DISTRICT WATER SUPPLY ASSESSMENT

Northwest Florida Water Management District

Water Resources Assessment 98-2

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This report was prepared pursuant to Section 373.036(2)(b)4., Florida Statutes. It also fulfills the portion of Section 373.0391(2)(e), F.S., which requires "an assessment of regional water resource needs and sources for the next 20 years".

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LIST OF ACRONYMS

ADR	average daily rate
AFB	Air Force Base
AFSIRS	Agricultural Field Scale Irrigation Requirements Simulation Model
ASC	Areas of Special Concern
BEBR	Bureau of Economic & Business Research (University of Florida)
cfs	cubic feet per second
cfs/mi^2	cubic feet per second per square mile
CRV	coefficient of relative variation
ECUA	Escambia County Utilities Authority
F.S.	Florida Statutes
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
FDOT	Florida Department of Transportation
ft	feet
ft/d	feet per day
ft^2/d	feet squared per day
gal/d	gallons per day
gpm	gallons per minute
gpm/ft	gallons per minute per foot
HRS	Florida Department of Health & Rehabilitative Services
IFAS	Institute of Food and Agricultural Sciences (University of Florida)
in/yr	inches per year
MAPE	mean absolute percentage error
mg/L	milligrams per liter
Mgal/d	million gallons per day
mi^2	square miles
MOR	monthly operating report
MSE	mean standard error
NWFWMD	Northwest Florida Water Management District
Q_{90}	streamflow exceeded 90 percent of the time
RO	reverse osmosis
RUA	Walton/Okaloosa/Santa Rosa Regional Utility Authority
RWSDP	Regional Water Supply Development Plan
SEE	standard error of estimate

LIST OF ACRONYMS (CONTINUED)

TDS	total dissolved solids
USCB	United States Census Bureau
USGS	United States Geological Survey
VISA	Very Intensive Study Area
WFRPC	West Florida Regional Planning Council
WMD	Water Management District
WRCA	Water Resource Caution Area
WSA	Water Supply Assessment
WWTP	Wastewater Treatment Plant

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I. EXECUTIVE SUMMARY

In response to growing concerns about water resource planning and management issues throughout the State of Florida, Governor Lawton Chiles issued Executive Order 96-297 in September 1996. Among other requirements, the Executive Order directed the state's five water management districts to each develop a "districtwide water supply assessment" by July 1, 1998. During the 1997 session, the Florida Legislature also made significant changes to the statutes that govern water resource planning and management. These changes included language virtually identical to the Executive Order in regard to preparation of districtwide water supply assessments (WSA).

Preparation of the WSA is the initial step of a new water supply planning process that will be an ongoing responsibility of the District. The WSA is intended to determine future water needs and whether existing or "Reasonably-Anticipated" water sources and conservation efforts are adequate to supply water for all existing and projected reasonable-beneficial uses and to sustain the water resources and related natural systems [Section 373.0361(1), F.S.]. If the future water needs of a water supply planning region are such that they are currently causing or are likely to cause water resource problems over the 20-year planning horizon, the second step of the process begins. In this step, the water management district must prepare a "regional water supply plan" which analyzes various alternatives for meeting the anticipated needs.

The WSAs are a part of the District Water Management Plan required by Section 373.036(2), F.S., and as such, are subject to updates every five years. These regular updates will provide an opportunity to reassess current and future water needs as well as the condition of existing water supply sources. If water demands are increasing faster than anticipated in the previous WSA, adjustments can be made to ensure that water continues to be available from sustainable sources. In accordance with statutory requirements, the WSA will be incorporated into the *Northwest Florida Water Management District (NWFWMD) District Water Management Plan* when it is revised in 1999.

The WSA was prepared in close coordination with the four other water management districts in the state and the Florida Department of Environmental Protection (FDEP). These agencies have worked closely to ensure that all five WSAs have a consistent format and that there is agreement in regard to the methods used to assess water supply needs and sources.

This WSA provides the first comprehensive assessment of water supply needs and sources for the Northwest Florida Water Management District. Preparation of this document began with the identification of seven "Water Supply Planning Regions" comprised of either single counties or multiple counties that have similar water supply issues and water resource conditions (Figure 2-1). These regions were used as the basis for assessment of needs and evaluation of sources. Also identified are "Areas of Special Concern" for which water supply needs and sources were more closely examined.

Water needs through the year 2020 were quantified to a high level of detail at the utility or user level for the withdrawals that, in combination, account for over 95 percent of the water use in the District. Water withdrawal locations and sources are identified for each user with a permitted withdrawal rate of over 100,000 gallons per day. Availability of water from existing and anticipated water supply sources was quantified by water supply planning region to the degree possible using best available resource information. Environmental water demands are not explicitly quantified, but are addressed to the extent possible with existing information.

Water use in northwest Florida is projected to increase by 35 percent during the 1995–2020 planning timeframe. An additional 115 million gallons per day will be required to meet the future needs of the region. Most of the increase is attributable to a 41 percent increase in population that is projected to occur in this period.

On a regional basis, existing water supply sources are quite sufficient for meeting the projected future water demands of northwest Florida.

However, in Water Supply Planning Region II (Santa Rosa, Okaloosa, and Walton counties), anticipated future water supply sources have not been identified to safely meet the projected future needs. **Thus, development of a "Regional Water Supply Plan" pursuant to Section 373.0361, F.S., is recommended for Water Supply Planning Region II**.

The WSA also identifies some water supply issues in Bay, Franklin, and Gadsden counties that warrant either local action or close observation by the water management district.

In Bay County (Water Supply Planning Region III), wells used by the City of Panama City Beach are exhibiting signs of saltwater intrusion. An adequate amount of water is available from the Deer Point Lake Reservoir to meet the city's needs, but infrastructure improvements are necessary to transmit reservoir water to the Panama City Beach area. The improvements necessary fall under the statutory definition of "water supply development," and as such, are primarily the responsibility of the affected local governments and water supply utilities [Sections 373.0831 and 373.019(21), F.S.]. The NWFWMD and FDEP should closely monitor Floridan Aquifer water quality conditions in the area of the wells and undertake regulatory actions as appropriate to mitigate aquifer impacts.

In Franklin County (Water Supply Planning Region V), wells in the coastal area are susceptible to saltwater intrusion under excessive pumping scenarios. While there is evidence of saltwater intrusion beginning to occur in the City of Apalachicola's wells, this has yet to be documented for other water supply systems in the county. Floridan Aquifer conditions throughout the coastal area of Franklin County should be closely monitored. Saltwater intrusion issues in Franklin County can likely be addressed by simply moving the withdrawal points inland. This activity would fall under the statutory definition of "water supply development," and as such, would primarily be the responsibility of the affected local governments and water supply utilities.

In Gadsden County (Water Supply Planning Region VI), two water supply issues warrant close monitoring by the NWFWMD. First, agricultural demands and streamflows in the Telogia Creek Basin Water Resource Caution Area (WRCA) should continue to be closely monitored. Because agricultural demands currently and historically have been constrained by a lack of available water, these demands will continue to be limited. Present day permitting thresholds, along with good monitoring data, will allow available water to continue to be used in a reasonable-beneficial fashion. While wetlands and similar water resources will continue to be sustained as they are today, these systems have been highly altered due to extensive structural modification of the creek with impoundments and related past agricultural practices. These alterations took place prior to the establishment of the NWFWMD.

Second, the geology of central Gadsden County is such that excessive withdrawals can cause intrusion of poor quality water from the lower portions of the Floridan Aquifer. This can be avoided by carefully locating any new wells with large withdrawals and ensuring that adequate spacing is provided between smaller wells in areas with aquifer constraints.

II. INTRODUCTION

Background

Since their creation in 1972, Florida's five water management districts (WMDs) have been involved in water supply planning in varying degrees. For the most part, these efforts were somewhat incremental in nature and tended to focus only on areas where water supply problems were already being experienced or were obviously eminent. The NWFWMD's primary water supply planning efforts have historically been focused on issues in the coastal areas of Santa Rosa, Okaloosa, and Walton counties. As the state's water supply problems increased in intensity, a need for more comprehensive, proactive water supply planning was recognized.

In 1996 and 1997, Florida's Department of Environmental Protection (FDEP) and the five water management districts were directed by Governor Lawton Chiles and the Florida Legislature to implement an enhanced, two-tiered water supply planning program. These directives came in the form of an Executive Order from the Governor in September 1996, and in legislation passed during the 1997 session of the Florida Legislature.

The water supply planning requirements of Executive Order 96-297 and Chapter 97-160, Laws of Florida, are virtually identical. They require the water management districts to identify one or more "Water Supply Planning Regions" within their respective jurisdictions and develop a "districtwide water supply assessment" to examine, by region, future water supply needs (demands) for a 20-year planning period and the ability of existing sources to meet the projected demands. If the assessment determines that "existing and reasonably anticipated sources of water and conservation efforts" are not adequate "to supply water for all existing legal uses and reasonably anticipated future needs, and to sustain the water resources and related natural systems" in a particular region, a regional water supply plan must be prepared for that region.

This document has been prepared to meet the requirements of Executive Order 96-297 and Chapter 97-160 Laws of Florida, for development of a districtwide water supply assessment. Included herein is a description of the Northwest Florida Water Management District (NWFWMD or District) current water supply planning efforts, including an overview of the Water Supply Planning Regions, and Water Resource Caution Areas (WRCAs); Descriptions of the Assessment Approach and Methodologies; Water Supply Assessments for each of the seven Water Supply Planning Regions; and a Conclusions section that includes recommendations for future water supply planning in northwest Florida.

Water Supply Planning Regions

Figure 2-1 illustrates the seven Water Supply Planning Regions that have been delineated for use by the District's water supply planning programs. These regions are:

- **I. Escambia County**
- **II. Santa Rosa, Okaloosa and Walton Counties**
- **III. Bay County**
- **IV. Holmes, Washington, Jackson, Calhoun and Liberty Counties**
- **V. Gulf and Franklin Counties**
- **VI. Gadsden County**
- **VII. Leon, Wakulla and Jefferson Counties**

The primary factors considered in delineation of the regions were county boundaries and similarity of current water supply conditions. County boundaries were used because independent population projections are readily available at this level and are needed as a foundation for projecting smaller units. Also, agricultural information needed for estimating water use is typically available at the county level. The water supply conditions considered when delineating the regions included primary water sources used, relative availability of water and the presence or absence of current water supply problems or issues.

Also identified on Figure 2-1 are "Areas of Special Concern" (ASC), which are sub-regional areas that either have an identified water supply problem or are considered to be susceptible to

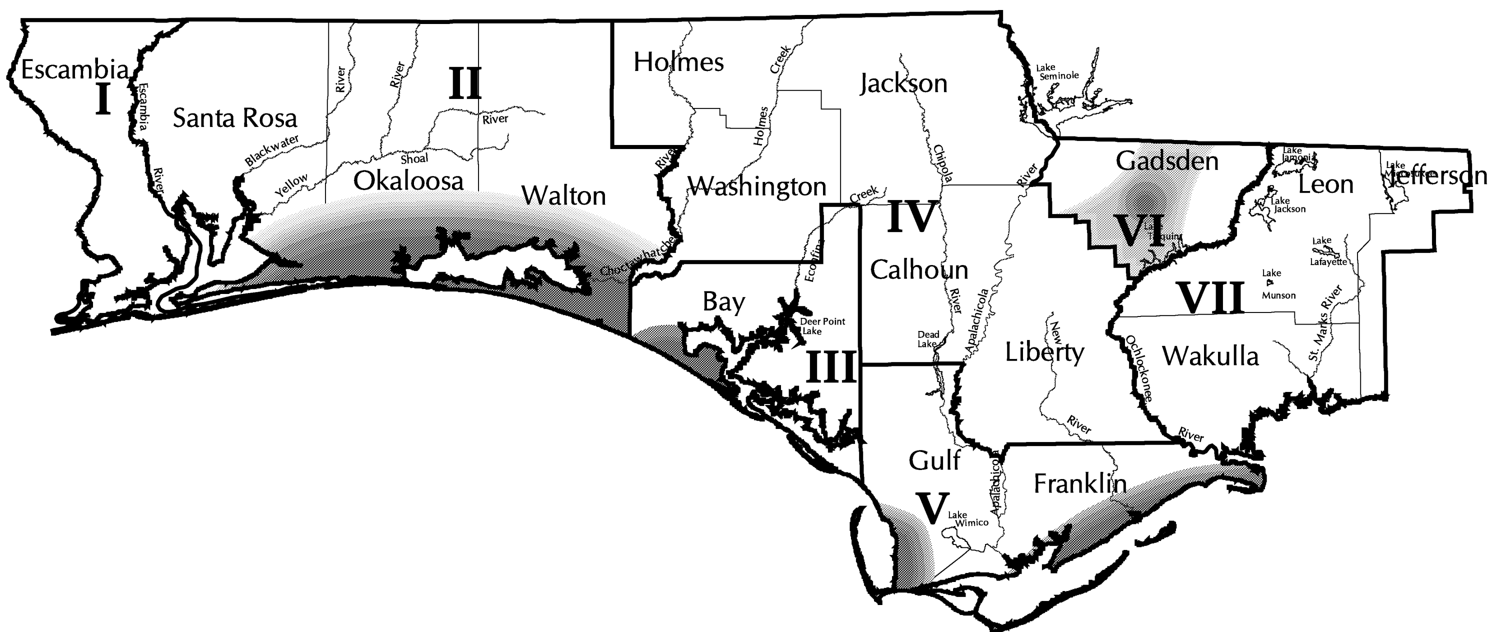
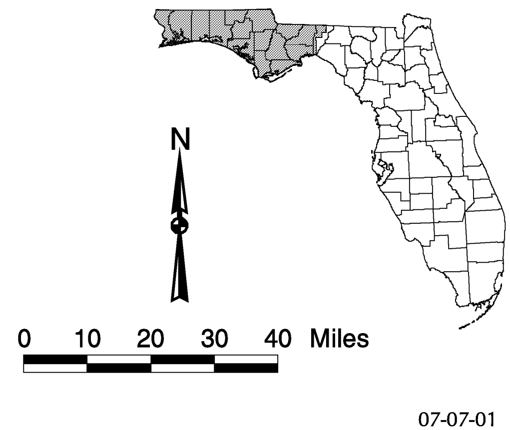


Figure 2-1
Northwest Florida Water Management District
Water Supply Planning Regions

I — Primary Water Supply Planning Region

Areas of Special Concern (ASCs)



development of future problems. This susceptibility is based upon either rapidly increasing demands, decreasing availability of existing water sources, or a combination of issues. Separate water demand projections were prepared for each ASC for the purposes of comparing the demand projections to the estimated amount of water available in the particular area.

Water Resource Caution Areas

In response to existing and anticipated water supply problems, the NWFWMD Governing Board has designated two Water Resource Caution Areas (WRCAs) and set more stringent water use permitting criteria in these areas. The designated Water Resource Caution Areas include the coastal area of Santa Rosa, Okaloosa and Walton counties and the Upper Telogia Creek drainage basin in Gadsden County (Figure 2-2).

