9 Mgal/d (10 percent) between 1995 and 2020. Although power generation water use shows an increase during this time, plant capacities are not projected to change during this period. Water-use projections indicate that the demands will increase in most of the seven Planning Regions over the next 25 years. Planning Region III will continue to be the largest user of water, but the largest increase will occur in PR II and VII.

SELECTED REFERENCES

Barrett, Daffin, and Carlan, Incorporated, 1982, Regional water supply development plan and engineering and financial feasibility study for coastal areas of Escambia, Santa Rosa, Okaloosa, Walton, and Bay Counties; Tallahassee, 36 p.

Bielby, Camille, 1987, 1985 Annual water use survey: Havana, Northwest Florida Water Management District Program Development Series 87-1, 107 p.

Davis, W.Y., Rodrigo, D.M., Opitz, E.M., Dziegieleski, B., Baumann, D.D., and Boland, J.J., 1988, IWR-main water use forecasting system, version 5.1: Users manual and users description: Fort Belvoir, Va., U.S.

Army Corps of Engineers, Institute for Water Resources, IWR Report 88-R-6, 273 p.
DeLorme Publishing Company, 1986, Florida Atlas and Gazetteer: Freeport, Maine, 127 p.
Dietrich, T.S., 1978, The urbanization of Florida's population: An historical perspective of county growth 1830-1970: Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 211 p.
Fernald, E.A., and Patton, D.J., 1984, Water resources atlas of Florida: Tallahassee, Florida State University, Institute of Science and Public Affairs, 291 p.
Fernald, E.A., and Purdum, E.D., 1992, Atlas of Florida: Tallahassee, Florida State University, Institute of Science and Public Affairs, 280 p.
———1998, Water resources atlas of Florida: Tallahassee, Florida State University, Institute of Science and Public Affairs, 320 p.
Florida Department of Commerce, 1995, Florida visitor study, 1995: Tallahassee, Bureau of Economic Analysis, Office of Tourism Research, 90 p.
Florida Department of Environmental Regulation, 1990, Drinking water standards, monitoring, and reporting: Tallahassee, Chap. 17-550, 48 p.
Florida Sports Foundation, 1994, Fairways in the Sunshine, Official Florida Golf Guide: Tallahassee, Florida Sports Foundation, Hillsboro Printing Company, 54 p.
Healy, H.G., 1972, Public water supplies of selected municipalities in Florida, 1970: Tallahassee, Florida Bureau of Geology Information Circular 81, 213 p.
———1977, Public water supplies of selected municipalities in Florida, 1975: U.S. Geological Survey Water-Resources Investigations Report 77-53, 309 p.
Hughes, G.H., 1975, Perspective on use of freshwater for cooling systems of thermoelectric power plants in Florida: U.S. Geological Survey Water-Resources Investigations Report 43-75, 30 p.
Leach, S.D., 1978, Source, use, and disposition of water in Florida, 1975: U.S. Geological Survey Water-Resources Investigations Report 78-17, 90 p.
———1983, Source, use, and disposition of water in Florida, 1980: U.S. Geological Survey Water-Resources Investigations Report 82-4090, 337 p.
Leach, S.D., and Healy, H.G., 1980, Estimated water use in Florida, 1977: U.S. Geological Survey Water-Resources Investigations 79-112, 76 p.
Klosterman, R.E., 1990, Community analysis and planning techniques: Savage, Md., Rowman and Littlefield Publishers, Inc., 262 p.
Kranzer, B.S., 1983, Water use in the Northwest Florida Water Management District, an examination of current and past use: Havana, Northwest Florida Water Management District Water Resources Special Report 83-3, 47 p.
Mahon, G.L., Sepulveda, A.A., and Choquette, A.F., 1997, Potentiometric surface of the upper Floridan aquifer in Florida, May and June 1995: Tallahassee, Florida Geological Survey Map Series 140, 1 sheet.
Marella, R.L., 1988, Water withdrawals, use and trends in Florida, 1985: U.S. Geological Survey Water-Resources Investigations Report 88-4103, 43 p.
———1990, Public supply water use in Florida, 1987: U.S. Geological Survey Open-File Report 90-596, 39 p.
———1992a, Water withdrawals, use and trends in Florida, 1990: U.S. Geological Survey Water-Resources Investigations Report 92-4140, 38 p.
———1992b, Factors that affect public-supply water use in Florida, with a section on projected water use to the year 2020: U.S. Geological Survey Water-Resources Investigations Report 91-4123, 35 p.
———1993, Public supply water use in Florida, 1990: U.S. Geological Survey Open-File Report 93-134, 46 p.
———1995, Water-use data by category, county, and water management district in Florida, 1950-90: U.S. Geological Survey Open-File Report 94-521, 114 p.
———in press, Water withdrawals, consumption, use, and trends in Florida, 1995: U.S. Geological Survey Water-Resources Investigations Report.
May, J.W, and Casella, Sam, 1997, Population and water use in southern Okaloosa County: Tallahassee, Florida State University, Institute of Science and Public Affairs, 149 p.
Moss, Charles, and de Bodisco, Chris, 1998, Projected water demand by agriculture in the Northwest Florida Water Management District: Gainesville, University of Florida, College of Agricultural Science, Food and Resource Economics Department, Economic Information Report, 77 p.
National Golf Foundation, 1997, 1995-96 National golf course directory: Jupiter, Florida, v. I, Alabama-Montana, 543 p.
Northwest Florida Water Management District, 1981, Public water supply systems in the coastal areas of Escambia, Santa Rosa, Okaloosa, Bay, and Walton Counties: Havana, Northwest Florida Water Management District, Water Resources Special Report 81-3, 153 p.
———1996, 1995 Annual Reuse Report: Havana, Northwest Florida Water Management District, 29 p.
Polyengineering of Florida Incorporated, 1996, Intergrated water resources plan for Okaloosa County, Florida; Dothan, Alabama, Project No. 41-244, 114 p.
Richards, C.J., 1993, Historical water use and projected demands for southeastern Santa Rosa County: Havana, Northwest Florida Water Management District, Water Resources Technical File Report 93-1, 33 p.
Smajstrla, A.G., 1986, Agricultural field scale irrigation requirements simulation model: Technical Manual: Gainesville, University of Florida, College of Agricultural Science, Agricultural Engineering Department, 52 p.