The WRCA designation subjects all non-exempt withdrawals to more rigorous scrutiny to ensure that the proposed withdrawal does not result in unacceptable impacts to the resource. Permittees within a WRCA also have increased water use reporting requirements, must implement water conservation measures, and must improve water use efficiencies. They are also required to perform an evaluation of the technical, environmental, and economic feasibility of providing reclaimed water for reuse. The WRCA designation in the coastal areas of Santa Rosa, Okaloosa, and Walton counties also prohibits use of the Floridan Aquifer for non-potable purposes.

NWFWMD Water Supply Planning Programs

This document is the first assessment of its type for the entire 16-county area comprising the NWFWMD. Financial limitations had previously prevented the District from performing water supply work at the district wide level. However, the NWFWMD has been involved in water supply planning in priority areas for a number of years.

In the early 1980s, the NWFWMD utilized grant funds to develop a water supply assessment and plan for major coastal communities. The study culminated in November 1982, with the release of a report titled: "Regional Water Supply Development Plan for the Coastal Areas of Northwest Florida" (RWSDP). The purpose of the plan was to identify alternatives for meeting the future water supply needs of the study area and to evaluate and rank the alternatives based on engineering and financial feasibility.

The final plan provided specific recommendations for water supply development in each of nine smaller planning units. In several of the areas, the existing supply was considered sufficient to meet the needs of the area through the year 2020. In other areas, where future needs were projected to be greater than available sources, specific recommendations regarding alternatives to supplement the existing supply sources were included.

The areas identified as the highest priorities for needs and sources planning and the development of alternative supplies were the coastal (southern) areas of Walton, Okaloosa, and Santa Rosa counties. Subsequent to the development of the RWSDP, the District has continued to work with state, regional, and local levels of government on a number of water supply planning and development efforts in these priority areas.

Over the years, the District has also performed numerous ground and surface water studies in other areas, many of which were performed in support of local government or utility water supply planning efforts.

Preparation of this document begins a new era of water supply planning in northwest Florida. The 1997 revisions to the water supply planning laws require the District to develop regional water supply plans for areas identified in this document as having inadequate supplies to meet the projected demands. Further, the District is required to update the *Districtwide Water Supply Assessment* every five years. These regular updates will help water managers identify potential problems far enough in advance to allow for the development and implementation of strategies to prevent water shortages and unacceptable resource impacts.

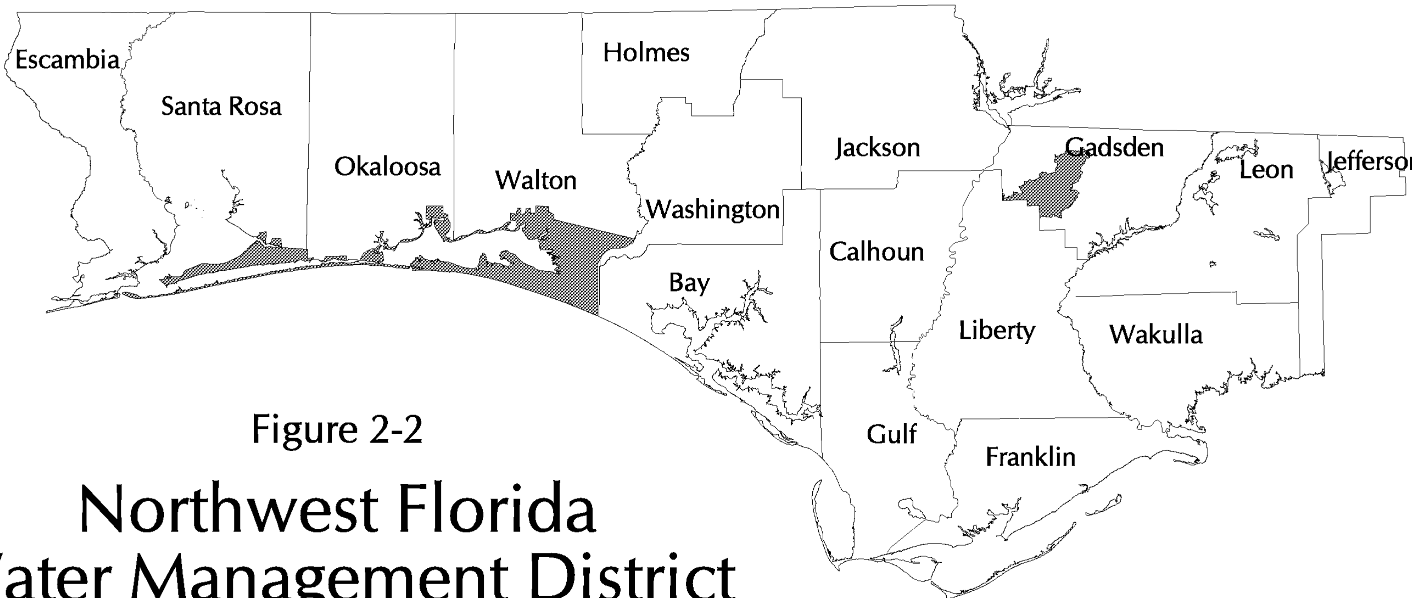
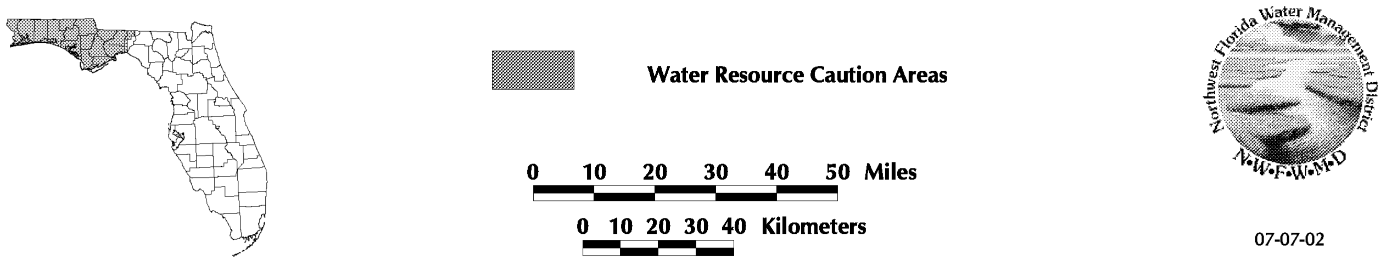


Figure 2-2

Northwest Florida
Water Management District
Water Resource Caution Areas



Note: This map was prepared for infomation purposes only and does not conform to National Map Accuracy Standards

Districtwide Water Use and Population Projections

For the purposes of water supply planning, water use is divided into six categories:

- Public Supply
- Domestic Self-Supply and Small Public Supply Systems
- Commercial-Industrial Self-Supply
- Agricultural Irrigation
- Thermoelectric Power Generation
- Recreational Irrigation Self-Supply

In 1995, total water use in northwest Florida was approximately 323.75 million gallons per day (Mgal/d) (Marella et al. 1998). As illustrated in Table 2-1, the largest use category in 1995 was the Public Supply category, with approximately 139.79 Mgal/d, or about 43 percent of the total water used.

Figure 2-3 illustrates the locations of the larger permitted water users (over 100,000 gallons per day permitted) in northwest Florida. As expected, the metropolitan urban areas of Pensacola, Fort Walton Beach, Panama City, and Tallahassee are the areas where much of the water use occurs. Agricultural Irrigation is concentrated in Jackson and Gadsden counties, while the larger Commercial-Industrial and Power Generation uses are scattered throughout the region.

By 2020, water use in the District is projected to increase by 35 percent, or approximately 114.67 Mgal/d over the 1995 amounts. As indicated in the "1995-2020 Percent Increase" column of Table 2-1, the rates of growth for some water use categories are quite substantial; however these rates should be considered in light of the actual quantities consumed in these categories.

Thus, the largest increases in amount of water needed are expected in the Public Supply and Commercial-Industrial Self-Supply categories (73.42 and 12.94 Mgal/d, respectively), while the largest rates of growth are expected in the Public Supply, Agricultural Irrigation and Power Generation categories.

The increases projected to occur in the Public Supply and Domestic Self-Supply and Small Public Supply System water use categories are attributable to projected increases in population within the NWFWMD. As illustrated in Table 2-2, districtwide population is projected to increase by 464,612 persons to a total of 1,596,888 by the year 2020; a 41 percent increase over the 1995 population. Population distribution between the water supply planning regions is not expected to change dramatically, with regions I, II, III and VII remaining as the largest population centers in northwest Florida.

If past trends continue, districtwide per capita water use is projected to increase slightly over the planning period, from 151 gal/d to 157 gal/d (Table 2-3). It should be noted that projections found in Table 2-3 were derived through a methodology that does not allow for the consideration of many factors that are known to affect per capita water use. These factors include increased water efficiency for new construction, implementation of various conservation programs by utilities and local governments, changes in the cost of water, and changing composition of use types (i.e., increased amounts of multi-family development). It is apparent that some of these factors are already resulting in per capita decreases in certain regions, and it is reasonable to assume that per capita water use in 2020 will be lower than amounts projected in Table 2-3.

Table 2-1 NWFWMD Total Water Use 1995 (Estimated) and 2020 (Projected), Percentages of Total by Category and Projected Increases

Water Use Category	Water Use 1995 Mgal/d	Percent of Total	Water Use 2020 Mgal/d	Percent of Total	Increase 1995-2020 Mgal/d	Percent Increase 1995-2020
Public Supply	139.79	43%	213.21	49%	73.42	53%
Domestic SS/Small Public Supply Systems	32.14	10%	41.35	9%	9.21	29%
Commercial-Industrial SS	112.45	35%	125.39	29%	12.94	12%
Recreational Irrigation SS	11.50	4%	16.47	4%	4.97	43%
Agricultural Irrigation	23.40	7%	35.27	8%	11.87	51%
Power Generation	4.47	1%	6.73	2%	2.26	51%
Total	323.75	100%	438.42	100%	114.67	35%

Table 2-2 NWFWMD Population 1995 (Estimated) and 2020 (Projected) by Water Supply Planning Region, Percentages of Total by Region and Projected Increases

Water Supply Planning Region	Population 1995	Percent of Total	Population 2020	Percent of Total	Population Increase 1995-2020	Percent Increase 1995-2020
I	282,742	25%	364,768	23%	82,026	29%
II	292,213	26%	442,351	28%	150,138	51%
III	139,200	12%	186,960	12%	47,760	34%
IV	101,833	9%	122,227	8%	20,394	20%
V	23,507	2%	39,558	2%	16,051	68%
VI	44,734	4%	52,719	3%	7,985	18%
VII	248,047	22%	388,305	24%	140,258	57%
Total	1,132,276	100%	1,596,888	100%	464,612	41%

Table 2-3 NWFWMD Per Capita Water Use* 1995 (Estimated) and 2020 (Projected) by Water Supply Planning Region

Water Supply Planning Region	Per Capita Water Use 1995 (gal/d)	Per Capita Water Use 2020 (gal/d)	Per Capita Change 1995-2020 (gal/d)	Percent Change
I	150	136	-14	-9%
II	137	152	15	11%
III	191	221	30	16%
IV	164	187	22	13%
V	151	139	-12	-8%
VI	128	142	14	11%
VII	147	154	7	5%
District Average	151	157	6	4%

* *Per capita water use is calculated by dividing Public Supply water use by the population served by public supply systems.*

Figure 2-3

Insert 11” x 17” Map

This water supply assessment has been developed as the first step of a districtwide resource planning and management program that will continue in the future. It is the first time that this level of comprehensiveness and detail has been applied to water supply planning for northwest Florida.

The purpose of the districtwide WSA is to determine whether intensified water supply planning in the form of a Regional Water Supply Plan is needed for a particular region. The overall approach to preparation of the assessment was to use as much existing information and institutional knowledge as possible to determine whether water supply problems exist or are likely to develop as a result of future demands. In general, the assessment approach consists of the following components:

- Estimation of future regional water needs
- Evaluation of regional water sources and conservation in relation to estimated needs
- Identification of regions that are in need of intensified regional water supply planning

Although much of the data used for the WSA was not originally gathered for this specific purpose, methods were developed to utilize existing information to the greatest extent possible. Limited data availability for some water uses make estimation of future needs for certain categories inherently difficult. Thus, it is recognized that the accuracy of the information provided in the WSA can be improved upon, and there is a commitment to work towards this end in the future. However, there is also a high level of confidence that this document identifies the water supply issues of greatest importance in northwest Florida and includes the appropriate recommendations for addressing these issues.

Future Water Needs Assessment

Two basic types of information are needed to prepare a WSA: projections of future water needs and information about availability of water from existing sources. Projections of future water needs are best prepared in a manner such that they can be located spatially, at least at a county level, but preferably at the point of withdrawal, or user level in areas where there are concerns about resource availability.

Because user-level water needs projections are not readily available from any single or consistent data source, the District requested assistance with the preparation of water supply needs projections from the U.S. Geological Survey (USGS) Tallahassee office. This USGS office has expertise with the compilation and analysis of water use information for the state of Florida and expressed interest in participating in development of the District's WSA. In January 1997, the District and USGS executed a Joint Funding Agreement for a project titled "Projected Water Demands by Planning Unit in the Northwest Florida Water Management District, 2000-2020."

The agreement with the USGS stipulated that water needs projections would be prepared for the Public Supply, Domestic Self-Supply and Small Public Supply Systems, Commercial-Industrial Self-Supply, Recreational Irrigation and Thermoelectric Power Generation water use categories. Since projection of agricultural water use requires specialized application of agriculture data sets, the District contracted with the Institute of Food and Agricultural Sciences (IFAS) at the University of Florida to develop projections for the Agricultural Irrigation water use category.

Source Assessments

The water supply source assessments were prepared by staff from the District's Resource Management Division using existing best available information. Highly detailed assessments of localized conditions and development of new models for evaluation of water supply sources were considered to be unnecessary for determining the regional water supply planning needs for a particular area. For the water resource and water supply situations that exist in northwest Florida this determination can be made with relatively basic, readily available information. Where advanced ground and surface water models exist, they were used in the WSA, but water availability in some areas had to be estimated using relatively basic techniques.

Methodologies Used

The specific methodologies used for preparing the water demand projections are found in the next section (Section IV) of this report. Methods and information used for each regional source evaluation are described in the individual planning region assessments found in Section V.

General Assessment Criteria

After water demand projections and source evaluations are developed, these two components are compared to determine whether the existing sources can provide enough water for future needs while sustaining water resources and related natural systems. To make this determination, specific resource-oriented criteria must be considered to assess potential impacts. In general, this requires developing an understanding of how excessive water withdrawals from existing sources would manifest themselves in terms of resource impacts. This information can be used to make a general determination of the amount of water that is available from existing sources and whether projected demands would approach or exceed these amounts.