Smith, S.K., 1991, Population growth of States and regions 1980-1990: Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, Economic Leaflets, v. 50, no. 1, 4 p.

Smith, S.K., and Nogle, June, 1997, Projections of Florida population by county 1996-2020: Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, v. 30, no. 2, bulletin no. 117, 8 p.

Smith, S.K., and Cody, Scott, 1996, Number of households and average household size in Florida: 1980, 1990 and 1995: Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, v. 29, no. 1, bulletin no. 113, 4 p.

U.S. Bureau of the Census, 1983, 1980 Census of population, number of inhabitants: Florida: Washington D.C., U.S. Department of Commerce, Bureau of the Census, p.

———1993, 1990 Census of Housing, detailed housing characteristics: Florida: Washington D.C., U.S. Department of Commerce, Bureau of the Census, Ch-2-11, 793 p.

University of Florida, 1971, 1971 Florida statistical abstract (5th ed.): Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 586 p.

———1976, 1976 Florida statistical abstract (10th ed.): Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 643 p.

———1981, 1981 Florida statistical abstract (15th ed.): Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 696 p.

———1983, 1983 Florida statistical abstract (17th ed.): Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 700 p.

———1986, 1986 Florida statistical abstract (20th ed.): Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 730 p.

———1991, 1991 Florida statistical abstract (25th ed.): Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 736 p.

———1993, 1993 Florida statistical abstract (27th ed.): Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 760 p.

———1996, Florida estimates of population, 1995: Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 60 p.

———1997, 1997 Florida statistical abstract (31st ed.): Gainesville, University of Florida, College of Business Administration, Bureau of Economic and Business Research, 809 p.

Wagner, J.R., Hodecker, E.A., and Murphy, Robert, 1980, Evaluation of industrial water availability for selected areas of the Northwest Florida: Havana, Northwest Florida Water Management District, Water Resources Assessment 80-1, 391 p.

Zimet, D.J., Hewitt, T.D., Musgrove, R.J., and Smith, W.P., 1988, Evaluation of the potential for the aquaculture industry in the north Florida region: Havana, Northwest Florida Water Management District Program Development Series 88-1, 62 p.