The criteria used to assess sustainability of water supply sources vary from region to region due to regional differences in hydrology. For example, excessive withdrawals from the Floridan Aquifer in Region VII would likely impact (reduce) spring flows in the region, while excessive withdrawals from the Floridan Aquifer in coastal areas of Regions II, III, and IV would likely cause saltwater intrusion. Surface water sources such as Deer Point Lake in Region III and Quincy Creek in Region VI also require assessment criteria much different than those used for ground water sources. Thus, the specific assessment criteria used to evaluate sustainability of water supply sources are identified in the individual Planning Region Assessments found in Section V.

Assumptions and Considerations

The preparation of future water needs projections and assessments of current and future water supply conditions for a 16-county area are enormous undertakings. The number of individual water use permits in northwest Florida, combined with other factors, necessitated the development of methods specific to the task at hand. The methods employed to project future water needs may render the information presented herein inappropriate for other applications. Users are cautioned that the use of these data for other than the intended purposes could result in inappropriate or inaccurate results. A brief discussion of some of the specific considerations and constraints on the use of this information follows.

Unconstrained Aggregate Projections

Public Supply water use is the largest and fastest growing of the six water use categories. Thus, it is important that the projections for this category be as accurate as possible while also ensuring that the projections are prepared in a consistent manner between utilities. Some utilities have very sophisticated data gathering programs to determine how the water they sell is being used, while others may know little more than how much water was pumped on a daily basis.

These types of data discrepancies, coupled with the need to project water demands for approximately 100 individual utilities, required the District and the USGS to employ an economical method for making projections within the allotted time. In the selection of a projection method, it is important to make the best possible use of available information and to ensure that the method is sufficient for the particular application or final use of the results (Jones 1984). The methodology used to project future water needs for the Public Supply water use category meets these criteria. It uses the best possible information that is available on a consistent basis for all utilities in northwest Florida and it projects future water needs in a manner consistent with the requirements of Chapter 373, F.S. (“reasonably anticipated future needs”).

A detailed explanation of the methodology for projecting Public Supply needs is contained in Section IV. In general, the method uses past water use trends to estimate future needs in an aggregate, unconstrained manner. Because the method examines water use in aggregate for each utility, it is not possible to determine the amount of water distributed by a utility to each type of user (residential, commercial, industrial, landscape irrigation, etc.) connected to the system. The resulting projections are insensitive to differing community structures or water use patterns. Certain trends in communities, such as an increase in multi-family housing are ignored and contributions from non-residential uses are assumed to remain steady in proportion to residential use (Jones 1984).

When used in projecting water use, the term "demand" is often defined as a schedule of the quantities that consumers would use per unit of time at particular prices per unit of water used (Kindler 1984). However, the projections prepared for this WSA are considered to be "unconstrained demand" since they do not consider institutional, economic and social considerations that could change the rates of water use over time in response to the price of water. Therefore, the method does not account for demand reductions that would result from increased conservation practices, changes in water rates and other socioeconomic factors.

These projections can provide a good starting or comparison point for other applications, but should not be used as the sole source of information for applications that may result in a large expenditure of funds or may impact public health and safety.

Utility Service Areas

This project used utilities as the reporting unit and combined the water needs projections into countywide and regional totals. While many utilities are owned by and have the same name as municipalities, their service areas rarely match municipal boundaries. Municipally-owned water utilities sometimes do not serve the entire area within the jurisdiction, and often serve areas outside of the municipal boundaries. Therefore, direct comparisons of the population data herein with municipal population data may not produce consistent results.

Utility service areas also tend to expand due to growth or go through changes due to acquisitions, sales and mergers. The methods employed for the WSA cannot anticipate these types of changes or reflect specific service area changes that occurred in the past. The methods simply project a trend that is observed from past water use. If service area expansions would be needed to accommodate the projected growth, it is assumed that these would occur.

Additional Data and Source Assessment Needs for Regional Water Supply Plans

The information contained herein can be considered a good starting point toward the development of any regional water supply plans (RWSPs) needed in northwest Florida. However, the development of regional water supply plans will require considerable refinement of the information contained in the WSA. Because RWSPs must fully evaluate the environmental and economic costs and benefits of various water supply alternatives, more detailed information will need to be acquired for use in this analysis and to determine a recommended course of action.

In terms of future water needs, more specific information will need to be gathered concerning the composition of utility water users by use type (residential, commercial, industrial etc.) for each utility. Also needed will be socioeconomic information that can be used to assess demand management alternatives.

Additional water supply source information needed for a RWSP would include an improved source assessment, using more advanced techniques such as regional and subregional ground water models and/or surface water models, as appropriate. These would be used to more accurately define the amounts of water available from existing sources on a sustainable basis and to more accurately define when alternative sources will be needed. Improved information on the status of water conservation and water reuse measures would also be needed to determine whether, and to what extent, these alternatives could be more fully utilized as alternative "sources" of water.

IV. METHODOLOGY OF DEMAND PROJECTIONS FOR ALL WATER USE CATEGORIES

Overview

This section of the WSA describes the methodologies used to project future water demands for the six individual water use categories. It includes detailed descriptions of the methodologies used to project average water demand through the year 2020. Also included are descriptions of the methods used to determine water needs during a 1-in-10 year drought to address the “level-of-certainty planning goal” of meeting the water supply needs of existing and future reasonable-beneficial uses during this type of drought condition.

Demand Projection Methodologies

As discussed in Section III, the water demand projections for the Water Supply Assessment were prepared by the U.S. Geological Survey (USGS) and the University of Florida Institute of Food and Agricultural Sciences (IFAS) using methodologies developed by the contractors. Summaries of the specific methodologies for projecting average water demand are provided below. The summaries of all categories except Agricultural Irrigation were extracted from the USGS report (Marella 1998). More specific information about these methods and the data sources used can be found in the reports prepared by USGS and IFAS (Marella 1998 and Moss and de Bosisco 1998).

Public Supply

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 of the most widely used curves for this type of process 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) and time are related in some manner. The first three 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. The remaining three curves are all asymptotic; they all change in relation to a fixed value that they neither exceed nor fall below, yet get ever closer to. The assumption inherent in these three 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, thereby eliminating those curves that produced extreme or unrealistic results. 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 produced for each curve. Input criteria measure how closely the assumptions made in the curve's changes correspond to changes in the actual historic data. For this study, the CRV was chosen as the input statistic. This number 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 varying data can be compared. While input criteria measure discrepancies between the changes in the predicted values, output criteria measure the discrepancy between the actual values with the predicted values. The output statistics include the MSE, SEE and the MAPE. The MSE and SEE are measures of how well the predicted values correlate to the actual values. The MAPE is also 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 five-year increments beginning with 1970. Generally, the U.S. Census Bureau (USCB) has the most reliable and comprehensive data available, and it was the primary source for these population projections but is only available every ten years.

The mid-decade population numbers are derived from the University of Florida Bureau of Economic and Business Research (BEBR). For all mid-decade population figures collected, the most recent data available is used. With the exception of 1995, only mid-Census estimates that were calculated after the following Censuses were used. Thus, the 1975 and 1985 population data are from the 1981 and 1991 Florida Statistical Abstract (University of Florida 1981 and 1991). Though 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 have small differences 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 are 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 USCB and BEBR and extrapolating it into the future in five-year increments. The six curves mentioned 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 published by BEBR in the county comprehensive plans, or from any other sources. After further scrutiny, the projection was either accepted or rejected. If rejected, the process would begin again without the first curve chosen. Estimates of the population within the ASC portion of the county were made by using the percent of the public supply population served within the ASC from the total population served within the county.

Public Supply Population Served Projections

Population served projections were made using historical population-served data in five year increments. Either five (1975, 80, 85, 90, and 95) or six (1970, 75, 80, 85, 90, and 95) data points were used, depending on available data. For utilities that did not supply water before 1975, as many data points as were available were used to estimate the future population served. Data came primarily from the USGS water use data base (five- year assessments), but were also derived from service connections multiplied by people per household, FDEP Sanitary Surveys, BEBR, NWFWMD water use permit data base, or from other sources. If the historical population served data were missing for one of the 5 or six data points (years), the 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. If the per capita 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 six (1991, 92, 93, 94, 95, and 96), nine (1988, 89, 90, 91, 92, 93, 94, 95 and 96), or 12 (1985, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, and 96) year periods between 1985 and 1996. The period selected (six, nine or 12 years) was based on the reliability of the data and the pattern of water use for the utility. The projections were made by fitting a curve to the historical data and extrapolating it. The appropriate curve was selected by statistical analysis and past trends, and was compared against those provided by the utility (if they 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 within each county and ASC. 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 was generated per utility. The per capita value was used to help verify the utility population served and water use projection. If the estimated per capita value was less than 100 gal/d or more than 200 gal/d, then the projection variables were re-examined and recalculated if needed.

Peak day, monthly peak, and three-month peak 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, monthly peak, and three-month peak) and multiplying it by the projected annual daily average. The peak day, monthly peak, and three-month peak were obtained from the historical records of the utilities contacted through the public supply questionnaire or from the FDEP monthly operating report (MOR) files, and for the smaller utilities where data was not available, the county average was applied.

The value used as the ratio for each (peak day, monthly peak, and three-month peak) was the highest ratio of the particular peak to that year's annual daily average since 1985. Using the ratio between the annual daily average and the monthly peak and the three-month peak accommodated for seasonality as these values reflect the increase in the use of public supply water caused by lawn watering, seasonal population and daily visitors. Due to the fact that the water demand increase caused by lawn watering, seasonal population, and daily visitors occur during the same time of the year (May through September), it would be difficult to differentiate the demand for lawn watering or visitors out of the total. This assumes that the ratio between the annual average daily use and peak day, monthly peak, and three-month peak will remain the same and that all peak events will occur at approximately the same time of year. To verify these values, the trend in ratios was examined and anomalies were omitted (based on contact with the utilities).

Domestic Self-supply and Small Public Supply Systems

Projections for Domestic Self-Supplied and Small Public Supply Systems populations were made by subtracting the county population on Public Supply from the total county population. This assumes the remaining population to be self-supplied or served by small public supply systems that are below the 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-Supply

Projections for the 14 major self-supplied commercial-industrial facilities were provided directly by the users. Peak day, monthly peak, and three-month peak values were projected using a calculated ratio between the actual peak value per facility for each (peak day, monthly peak, and three-month peak) and then multiplying it by the projected annual daily average. The 14 Commercial-Industrial Self-Supplied Systems inventoried and projected individually include, Arizona Chemical (Bay County), Champion International Paper (Escambia County), Solutia Incorporated (Escambia County), Pensacola Naval Air Station (Escambia County), Eglin Air Force Base (AFB) (Okaloosa County), Hurlbert AFB (Okaloosa County), Sterling Fibers (Santa Rosa County), Air Products Incorporated (Santa Rosa County), Purdue Farms (Walton County), Stone Container Incorporated (Bay County), Arizona Chemical (Gulf County), Florida Coast Paper Company (Gulf County), Quincy Farms (Gadsden County), and Primex Technologies Incorporated (Wakulla County). Values for the remaining users in this category were assumed to stay at current (1995) demand with no changes.

Recreational Irrigation

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). Those in coastal counties (Bay, Escambia, Franklin, Gulf, Okaloosa, Santa Rosa, and Walton) used 30 inches per acre and those in inland counties (Calhoun, Gadsden, Holmes, Jackson, Jefferson, Leon, Liberty, Wakulla, and Washington) used 21 inches per acre. 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 were obtained from the master list of golf courses compiled 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 1996). 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 was made for each county. A ratio of people per golf course hole was developed for 1995 and applied to project additional water demands for this category. The people per hole ratio was calculated by dividing a county's total population by the total number of golf course holes in that county for 1995. This ratio was then multiplied by the projected population to determine the additional number of golf course holes per county. The number of holes were 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.

Agricultural Irrigation

Future water demand projections for Agricultural Irrigation were prepared by the University of Florida IFAS. The projections were developed through application of economic theory to historical agricultural trends. This work included development of historical estimates of agricultural water use in the NWFWMD from 1970 through 1995 and projection of future water needs through 2020. Historical water use was derived from data available from the Census of Agriculture, the Florida Agricultural Statistical Service and pumping records maintained by the NWFWMD. Using the historic data set with input and output price data, cost of production data and observed crop yields in the counties, a profit function was used to derive estimates of the investment in irrigation over time. This investment, along with the estimated shares of crops also derived from the profit representation, was then used to forecast the total water demand (Moss and de Bosisco 1998).

Thermoelectric Power Generation

Projections for the five major power plants were provided directly by the users. This includes the Crist (Escambia County), Schotz (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 ten years (no information was available beyond then). The Purdom Plant is in line to be expanded over the next five years, and reported projections for this facility from the City of Tallahassee reflect this change. Projections provided for each facility include demands for both fresh and saline water; however, only the freshwater demands were included in the tables. Most of the fresh water as well as all of the saline water withdrawn for power generation is used for once-through cooling, and all of this water is returned to its source.

Level-of-Certainty Analysis for Assessing Drought Condition Water Demands

With the passage of Chapter 97-100, Laws of Florida during the 1997 Legislative Session, the Florida Legislature placed a series of new water supply planning requirements into Chapter 373, F.S., including a section that states:

> "*The level-of-certainty planning goal associated with identifying the water supply needs of existing and future reasonable-beneficial uses shall be based upon meeting those needs for a 1-in-10 year drought event*." (Section 373.0361(2)(a)1., F.S.)

Although this requirement is found in a section of the statute that deals with regional water supply plans, there is agreement between the water management districts that this planning goal should also be considered in the districtwide water supply assessments.

During drought events, certain factors come into play when determinations must be made concerning availability of water to meet the needs of both permitted users and the natural systems. First, in drought conditions, demands will increase for certain water uses such as Agricultural Irrigation and outdoor water use (landscape irrigation). Indoor water uses, Commercial-Industrial and Thermoelectric Power Generation uses do not tend to increase as a result of drought conditions.

Second, in certain circumstances, drought conditions can reduce the amount of water that is available for withdrawal from a given source without causing harm to natural systems. This tends to be most applicable to surface water supply sources (rivers and lakes/reservoirs) and aquifers that, because of their geologic characteristics, tend to fluctuate widely in response to short-duration climatic events.

Estimating the increased water needs during drought conditions is relatively easy for the Agricultural Irrigation and Recreational Irrigation water use categories; however, the increased demands are quite difficult to estimate for outdoor water use associated with the Public Supply and Domestic Self-Supplied and Small Public Supply Systems categories. The methods used in this assessment to analyze drought condition water demands are described below.

Public Supply and Domestic Self-Supply and Small Public Supply Systems

Developing accurate estimations of increased water needs during drought conditions for the Public Supply and Self-Supplied Domestic/Small Public Supply Systems water use categories is difficult because the increases are often the result of numerous factors that may or may not be related to one another. For example, pumpage data for coastal communities in northwest Florida usually reflects increased water demand during the month of May. This increase in demand is the result of a number of factors including increased landscape irrigation due to typically dry weather; increased population (tourists, some staying in hotels/condos and some "day trippers" who don't stay overnight); and increased other outdoor water uses (car, boat, and pet washing, water play, swimming pools, etc.). An extensive set of water use data is needed to accurately estimate which combination of these factors cause water demand increases which are "typical" (not related to drought), and which increases are attributable to a drought situation. This data set would require disaggregation of the total water use for each utility to determine how much water is used for indoor use versus outdoor use.

Appropriate data are not available to accurately estimate the 1-in-10 year water demands for the Public Supply and Self-Supplied Domestic/Small Public Supply Systems water use categories in northwest Florida. However, guidance on this issue was provided by the 1-in-10 year Drought Subcommittee of the statewide Water Planning Coordination Group. This subcommittee, composed of staff from the five water management districts and the FDEP, examined alternative methods for estimating drought related demand increases. The committee concluded for the Public Supply and Domestic Self Supply and Small Public Supply Systems water use categories, that a factor of six percent above average yearly demand would suffice for the purposes of the WSA (Vergara 1998).

Thus, calculation of drought related demand increases for the Public Supply and Domestic Self- Supply and Small Public Supply Systems water use categories was accomplished by increasing the projected average demands by six percent.

Agricultural Irrigation

The 1-in-10 year Agricultural Irrigation rates for each crop grown in the District were generated by the AFSIRS model (Smajstrla 1986), using Orangeburg soil (typical for northwest Florida agriculture) and typical climactic conditions for inland areas of northwest Florida. These rates were then applied to the crop acreage projections for each county that were developed by IFAS (1998) for the years 2000, 2005, 2010, 2015, and 2020.

Recreational Irrigation

Golf course irrigation is the only water use projected for this category. The 1-in-10 year irrigation rates generated by the AFSIRS model (Smajstrla 1986) for golf course fairways were applied to golf course acreage projections for each county that were developed by USGS (Marella et al. 1998) for the years 2000, 2005, 2010, 2015, and 2020. Two different application rates were used depending upon the location of the golf courses. Golf courses in coastal counties had a 1-in-10 year irrigation rate of 36 inches/acre/year, while those in inland counties had a rate of 25 inches/acre/year.

V. WATER SUPPLY PLANNING REGION ASSESSMENTS

Section V contains detailed water supply assessment information for each of the seven Water Supply Planning Regions in the NWFWMD. The planning regions were delineated as single or multiple counties based upon similarity of water supply conditions such as primary water source used, relative availability of water and the presence or absence of current water supply issues.

The water supply assessments provide regional overviews, 1995 existing legal water use and projected future water supply demands through 2020. Water use figures are provided in five-year increments by both county and water use category (Public Supply, Domestic Self-Supply and Small Public Supply Systems, Commercial-Industrial Self-Supply, Recreational Irrigation, Agricultural Irrigation, and Thermoelectric Power Generation). In addition to demand projections, the regional water supply assessments also examine the ability of existing and reasonably-anticipated sources of water and conservation efforts to meet identified future demands while sustaining natural systems. Table 5-1 provides a summary of information contained in Section V including size, population, water use information by county and region, and primary water source.

Table 5-1 NWFWMD Water Supply Planning Regions Summary

Region (Counties)	**Square Miles**	**Population**		**Total Average Water Use (Mgal/d)**		**Primary Water Source**
		1995	**2020**	**1995**	**2020**	
Region I						Sand-and-Gravel Aquifer
Escambia	762	282,742	364,768	84.99	101.12	
Region I Total	762	282,742	364,768	84.99	101.12	
Region II						
Santa Rosa	1,152	96,091	162,475	20.21	33.25	Floridan Aquifer/Sand-and-Gravel Aquifer
Okaloosa	998	162,707	229,567	30.86	46.67	
Walton	1,135	33,415	50,309	7.79	13.00	
Region II Total	3,285	292,213	442,351	58.86	92.92	
Region III						
Bay	861	139,200	186,960	56.56	72.08	Deer Point Lake
Region III Total	861	139,200	186,960	56.56	72.08	
Region IV						
Calhoun	576	11,988	15,090	3.92	7.64	Floridan Aquifer
Holmes	490	17,385	21,920	4.78	6.63	
Jackson	938	46,577	49,696	17.26	25.56	
Liberty	845	6,873	10,248	1.63	2.87	
Washington	611	19,010	25,273	4.24	5.67	
Region IV Total	3,460	101,833	122,227	31.83	48.37	
Region V						
Gulf	578	13,271	19,432	30.51	31.21	Floridan Aquifer/Surficial Aquifer/Chipola River
Franklin	565	10,236	20,126	1.77	3.24	
Region V Total	1,143	23,507	39,558	32.28	34.45	
Region VI						Floridan Aquifer/Telogia Creek/Quincy Creek
Gadsden	528	44,734	52,719	12.50	15.78	
Region VI Total	528	44,734	52,719	12.50	15.78	
Region VII						
Jefferson	609	13,509	16,980	6.64	8.08	Floridan Aquifer
Leon	696	217,533	332,610	37.10	58.79	
Wakulla	635	17,005	38,715	3.00	6.83	
Region VII Total	1,331	248,047	388,305	46.74	73.70	
Total	11,370	1,132,276	1,596,888	323.75	438.42	

REGION I: ESCAMBIA COUNTY

Region-at-a-Glance		
	1995	2020
Population:	282,742	364,768
Average Water Use (Mgal/d):	84.99	101.12
Primary Source:	Sand-and-Gravel Aquifer	
Regional Water Supply Plan Recommendation:	No plan needed	

Overview

Water Supply Planning Region I consists of Escambia County. The region's population is concentrated in the southern portion of the county along the Perdido, Escambia and Pensacola bays, and the Gulf of Mexico. The county is fairly rural, with the majority of people residing in unincorporated areas. Although forestry is an important component of the regional economy, major employment sectors are services and retail trade with a significant amount of employment attributed to the Pensacola Naval Air Station.

Escambia County is the most industrialized area in the District and Commercial-Industrial is the largest water use category within the region. Public Supply is the region's other major water use category. The uses in Escambia County are dependent upon both surface and ground water, with ground water supplying the majority of all fresh water used in the region. Surface water is used primarily for Power Generation and Commercial-Industrial Self-supply. Because the Floridan Aquifer is brackish and highly mineralized in Escambia County, virtually all potable ground water is withdrawn from the highly productive Sand-and-Gravel Aquifer. The local rivers and bays in the region are the receiving waters of a large watershed area that extends well outside the region into Alabama and northwest Florida. The estuarine water resources of the region are almost entirely dependent upon surface water, with only minor contributions from ground water.

The coastal area of Escambia County was included in the District's 1982 Regional Water Supply Development Plan, and Escambia County is part of both the District's Ambient Background and Very Intensive Study Area (VISA) ground water monitoring networks.

Existing Water Use (1995)

Table 5-2 contains 1995 water use in Region I by water use category. In addition, Figure 5-1 depicts the general location of permitted water withdrawals within Region I greater than 0.1 Mgal/d.

Table 5-2 Region I: 1995 Water Use (Mgal/d)

	Escambia County
Public Supply	36.94
Domestic SS/Small Public Supply Systems	5.37
Commercial-Industrial SS	40.28
Recreational Irrigation	1.81
Agricultural Irrigation	0.14
Power Generation	0.45
Total	84.99

Public Supply

Public Supply is the second largest water use category in the region. In 1995, approximately 36.94 Mgal/d or 35 percent of regional water use was used for Public Supply. Escambia County Utilities Authority is by far the region's largest public supplier, with water use of approximately 32.11 Mgal/d in 1995.

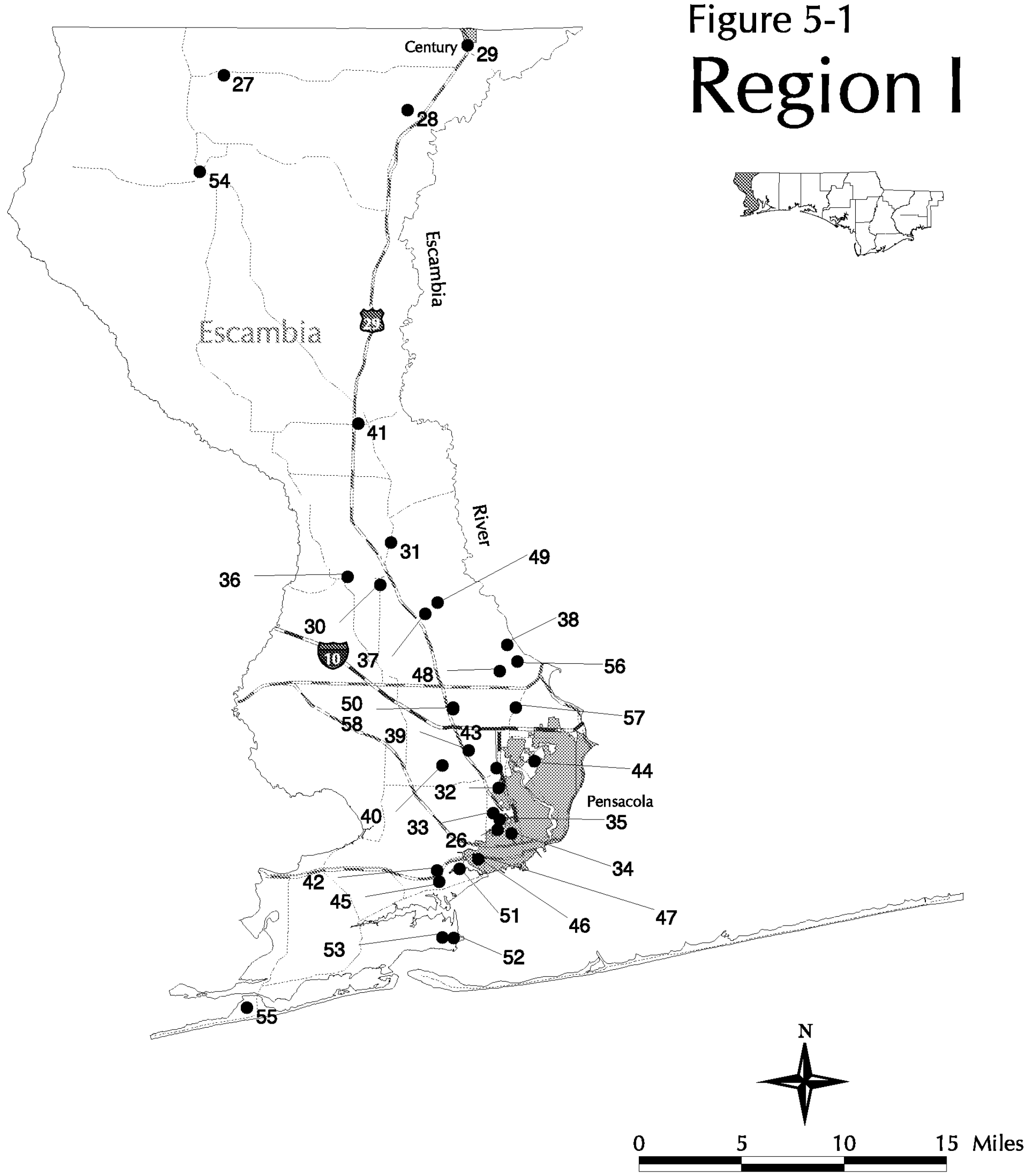
Domestic Self-Supply and Small Public Supply Systems

In 1995, Domestic Self-Supply and Small Public Supply Systems used an average of approximately 5.37 Mgal/d or five percent of the total amount of water used in Region I.

Commercial-Industrial Self-Supplied

Commercial–Industrial Self-Supplied is the largest water use category in Region I, accounting for approximately 62.33 Mgal/d or 59 percent of average regional water use in 1995. The primary water user in this category is Champion International (29.43 Mgal/d). Solutia Incorporated (formerly Monsanto Company) withdrew approximately 31.952 Mgal/d in 1995. Most of the 22.05 Mgal/d of surface water was used for direct, once-through cooling and returned to the

Figure 5-1
Region I



This map is for planning purposes only.
Withdrawal locations are approximate.

07-07-03

1995 Permitted Average Daily Rates (ADR) Greater Than 0.1 Mgal/d

(See following page for map key)

Figure 5-1 Map Key

Index #	Permit #	Name	Primary Use*	Permitted ADR (gal/d)	Aquifer/ Surface Water	Source
26	870196	Baptist Hospital	LA	317,740	Sand-and-Gravel	GW
27	870030	Bratt-Davisville Water System	PS	240,000	Sand-and-Gravel	GW
28	920037	Central Water Works	PS	294,000	Sand-and-Gravel	GW
29	830005	Town of Century	PS	474,357	Sand-and-Gravel	GW
30	850014	Champion International	PS	27,500,000	Sand-and-Gravel	GW
31	940061	Cottage Hill Water Works	PS	356,000	Sand-and-Gravel	GW
32	930032	CSX Transportation	AR	100,800	Sand-and-Gravel	GW
33	940069	FDEP	AR	172,800	Sand-and-Gravel	GW
34	950003	FDEP	AR	166,000	Sand-and-Gravel	GW
35	830083	Escambia County Utilities Authority	PS	44,700,000	Sand-and-Gravel	GW
36	850145	Farm Hill Utilities	PS	389,000	Sand-and-Gravel	GW
37	840081	Gonzalez Utilities	PS	390,000	Sand-and-Gravel	GW
38	850074	Gulf Power Company	PP	243,600,000**	Sand-and-Gravel/ Escambia River	GW/SW
39	950020	Hartwig, Matteson and Mays	LA	108,000	Sand-and-Gravel	GW
40	900038	Marcus Creek Partnership	GI	171,000	Sand and Gravel/ Bayou Marcus Creek	GW/SW
41	830002	Molino Utilities	PS	599,000	Sand-and-Gravel	GW
42	841646	United States Navy (Corry Station)	PS	5,600,000	Sand-and-Gravel	GW
43	890035	Pensacola Christian College	LA	310,000	Sand-and-Gravel	GW
44	880066	Pensacola Junior College	LA	149,982	Sand-and-Gravel	GW
45	830018	Peoples Water Service	PS	2,360,000	Sand-and-Gravel	GW
46	870034	Reichhold Chemicals	IN	490,000	Sand-and-Gravel	GW
47	880145	Reichhold Chemicals	AR	432,000	Sand-and-Gravel	GW
48	870150	Scenic Hills Country Club	GI	233,000	Sand-and-Gravel/ Thompson Bayou	GW/SW
49	840091	Solutia, Inc.	IN	29,900,000**	Sand-and-Gravel/ Escambia River	GW/SW
50	910122	George M. Threadgill	AQ	123,120	Sand-and-Gravel	GW
51	940049	Department of Transportation	AR	1,728,000	Sand-and-Gravel	GW
52	950009	United States Navy	LA	200,000	Sand-and-Gravel	GW
53	950032	United States Navy	GI	516,000	Sand-and-Gravel/ Unnamed Pond	GW/SW
54	920036	Walnut Hill Water Works	PS	194,000	Sand-and-Gravel	GW
55	920045	William A. Welch	GI	211,000	Sand-and-Gravel	GW
56	830028	University of West Florida	PS	310,000	Sand-and-Gravel	GW
57	830041	West Florida Hospital	HS	100,000**	Sand-and-Gravel	GW
58	880205	Levelle Williams	NI	120,000	Sand-and-Gravel	GW

* AI= Agricultural Irrigation, AR = Aquifer Recharge, GI = Golf Course Irrigation, HS = Heat Pump Supply, IN = Industrial, LA = Landscape Irrigation, NI = Nursery Irrigation, PP = Power Production, PS = Public Supply, AQ = Aquaculture, GW = Ground water, SW = Surface Water

** Virtually all water returned to the source.

Escambia River and therefore not considered consumed for this report. For water supply planning purposes, only the amount of water withdrawn and not returned (approximately 9.90 Mgal/d in 1995) is considered consumed.

Recreational Irrigation

Recreational Irrigation water use accounts for a small percentage of the region's total water use. In 1995, an average of only 1.81 Mgal/d (two percent of average regional water use) was used for Recreational Irrigation. The major users of water for Recreational Irrigation within the region are golf courses located in Escambia County.

Agricultural Irrigation

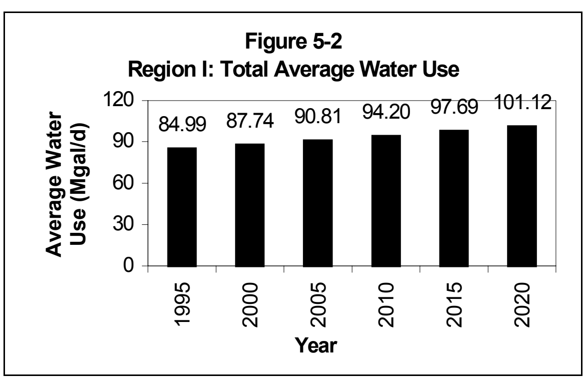
In 1995, less than one percent (0.14 Mgal/d) of regional water use was attributed to Agricultural Irrigation. The majority of Agricultural Irrigation was used for corn and nurseries.

Power Generation

Gulf Power Company's Crist Power Plant in Escambia County withdrew an average of approximately 164 Mgal/d in 1995. However, the majority of this surface water was used for direct, once-through cooling and returned to the Escambia River. For water supply planning purposes, only the amount of water withdrawn and not returned (approximately 0.45 Mgal/d in 1995) is considered consumed.

Reasonably-Anticipated Future Needs for Each Water Use Category Through 2020

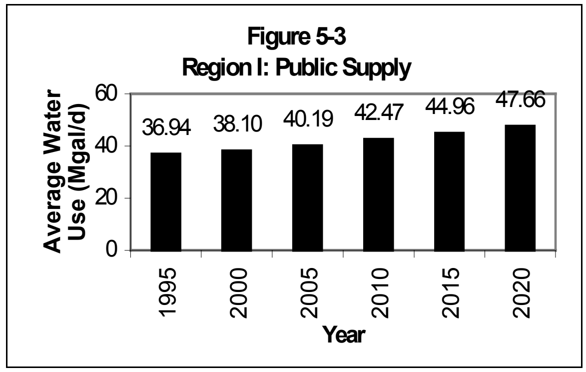
Average regional water use is projected to increase from approximately 84.99 Mgal/d in 1995 to 101.12 Mgal/d in the year 2020, an increase of approximately 19 percent (Figures 5-2



and 5-7). Commercial-Industrial is expected to be the largest water use category in the region through 2020.

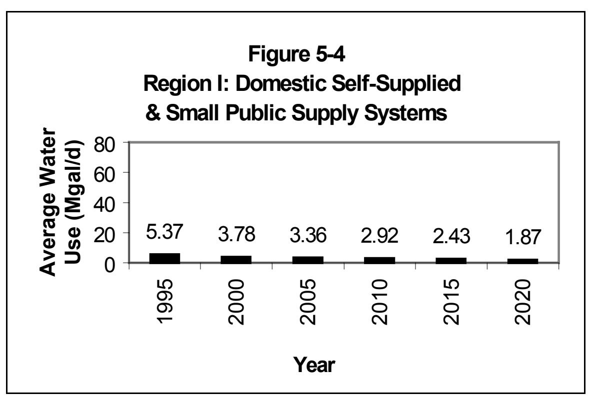
Public Supply

Water use projections suggest that Public Supply will continue to be a predominant water use within Region I through 2020. Regional water use projections indicate that use will increase approximately 29 percent from an average of 36.94 Mgal/d in 1995 to 47.66 Mgal/d in 2020 (Figure 5-3). Escambia County Utilities is expected to continue to account for the vast majority of regional Public Supply water use (Table 5-3).



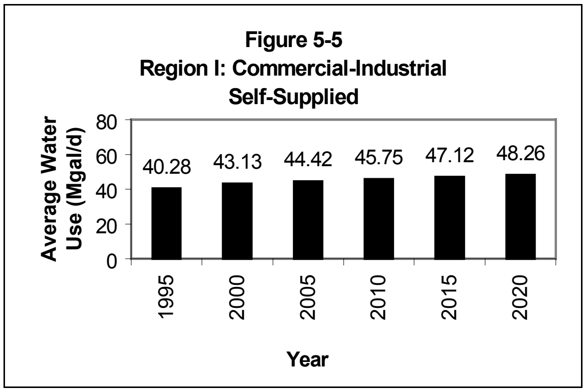
Domestic Self-Supply and Small Public Supply Systems

This water use category is projected to decrease approximately 65 percent between 1995 (5.37 Mgal/d) and 2020 (1.87 Mgal/d) (Figure 5-4). The projected decrease is due to historical trend away from Domestic Self-Supply and Small Public Supply Systems and towards larger Public Supply Systems.



Commercial-Industrial Self-Supplied

The Commercial-Industrial water use category accounts for the majority of water used in the region. Regional water use in this category is expected to increase approximately 20 percent or 7.98 Mgal/d between 1995 (40.28 Mgal/d) and 2020 (48.26 Mgal/d) (Figure 5-5).

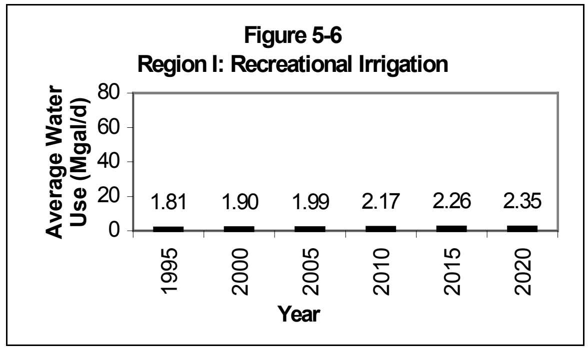


Recreational Irrigation

Recreational Irrigation includes water used for Golf Course Irrigation and accounts for only a small percentage of the region's total water use. Water use in this category is expected to increase by approximately 29 percent from 1.81 Mgal/d in 1995 to 2.35 Mgal/d in 2020 (Figure 5-6).

Agricultural Irrigation

Water used for Agricultural Irrigation in Region I is anticipated to increase from 0.14 Mgal/d in 1995 to 0.46 Mgal/d in 2020. Even though this is a large percentage increase for the category, the amount of water used for Agricultural Irrigation will still account for less than one percent of total regional water use in 2020.



Power Generation

Water withdrawn for Power Generation was approximately 164 Mgal/d in 1995 and is anticipated to increase to approximately 173 Mgal/d in 2020. However, because this report considers impacts to the resource, the figures reported here are for water that is actually consumed by Power Generation. For planning purposes, water is considered consumed when it is withdrawn and either not returned or not returned in the same location where it was withdrawn. Many power plants utilize surface water for once-through cooling, returning virtually all of the water to the point of withdrawal. Water consumption in the Power Generation category is expected to increase by approximately 16 percent from 0.45 Mgal/d in 1995 to 0.52 Mgal/d in 2020.

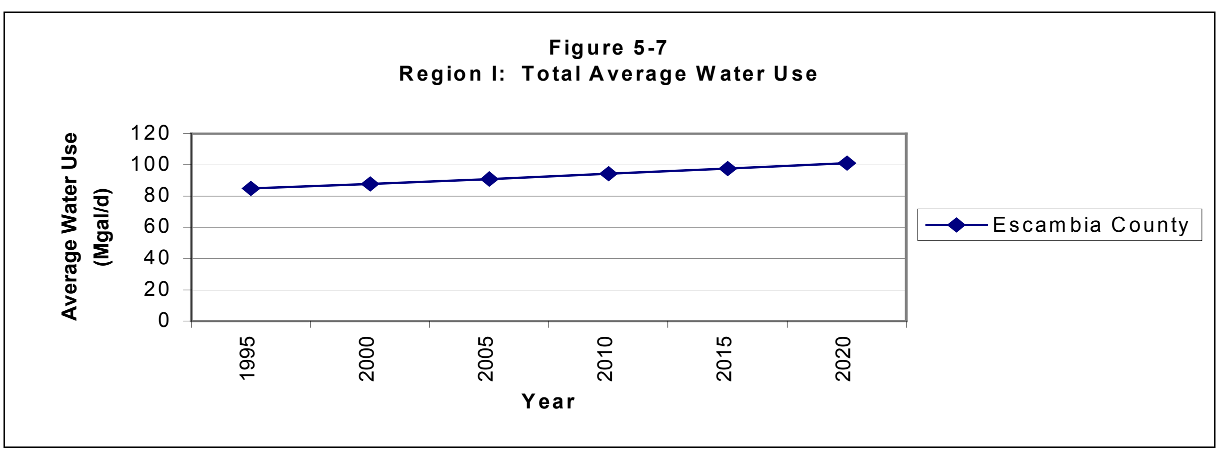


Table 5-3 Escambia County Water Demand Data (Water Amounts in Mgal/d)

Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	36.94	38.10	40.19	42.47	44.96	47.66
Domestic SS/Small Public SS	5.37	3.78	3.36	2.92	2.43	1.87
Commercial-Industrial SS	40.28	43.13	44.42	45.75	47.12	48.26
Recreation Irrigation	1.81	1.90	1.99	2.17	2.26	2.35
Agricultural Irrigation	0.14	0.37	0.37	0.39	0.41	0.46
Power Generation	0.45	0.46	0.48	0.50	0.51	0.52
Total	84.99	87.74	90.81	94.20	97.69	101.12
Large Public Supply System Water Use	1995	2000	2005	2010	2015	2020
Total population served	246,878	273,287	292,060	311,195	330,788	350,965
Percent of total population	87%	91%	92%	94%	95%	96%
Per capita (gal/d)	150	139	138	136	136	136
Average Daily Flow of Large Public Supply Systems (Mgal/d)	1995	2000	2005	2010	2015	2020
Utility						
Bratt-Davisville	0.20	0.26	0.31	0.39	0.51	0.67
Central Water Works	0.26	0.32	0.36	0.40	0.44	0.49
Century Utilities	0.51	0.54	0.66	0.79	0.91	1.03
Cottage Hill Utilities	0.33	0.32	0.33	0.35	0.36	0.37
Escambia County Utilities	32.11	32.85	34.29	35.72	37.16	38.60
Farm Hill Utilities	0.29	0.36	0.42	0.48	0.56	0.65
Gonzalez Utilities	0.39	0.44	0.50	0.57	0.64	0.73
Molino Utilities	0.58	0.68	0.80	0.91	1.03	1.15
Peoples Water System	2.08	2.13	2.32	2.65	3.13	3.75
Walnut Hill Water Works	0.19	0.20	0.20	0.21	0.21	0.22
Total	36.94	38.10	40.19	42.47	44.96	47.66

Source Evaluation

For virtually all uses within Region I, ground water is the traditional source of supply. Further, the vast majority of ground water is obtained from the main-producing zone of the Sand-and-Gravel Aquifer System. Given the high availability of ground water from the Sand-and-Gravel Aquifer and its high quality, it is reasonable to anticipate that this use pattern will continue through the year 2020. Accordingly, the water supply source evaluation presented here emphasizes the characterization of ground water availability from the Sand-and-Gravel Aquifer System.

Overview of Hydrologic System

The hydrostratigraphic framework of Region I consists of an alternating sequence of aquifers and confining units. These hydrologic units include the Sand-and-Gravel Aquifer System, the Intermediate System, the Floridan Aquifer System and the Sub-Floridan System. In Region I, the Surficial Aquifer is specifically referred to as the Sand-and-Gravel Aquifer due to its thickness, highly productive nature and its importance in meeting the local water supply demands.

Due to highly mineralized water in the upper and lower units of the Floridan Aquifer System and very low production potential from sand units within the Intermediate System, the Sand-and-Gravel Aquifer is the principal source of water for Escambia County. The good water quality and high availability of ground water from the Sand-and-Gravel Aquifer System make the Sand-and-Gravel Aquifer System the only aquifer of interest in regard to existing and reasonably anticipated water use.

The sediments that comprise the Sand-and-Gravel Aquifer System consist of quartz sand with some gravel, silts and clays. Low permeability clay units are interlayered with productive zones of sand and gravel. The Sand-and-Gravel Aquifer is up to approximately 350 ft thick in the southwestern portion of the county and thickens to approximately 530 ft in some areas of central and northern Escambia County.

In the southern half of the county, the Sand-and-Gravel Aquifer is divided into three significant hydrostratigraphic units. These units are the surficial zone, the low-permeability zone, and the main-producing zone. Specific capacity values range from seven to 77 gpm/ft for the Sand-and-Gravel Aquifer (Wilkins et al. 1985). The majority of water withdrawn from the Sand-and-Gravel Aquifer in Region I comes from the main-producing zone.

The surficial zone of the Sand-and-Gravel Aquifer consists mostly of fine to medium grained sand, with gravel beds and lenses (Randazzo and Jones 1997). The surficial zone typically exists under unconfined conditions. The water table represents the upper surface of the saturated sediments in the surficial zone. Clay beds within the overlying, generally unsaturated sediments can create "perched" water tables with elevated hydraulic heads.

The low-permeability zone is the first regionally-continuous semi-confining layer. The low-permeability zone consists of poorly sorted, intermixed clay, silt, and sand material. The thickness of this zone ranges from 20 ft to 100 ft within the region. The low-permeability zone impedes the flow of ground water between the surficial zone and the main-producing zone. The vertical hydraulic conductivity of the low-permeability zone was estimated to range between $1x10^{-4}$ ft/d and $1x10^{-2}$ ft/d in the northern half of Region I, and between $5x10^{-3}$ ft/d and $2x10^{-2}$ ft/d in the southern half of Region I. These estimates were based on the calibrated results of a regional ground water flow model (Roaza et al. 1993). A multi-well aquifer test on the main-producing zone yielded a measured value of the low-permeability zone vertical hydraulic conductivity of 0.25 ft/d (Roaza et al. 1993). The leaky nature of the low-permeability zone readily permits appreciable exchange of ground water between the surficial zone and the main-producing zone.

The main-producing zone is the portion of the Sand-and-Gravel Aquifer that is most extensively used in Region I for water supply. This unit is comprised of highly productive sand and gravel zones with inter-bedded clay layers. The productive sand and gravel zones are relatively free of clay and commonly yield more than 1,000 gpm to wells. Well yields can be as high as 2,500 gpm. A multi-well aquifer test yielded a transmissivity value of approximately 10,000 ft^2/d.

The Sand-and-Gravel Aquifer is underlain by the Intermediate System. The thickness of the Intermediate System ranges between 300 and 1,200 ft in Region I (Pratt et al. 1996). The Intermediate System is an effective, regional confining unit comprised of the lower portion of the Miocene Coarse Clastics and the Pensacola Clay lithostratigraphic units. However, the Intermediate System does contain a minor aquifer, the Escambia Sand member of the Pensacola Clay. Poor water quality and great depth make the Escambia Sand member an unused ground water source.

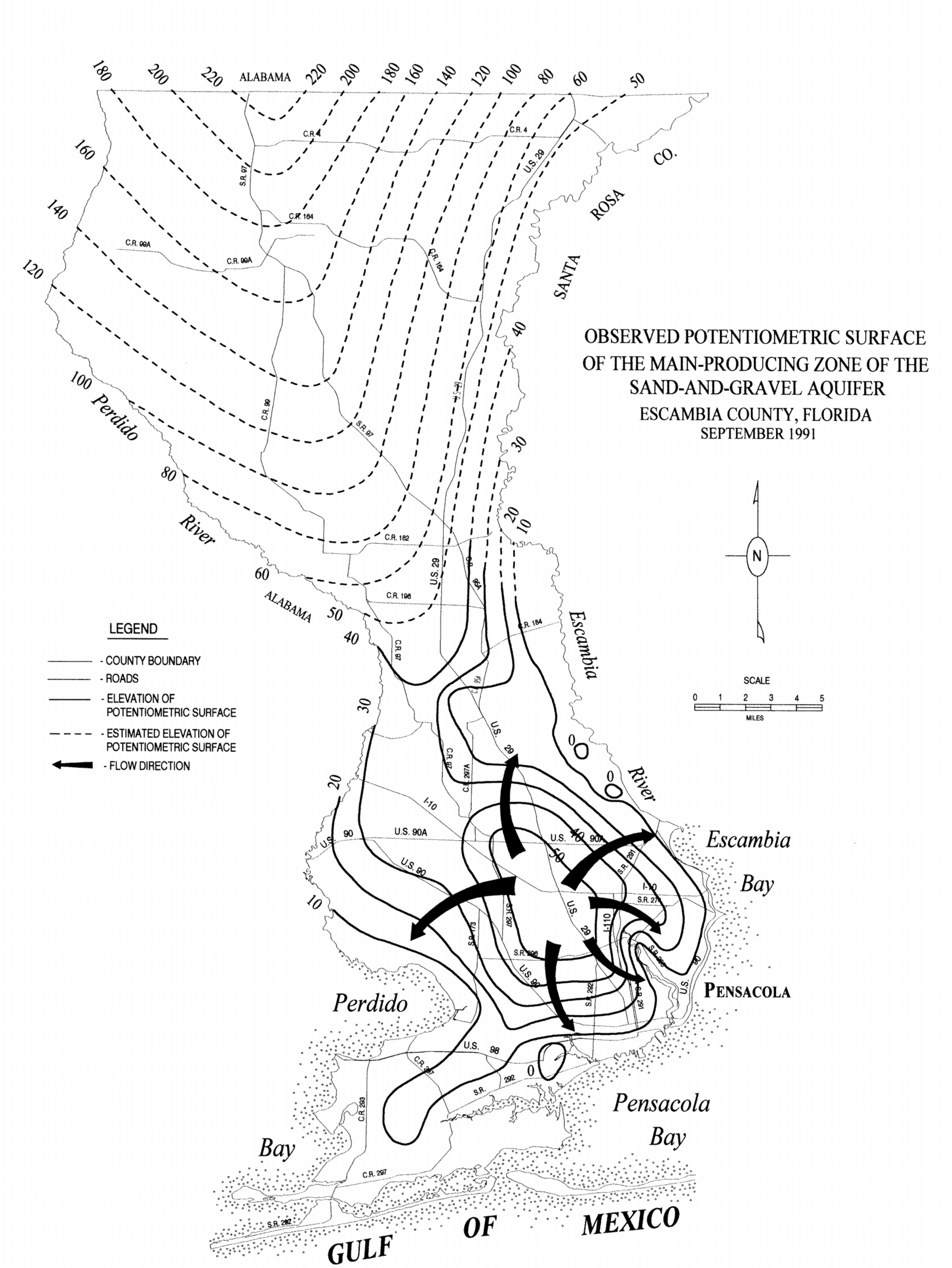
Below the Intermediate System is the Floridan Aquifer System. The Bucatunna Clay, a highly effective confining unit, separates the upper and lower carbonate units of the Floridan Aquifer System. Both the upper and lower Floridan Aquifer contain highly mineralized water. The top of the upper unit ranges from approximately 350 ft below sea level in the northeast to approximately 1,450 ft below sea level in the southwest. The lower Floridan Aquifer is hydraulically isolated from the potable water flow system and is used for injection of industrial wastes. Due to the depth of the upper Floridan Aquifer and the Floridan Aquifer's poor quality of water, the Sand-and-Gravel Aquifer, with its high availability of good quality ground water in wells less than 300 ft deep, is a much-preferred source in the region.

The Sub-Floridan System underlies and confines the Floridan Aquifer System. The hydraulic conductivity of this unit is considerably lower than that of the overlying Floridan Aquifer. The Sub-Floridan System forms the base of the Floridan Aquifer System.

Sand-and-Gravel Aquifer Water Levels

Throughout most of Region I, the elevation of the water table in the surficial zone of the Sand-and-Gravel Aquifer exceeds the elevation of the potentiometric surface of the underlying main-producing zone. Thus, most of the region is a recharge area for the underlying main-producing

Figure 5-8



OBSERVED POTENTIOMETRIC SURFACE
OF THE MAIN-PRODUCING ZONE OF THE
SAND-AND-GRAVEL AQUIFER
ESCAMBIA COUNTY, FLORIDA
SEPTEMBER 1991
LEGEND
- COUNTY BOUNDARY
- ROADS
- ELEVATION OF POTENTIOMETRIC SURFACE
- ESTIMATED ELEVATION OF POTENTIOMETRIC SURFACE
- FLOW DIRECTION
SCALE
0 1 2 3 4 5
MILES
N
ALABAMA
SANTA ROSA CO.
Perdido River
Escambia River
Escambia Bay
PENSACOLA
Perdido Bay
Pensacola Bay
GULF OF MEXICO

zone. In the vicinity of rivers, bays, and the Gulf of Mexico, a head reversal occurs. Here the hydraulic head in the main-producing zone exceeds that of the surficial zone. This results in upward leakage through the low-permeability zone and subsequent discharge into these surface water bodies.

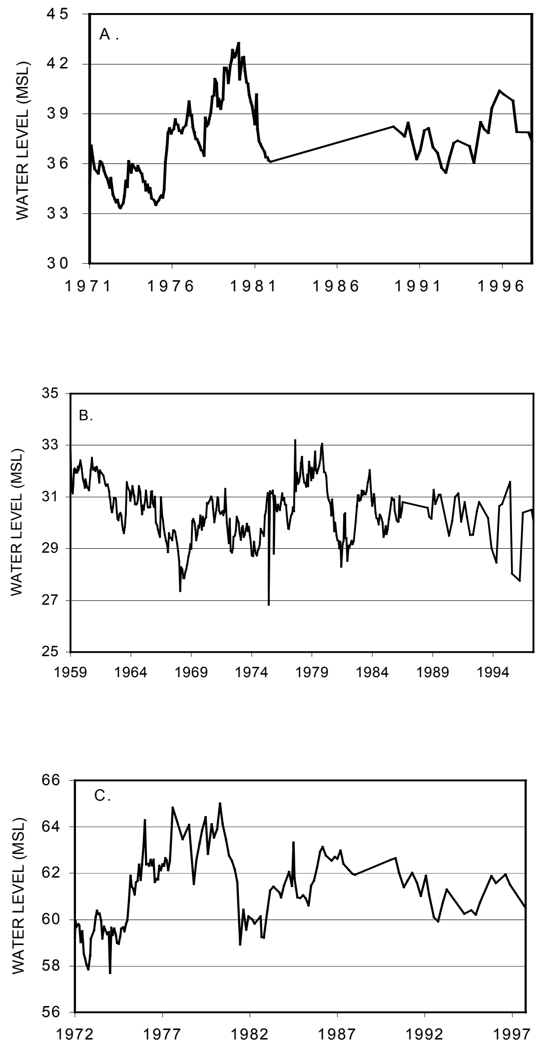
Region I is best conceptualized as two separate flow systems, the northern half of the county and the southern half. In the northern half of the region, the elevation of the potentiometric surface of the main-producing zone reaches a maximum height of approximately 220 ft above sea level. This maximum elevation is found in the north-central portion of the county. From this high, water levels decline to the east, west and south. The Escambia and Perdido rivers, which bound Escambia County on the east and west, are major discharge areas for the aquifer in the northern half of the region. To the south, additional ground water discharge occurs via pumpage at the Champion International wellfield at Cantonment. Other pumping wells also serve as minor discharge points for the main-producing zone in the northern portion of the county.

South of Cantonment, water levels in the main-producing zone rise, reaching a maximum elevation of about 50 ft above sea level near the intersection of I-10 and Highway 29. From this central potentiometric surface high, ground water elevations decline in all directions (Figure 5-8). Ground water moves to points of discharge, including the Champion International wellfield, the Perdido and Escambia rivers, Perdido Bay, and the Pensacola Bay System. In the southern half of the county, a significant quantity of water is also discharged by a number of major supply wells.

Hydrographs for three wells are presented to depict long-term trends in water levels measured in the developed southern half of the region (Figure 5-9). Data are presented for a well in Pensacola (USGS TH2), a well near Beulah (USGS 032-7241A), and a well near Cantonment (USGS TH13). Each of these wells is open to the main-producing zone of the Sand-and-Gravel Aquifer.

Two wells (USGS TH2 and USGS TH13) have approximately 25 years of data. The third well (USGS 032-7241A) has almost 40 years of data. In general, all three hydrographs show seasonal variation in water levels throughout the data record. Over the monitoring period, wells USGS TH2, USGS 032-7241A, and USGS TH13 had maximum water level variations of 9.93 ft, 6.36 ft, and 7.31 ft, respectively. The water level record for well USGS 032-7241A exhibits a negative trend between 1959 and 1967. All three hydrographs depict a positive trend between 1975 and 1980. This positive trend is consistent with a rebound of the declining water levels exhibited in well USGS 032-7241A. Overall the long-term fluctuation of water levels in these wells appear to be primarily related to, and coincide with, rainfall variations.

Figure 5-9 Hydrographs of the A) USGS TH2, B) USGS 032-7241A, and C) USGS TH13 Sand-and-Gravel Wells



There appear to be very limited impacts to water levels by ground water development in the southern half of Region I. In 1995, withdrawals from the Sand-and-Gravel Aquifer System were estimated at approximately 82 Mgal/d. The Escambia County Utilities Authority (ECUA) withdrew about 32 Mgal/d. The Monsanto Company (now Solutia, Inc.) withdrew about eight Mgal/d from the Sand-and-Gravel Aquifer. Champion International withdrew approximately 27 Mgal/d. Even at these levels of pumping, most impacts to the potentiometric surface of the aquifer are very localized due to well spacing and the substantial aquifer recharge rate. More significant impacts are limited to areas of concentrated withdrawal associated with Commercial-Industrial Self-Supply wellfields located in central Escambia County. Effects on water levels due to pumping in the northern half of the region are significantly less.

Sand-and-Gravel Aquifer Water Quality

Ground water from the Sand-and-Gravel Aquifer is suitable for all uses. The low mineral content of the ground water is typical of the Sand-and-Gravel Aquifer and is due to the relatively insoluble nature of the quartz matrix of the Sand-and-Gravel Aquifer. This lack of mineralization makes the Sand-and-Gravel Aquifer an economically-desirable source for potable and industrial water supply.

Water quality data were evaluated for three monitoring well clusters located in different parts of Region I. The Oakgrove well cluster is located in the northern one-third of Region I, approximately six miles south of the Alabama-Florida state line. The Muscogee well cluster is located in the central one-third of Region I, just west of Cantonment. The Weller Avenue well cluster is located in the southern one-third of Region I, approximately 0.5 mile north of the brackish waters of Bayou Grande. Each well cluster has a single well open to the surficial zone, the low-permeability zone, and the main-producing zone of the Sand-and-Gravel Aquifer.

The data in Table 5-4 reflect representative chloride, sodium, and TDS ground water concentrations within the northern, central, and southern portions of Region I. Ground water concentrations of these constituents appear to be low and fairly uniform throughout Region I.

Hydraulic heads in the Sand-and-Gravel Aquifer System in south/central Escambia County are currently 50 to 60 ft above sea level. This positive head gradient holds the saltwater interface just beyond the coastline beneath the bay system. Careful placement of major supply wells has prevented the salt water from migrating inland. However, the fresh water within the Sand-and-Gravel Aquifer is in close hydraulic connection with salt water beneath the coastal bays and estuaries. This requires continued careful planning to prevent excessive pumping in the coastal fringe of the southern half of the region. Such pumpage will result in saltwater intrusion problems.

Table 5-4 Region I: Water Quality Data for the Sand-and-Gravel Aquifer

ClusterLocation	Well	Mean Concentration (mg/L)					
		Chloride		Sodium		TDS	
Oakgrove (1986-1995)	Shallow	7.7	n = 32	1.8	n = 32	92	n = 12
	Medium	2.8	n = 6	1.6	n = 6	68	n = 5
	Deep	3.2	n = 3	2.7	n = 3	34	n = 2
Muscogee (1986-1995)	Shallow	4.2	n = 7	2.6	n = 7	35.6	n = 5
	Intermediate	3.5	n = 7	2.4	n = 7	25.5	n = 6
	Deep	3.4	n = 4	9	n = 4	88.3	n = 3
Weller Avenue (1989-1995)	Shallow	5.7	n = 35	3.3	n = 31	27.2	n = 13
	LPZ	9.5	n = 30	5.3	n = 27	102.5	n = 13
	MPZ	8.8	n = 32	6.1	n = 27	62.3	n = 13

The average regional pH values for the surficial zone (4.64), low-permeability zone (5.40) and main-producing zone (5.92) are indicative of an aquifer which lacks the carbonate clay and limestone units which tend to buffer the ground water. Due to the lack of dissolvable aquifer matrix, the low pH values are also associated, in general, with lower TDS concentrations. Low TDS is a desired ground water property for industrial and commercial users.

The Sand-and-Gravel Aquifer is highly susceptible to contamination from surface spills and waste disposal practices. Anthropogenic impacts have historically polluted the surficial zone of the Sand-and-Gravel Aquifer System in the southern half of the region. Since the main-producing zone is readily recharged by surficial zone leakage through the low permeability zone, contamination has spread to the main-producing zone. Numerous public supply wells in the region have documented the presence of solvent, hydrocarbon, and pesticide contamination. Water from these wells is treated for these contaminants prior to being introduced into the water distribution system.

The District, ECUA and other local utilities are working on well-head protection activities designed to limit future contamination of the major public supply wells (Richards et al. 1997). When completed, these activities will likely result in expanded protection for the major public supply wells.

Ground Water Budget

The majority of the water used for Public Supply in Region I comes from the main-producing zone of the Sand-and-Gravel Aquifer. To assess whether the Sand-and-Gravel Aquifer will be capable of meeting regional water supply needs through 2020, a regional scale ground water budget was prepared. The water budget represents an order-of-magnitude approximation of the major Sand-and-Gravel Aquifer sources and discharges for the region and was prepared from a calibrated flow model. Although a calibrated steady-state model does not account for seasonal or annual variation in flow, it does provide a means to estimate the relative magnitude of the various inflows to and outflows from the aquifer.

The flow system components were estimated using output from a steady-state, three-dimensional ground water flow model. The Escambia County regional ground water flow model (Roaza et al. 1993) was created for the ECUA by the District to evaluate the impact of ground water withdrawal on the regional flow system. The District utilized the numerical code SWICHA Version 5.05 (GeoTrans, Inc. 1991) to simulate ground water flow.

The model produced a water budget from which the regional ground water sources and discharges were determined. The water budget reflects only the inflows and outflows for the main-producing zone of the Sand-and-Gravel Aquifer, and as such, represents only the lower portion of the Sand-and-Gravel Aquifer flow system. Significant ground water flow within the surficial zone, including recharge to the surficial zone and surficial zone discharge to the rivers and bays, is not reflected in this water budget. The model was calibrated to conditions as they occurred in August and September of 1991.

The major regional ground water source to the main-producing zone of the Sand-and-Gravel Aquifer is leakage from the surficial zone through the low-permeability zone. This recharge occurs in areas where the elevation of the water table in the surficial zone is greater than the elevation of the potentiometric surface for the main-producing zone. During the 1991 calibration period, leakage into the main-producing zone was estimated to be 165.8 Mgal/d.

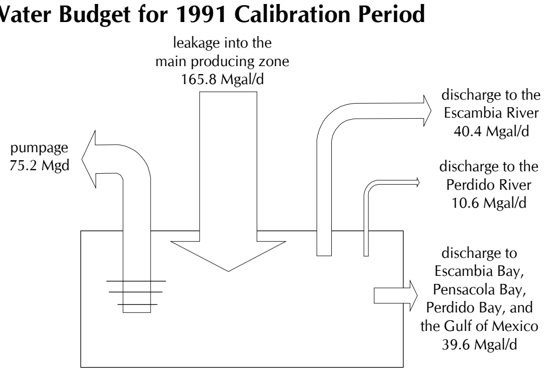
The major regional ground water discharges are 1) upward leakage through the low-permeability zone to the surficial zone and 2) ground water withdrawal via wells. Upward leakage from the main-producing zone occurs where the elevation of potentiometric surface for the main-producing zone is greater than the elevation of the water table. Discharge by upward leakage is represented in the water budget as discharge to regional surface waterbodies. The simulated, main-producing zone discharge flux to the Escambia River was estimated to be 40.4 Mgal/d. The simulated discharge flux to the Perdido River was estimated to be 10.6 Mgal/d. The Escambia Bay, Perdido Bay, and Gulf of Mexico received a simulated, combined discharge flux of 39.6 Mgal/d from the main-producing zone.

The region-wide recharge rate to the main-producing zone of the Sand-and-Gravel Aquifer

(165.8 Mgal/d) equates to an annual recharge rate of approximately 5.3 in/yr over the entire region. The total 1991 ADR of ground water withdrawal represented in the model (75.2 Mgal/d) approximates the 1995 water use summarized by the USGS (Marella et al. 1998). The reported 1995 ground water use value of 82 Mgal/d is 50 percent of the overall estimated main-producing zone ground water budget. The projected 2020 water demand (100 Mgal/d) represents 60 percent of the overall estimated Region I main producing zone ground water budget.

Vecchioli et al. 1990 calculated the total recharge to the Sand-and-Gravel Aquifer (including the surficial zone) for nearby Okaloosa County and portions of Santa Rosa and Walton counties to be approximately 20 in/yr. Given an estimated recharge rate of 20 in/yr to the entire aquifer, 1995 ground water withdrawals of 82 Mgal/d represents 13 percent of the total Sand-and-Gravel Aquifer water budget. The projected 2020 ground water demand (100 Mgal/d) represents 16 percent of the total Sand-and-Gravel Aquifer water budget. Thus, regional water resources will adequately meet future needs without adverse impact (Figure 5-10).

Figure 5-10 Region I: Sand-and-Gravel Aquifer Ground Water Budget for 1991 Calibration Period



Assessment Criteria Used

Two criteria were used to assess impacts on ground water resources; long-term depression of the potentiometric surface of the main-producing zone of the Sand-and-Gravel Aquifer and attendant alteration of ground water quality.

Impacts to Water Resources and Related Natural Systems

Given the relative magnitude of projected 2020 demands when compared to ground water availability, impacts to water resources and related natural systems as a result of ground water withdrawals are not anticipated.

Adequacy of Regional Sources

In Region I, the existing and reasonably-anticipated water sources are considered adequate to meet the requirements of existing legal users and reasonably-anticipated future water supply needs of the region (projected 2020 demands), while sustaining the water resource and related natural systems.

Water Quality Constraints on Water Availability

Locally water quality constrains water availability from the Sand-and-Gravel Aquifer System in areas where contaminant induction is likely to be caused by pumping. Heavy pumping in proximity to saline surface water bodies or areas of known contamination may rapidly move undesirable constituents into a well's capture zone. The high porosity and permeability of the Sand-and-Gravel Aquifer, which are its best qualities, can also cause the greatest problems in allowing virtually free movement of contaminants throughout the aquifer.

Level-of-Certainty

Using the methodology described in Section IV, water demand during drought conditions was estimated for Region I through the year 2020 (Table 5-5). On a regional basis, the amount of water available from traditional sources within this region is sufficient to meet all of the projected average and drought condition demands through the year 2020 while sustaining natural resources.

Reuse and Conservation

Within Escambia County, approximately 31 Mgal/d of wastewater treatment capacity existed in 1997; however, only 2.15 Mgal/d of wastewater treatment plant (WWTP) effluent was disposed of in a manner that meets the Department of Environmental Protection definition of reuse (Table 5-6). Information collected in 1997 (Marella et al. 1998) indicates that some water conservation programs have been implemented in the region.

It was beyond the scope of this assessment to fully evaluate the status and effectiveness of reuse and conservation programs. However, it is apparent that additional reuse and conservation programs could be implemented, possibly resulting in substantial reductions in potable water withdrawals. Water quality constraints and possible effects on the Sand-and-Gravel Aquifer System recharge area should also be an important consideration. As future water supply and wastewater treatment strategies are evaluated in Escambia County, the feasibility and potential effectiveness of additional reuse and conservation efforts should be examined.

Table 5-5 Region I: Estimated Water Demand During Drought Conditions (Mgal/d)

	2000	2005	2010	2015	2020
Water Use Category					
Public Supply	40.39	42.60	45.02	47.66	50.52
Domestic SS/Small Public Supply Systems	4.01	3.56	3.10	2.58	1.98
Commercial-Industrial Self-Supply	43.13	44.42	45.75	47.12	48.26
Recreational Irrigation	2.28	2.39	2.60	2.71	2.82
Agricultural Irrigation	0.88	0.90	0.95	1.00	1.13
Power Generation	0.46	0.48	0.50	0.51	0.52
Total	91.15	94.35	97.91	101.58	105.23
Increase Over Average Daily Demand	2.72	2.85	3.03	3.21	3.34

Table 5-6 Reuse of Domestic Wastewater in Region I in 1997

Domestic Wastewater Facility Name	Total Plant Capacity (Mgal/d)	Total Plant Flow (Mgal/d)	Reuse Capacity (Mgal/d)	Reuse Flow (Mgal/d)	Reuse Required
Escambia County					
Avondale (ECUA)	07.10	01.60	08.20	00.03	N
Cantonment (ECUA)	00.70	00.52	00.70	00.02	Y
Town of Century	00.45	00.29	00.00	00.00	N
Main Street (ECUA)	20.00	15.78	20.00	02.00	Y
Naval Air Station	04.00	01.68	00.00	00.00	N
Moreno Courts	00.14	00.10	00.14	00.08	N/A
Pensacola Beach (ECUA)	02.40	00.90	02.40	00.02	Y
Saufley Field N.A.S.	00.21	00.33	00.00	00.00	N
University of West Florida	00.50	00.16	00.00	00.00	N
County Total	00.20	00.14	00.00	00.00	3
Region I Total	**35.50**	**21.52**	**31.44**	**02.15**	**3**

Source: NWFWMD 1997 Annual Reuse Report (ND = No Data)

REGION II: OKALOOSA COUNTY, SANTA ROSA COUNTY, WALTON COUNTY

Region-at-a-Glance		
	1995	2020
Population:	292,213	442,351
Avg. Water Use (Mgal/d):	58.86	92.92
Primary Source:	Floridan Aquifer	
Regional Water Supply Plan Recommendation:	Water Supply Plan needed	

Overview

Water Supply Planning Region II is comprised of Okaloosa, Santa Rosa, and Walton counties. This region is predominantly rural with approximately 73 percent of the population residing in unincorporated areas. The greatest population concentrations are in the coastal area, which also has the highest growth rate in the region. Large public landholdings in the region are Eglin Air Force Base (AFB), including Hurlburt AFB and the Eglin AFB reservation, which covers approximately 464,000 acres in the center of the region, and the Blackwater State Forest, which covers approximately 189,370 acres in northern Okaloosa and Santa Rosa counties. The State of Florida also owns approximately 19,931 acres in southern Walton County, including the Point Washington State Forest, several state parks and recreation areas, and a state preserve. Additionally, the NWFWMD owns and manages 31,998 acres within Region II in the Garcon Point, Yellow River, and Choctawhatchee River Water Management Areas.

Retail trade and service are the major employment sectors in the region. The local importance of these employment sectors reflects the region's substantial seasonal population and tourism's notable role in the economy. In addition, a large portion of Okaloosa and Walton counties' employment can be attributed, either directly or indirectly, to Eglin AFB. Forestry is also a significant component of the economies of Santa Rosa and Walton counties.

Public Supply is the largest water use category in the region. All three counties rely primarily upon ground water from the Sand-and-Gravel and upper Floridan aquifers. Surface water is not used to any significant degree in the region. In the coastal area, the saltwater interface limits ground water withdrawals from the surficial aquifer system, including the Sand-and-Gravel Aquifer.

In the early 1980s, the District developed the "Regional Water Supply Development Plan" (RWSDP) for the coastal areas of northwest Florida in response to concerns of increasing water demands and dwindling supplies in coastal areas. The coastal (southern) areas of Okaloosa, Walton, and Santa Rosa counties were identified as the highest priority for needs and sources planning and the development of alternative supplies. As a result of this assessment, the southern portion of the region was designated in 1989 as a Water Resource Caution Area (WRCA) by the District pursuant to Chapter 40A-2, F.A.C. The WRCA designation subjects all non-exempt withdrawals to more rigorous scrutiny to ensure that the proposed withdrawal does not result in harm to the water resources. Permittees within a WRCA also have increased water use reporting requirements, must implement water conservation measures, and must improve water use efficiencies. They are also required to perform an evaluation of the technical, environmental, and economic feasibility of providing reclaimed water for reuse. In addition, the WRCA designation in Region II prohibits any new or expanded use of the Floridan Aquifer for nonpotable purposes. Existing nonpotable users of the Floridan Aquifer System are required to explore alternative sources.

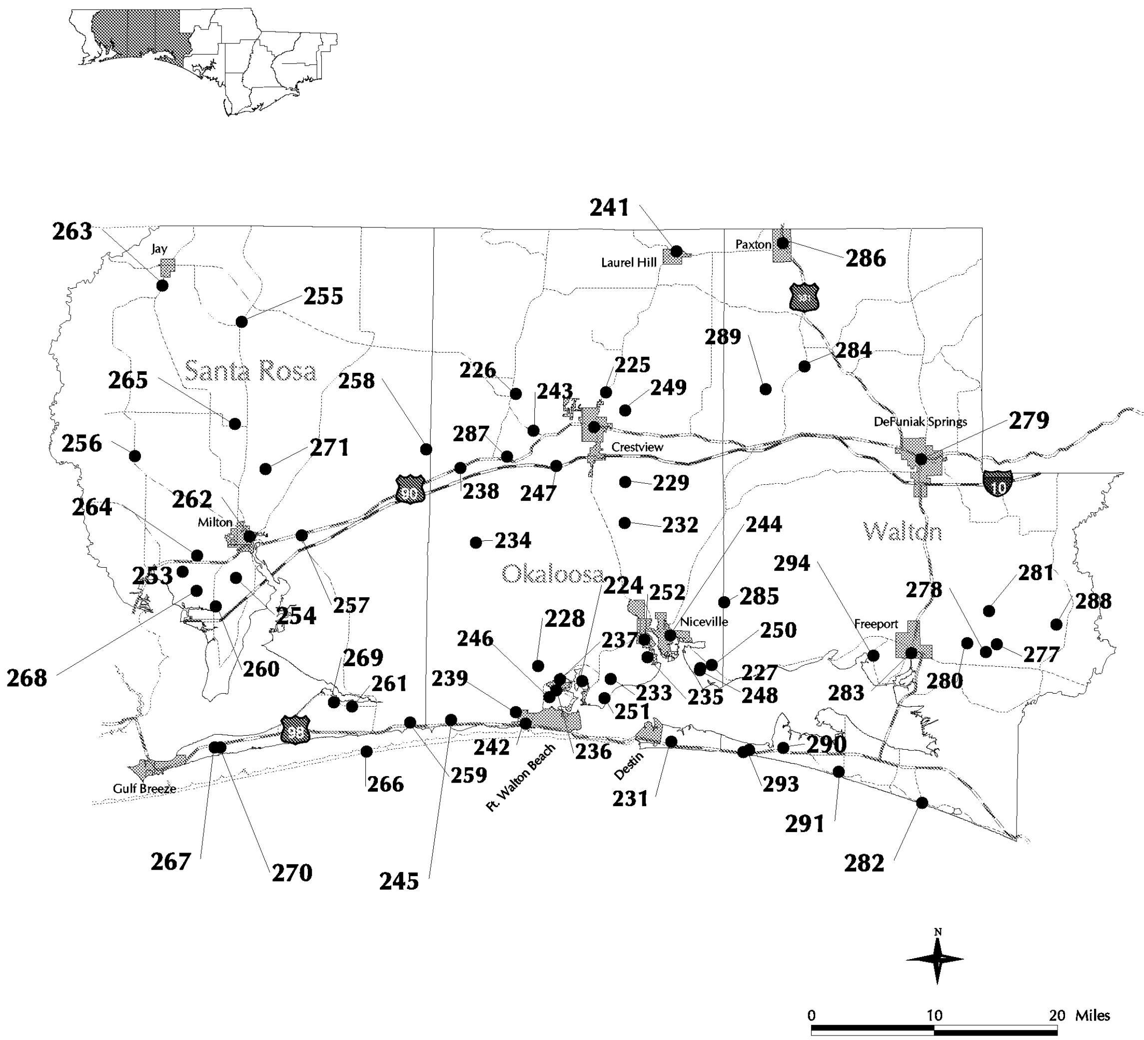
In identified areas of high water demand and limited resource availability, it is necessary to assess water demands at a sub-county level. For this purpose, the southern portion of Region II, including the WRCA, was identified as an Area of Special Concern (ASC) for the Water Supply Assessment (WSA) as illustrated in Figure 1.

Existing Water Use (1995)

Region II 1995 water use is shown by county and water use category in Table 5-7. In addition, Figure 5-11 depicts the location of permitted water withdrawals greater than 0.1 Mgal/d within Region II.

Figure 5-11

Region II



This map is for planning purposes only.
Withdrawal locations are approximate.

07-07-04

1995 Permitted Average Daily Rates (ADR) Greater Than 0.1 Mgal/d

(See following page for Map Key)

Figure 5-11 Map Key

Index #	Permit #	Name	Primary Use	Permitted ADR (gal/d)	Aquifer/ Surface Water	Source
224	880144	Air Force Enlisted Widows	LA	292,822	Sand-and-Gravel	GW
225	830078	Auburn Water System	PS	1,280,000	Floridan	GW
226	910141	Baker Water System	PS	245,000	Floridan	GW
227	850237	Bluewater Bay Development	LA	297,279	Floridan/Sand-and-Gravel	GW
228	950079	Okaloosa County Commission	ES	1,130,000	Sand-and-Gravel	GW
229	840118	Department of Corrections	PS	241,000	Floridan	GW
230	830023	City of Crestview	PS	2,500,000	Floridan	GW
231	830102	Destin Water Users	PS	3,250,000	Floridan	GW
232	850075	Eglin Air Force Base	PS	144,000	Floridan/Sand-and-Gravel	GW
233	850080	Eglin Air Force Base	PS	3,390,000	Floridan	GW
234	850076	Eglin Air Force Base	PS	174,000	Floridan	GW
235	850079	Eglin Air Force Base	PS	2,040,000	Floridan/Sand-and-Gravel	GW
236	850046	Florida Mining and Materials	IN	104,000	Floridan/Sand-and-Gravel	GW
237	842473	City of Fort Walton Beach	PS	4,140,000	Floridan/Sand-and-Gravel	GW
238	841586	Holt Water Works	PS	130,000	Floridan	GW
239	842711	Hurlburt Air Force Base	PS	1,270,000	Floridan/Sand-and-Gravel/ Hurlburt Lake	GW/SW
241	850236	City of Laurel Hill	PS	167,000	Floridan	GW
242	830020	City of Mary Esther	PS	750,000	Floridan	GW
243	900033	Milligan Water System	PS	105,000	Floridan	GW
244	840110	City of Niceville	PS	2,870,000	Floridan	GW
245	830075	Okaloosa Co. Water & Sewer (Seashore)	PS	840,000	Floridan	GW
246	840092	Okaloosa Co. Water & Sewer	PS	6,250,000	Floridan	GW
247	840112	Okaloosa Co. Water & Sewer	PS	952,000	Floridan	GW
248	850027	Okaloosa Co. Water & Sewer (BW Bay)	PS	1,218,000	Floridan	GW
249	850259	Okaloosa Co. Water & Sewer	PS	300,000	Floridan	GW
250	860020	Seminole Community Center	PS	113,000	Floridan	GW
251	842710	Shalimar Point Golf & Tennis Club	GI	241,000	Sand-and-Gravel	GW
252	840132	City of Valparaiso	PS	863,000	Floridan	GW
253	840832	Air Products and Chemicals	IN	3,000,000	Sand-and-Gravel	GW
254	850116	Bagdad-Garcon Water System	PS	400,000	Sand-and-Gravel	GW
255	850120	Berrydale Water System	PS	207,000	Sand-and-Gravel	GW
256	920110	Chumuckla Water System	PS	214,000	Sand-and-Gravel	GW
257	840127	East Milton Water System	PS	868,000	Floridan/Sand-and-Gravel	GW
258	900009	Game & Fresh Water Fish Commission	AQ	864,000	Floridan	GW
259	842631	Holley Navarre Water System	PS	1,630,000	Floridan	GW
260	920070	Richard McAlpin	GI	354,000	Sand-and-Gravel	GW
261	830036	Midway Water System	PS	1,650,000	Floridan	GW
262	842715	City of Milton	PS	2,380,000	Sand-and-Gravel	GW
263	830100	Moore Creek-Mt. Carmel Utilities	PS	515,000	Sand-and-Gravel	GW
264	830046	Pace Water System	PS	3,100,000	Sand-and-Gravel	GW
265	840007	Point Baker Water System	PS	890,000	Sand-and-Gravel	GW
266	842603	Santa Rosa County Commission	PS	412,000	Floridan	GW
267	850112	South Santa Rosa Utilities	PS	1,400,000	Sand-and-Gravel	GW
268	840128	Sterling Fibers	IN	3,270,000	Sand-and-Gravel	GW
269	930010	The Club at Hidden Creek	GI	259,000	Sand-and-Gravel	GW
270	860101	Tiger Point Golf and Country Club	GI	566,000	Sand-and-Gravel	GW
271	880084	United States Navy – Whiting Field	PS	479,000	Sand-and-Gravel	GW
277	880212	Mr. Don Baxter	AI	714,200	Floridan	GW
278	930048	D. I. Developers	GI	545,000	Floridan	GW

Figure 5-11 Map Key (continued)

Index #	Permit #	Name	Primary Use*	Permitted ADR (gal/d)	Aquifer/ Surface Water	Source*
279	830030	City of DeFuniak Springs	PS	1,050,000	Floridan	GW
280	842732	First American Farms	AI	432,000	Floridan	GW
281	842733	First American Farms	AI	2,200,000	Floridan	GW
282	870059	Florida Community Services	PS	850,000	Floridan	GW
283	840104	City of Freeport	PS	340,000	Floridan	GW
284	860127	Mossyhead Water Works	PS	170,000	Floridan	GW
285	910091	Mark Osborn	GI	254,000	Sand-and-Gravel	GW
286	950071	City of Paxton Water System	PS	265,000	Floridan	GW
287	840037	Perdue Farms	PS	1,550,000	Floridan	GW
288	930046	Red Bay Golf	GI	304,000	Floridan/Storage Ponds	GW/SW
289	910095	Donald D. Richardson	AI	151,000	Floridan	GW
290	870144	Sandestin Owner's Association	GI	1,770,000	Sand-and-Gravel	GW
291	842256	Santa Rosa Golf & Beach Club	GI	242,000	Floridan/Inter/Sand-and-Gravel	GW/SW
293	840010	South Walton Utility Company	PS	2,080,000	Floridan	GW
294	860151	TGM Development	PS	160,000	Floridan	GW

* AI= Agricultural Irrigation, AR = Aquifer Recharge, GI = Golf Course Irrigation, HS = Heat Pump Supply, IN = Industrial, LA = Landscape Irrigation, NI = Nursery Irrigation, PP = Power Production, PS = Public Supply, AQ = Aquaculture, GW = Ground Water, SW = Surface Water

Table 5-7 Region II: 1995 Water Use (Mgal/d)

	Okaloosa County	Santa Rosa County	Walton County	Total
Public Supply	21.18	11.50	4.35	37.03
Domestic SS/Small Public Supply Systems	1.86	0.76	0.52	3.14
Commercial-Industrial SS	3.97	6.20	1.60	11.77
Recreational Irrigation	2.62	1.54	1.27	5.42
Agricultural Irrigation	1.23	0.21	0.05	1.49
Power Generation	0.00	0.00	0.00	0.00
Total	30.86	20.21	7.79	58.86

Public Supply

Public Supply is the largest water use category in Region II, accounting for an average of approximately 37.03 Mgal/d or 63 percent of total regional water use in 1995. Okaloosa County Water and Sewer is the single largest public water supplier in the region, with an average withdrawal of 6.78 Mgal/d in 1995. The majority of Public Supply water use is within the region's coastal area, which is a popular tourist destination and is more heavily populated than the northern inland portions of the region. The southern portion of the region, identified by the District as an Area of Special Concern (ASC), uses on average approximately 24.25 Mgal/d for Public Supply compared to approximately 12.79 Mgal/d used in the remainder of the region.

Domestic Self-Supply and Small Public Supply Systems

Domestic Self-Supply and Small Public Supply Systems water use accounts for only a small percentage (five percent or 3.14 Mgal/d) of total water use within Region II. In 1995, an average of approximately 2.27 Mgal/d was used in the Region II ASC and another 0.87 Mgal/d was used in the remainder of the region.

Commercial-Industrial Self-Supplied

In 1995, the Commercial-Industrial Self-Supplied water use category accounted for an average of approximately 11.77 Mgal/d or about 20 percent of the region's total water use. The majority of this water was used within the non-ASC in Santa Rosa County. Major Commercial-Industrial users in Region II include Eglin Air Force Base (AFB) in

Okaloosa County, Air Products and Sterling Fibers (Cytec) in Santa Rosa County, and Purdue Farms (Showell) in Walton County.

Recreational Irrigation

Recreational Irrigation water use accounted for approximately 5.42 Mgal/d or nine percent of the region's total water use in 1995. The majority of water used for Recreational Irrigation, an average of approximately 4.56 Mgal/d in 1995, was used by golf courses located in the southern portion of the region. Some of the golf courses in the region use treated wastewater effluent (reuse water) for all or part of their irrigation demands.

Agricultural Irrigation

Approximately 1.49 Mgal/d was used for Agricultural Irrigation in 1995. This accounted for approximately three percent of the total average regional water use. The vast majority of water use in this category took place in Okaloosa County (1.23 Mgal/d). Nurseries and corn crops were the region's primary users of water for Agricultural Irrigation.

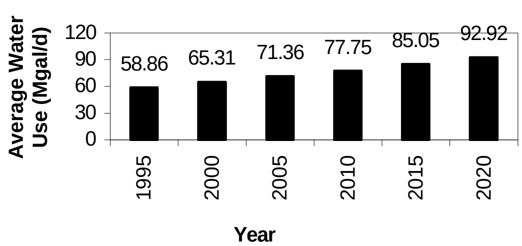
Power Generation

There is not any water used for Power Generation within Region II.

Reasonably-Anticipated Future Needs for Each Water Use Category Through 2020

Average regional water use is projected to increase from approximately 58.86 Mgal/d in 1995 to 92.92 Mgal/d in the year 2020, an increase of approximately 58 percent (Figure 5-12 and 5-17). Public Supply is expected to be the largest water use category in the region through 2020.

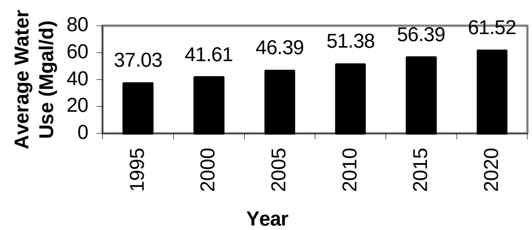
Figure 5-12
Region II: Total Average Water Use



Public Supply

Water use projections indicate that Public Supply will continue to be the predominant water use category within Region II through the year 2020. Regional water use projections suggest that use will increase approximately 66 percent from an average 37.03 Mgal/d in 1995 to 61.52 Mgal/d in 2020 (Figure 5-13). The majority of Public Supply water use is projected to occur within the southern portion of Okaloosa and Santa Rosa counties.

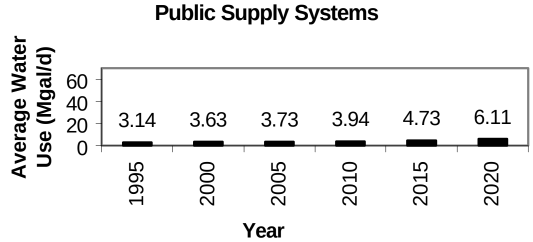
Figure 5-13
Region II: Public Supply



Domestic Self-Supply and Small Public Supply Systems

The amount of water used in Region II for Domestic Self-Supply and Small Public Supply Systems is expected to almost double between 1995 (3.14 Mgal/d) and 2020 (6.11 Mgal/d) (Figure 5-14). In addition, the percentage of the regional population dependent upon this water use category is projected to increase from approximately eight percent in 1995 to almost nine percent in 2020.

Figure 5-14
Region II: Domestic Self-Supplied & Small Public Supply Systems

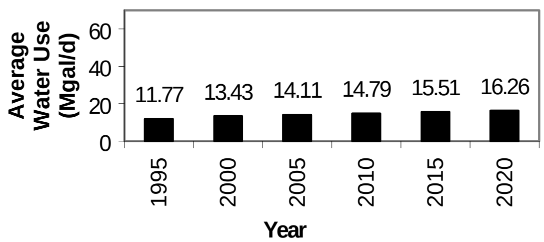


Commercial-Industrial Self-Supplied

The Commercial-Industrial water use category is projected to increase 38 percent from 11.77

Mgal/d in 1995 to 16.26 Mgal/d in 2020 (Figure 5-15). The majority of Commercial-Industrial water use will continue to occur in the non-ASC portion of Santa Rosa County (8.20 Mgal/d).

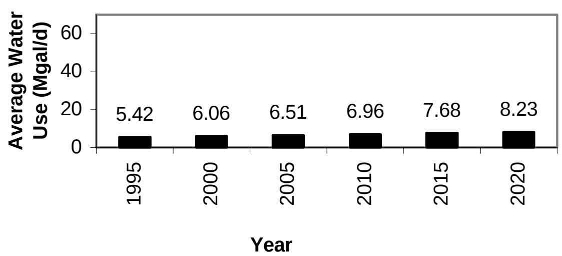
Figure 5-15
Region II: Commercial-Industrial Self-Supplied



Recreational Irrigation

Water used for Recreational Irrigation is projected to increase by approximately 52 percent between 1995 (5.42 Mgal/d) and 2020 (8.23 Mgal/d) (Figure 5-16).

Figure 5-16
Region II: Recreational Irrigation



Agricultural Irrigation

Projections indicate that Agricultural Irrigation will remain a small component of regional water use, accounting for one percent of total regional water use in 2020 (0.80 Mgal/d).

Power Generation

There is no water use projected for Power Generation within Region II.

Reasonably-Anticipated Future Needs by County Through 2020

Figure 5-17 and Table 5-8 illustrate projected total average water use by county through 2020. Okaloosa County accounts for the majority of water use in Region II with total average usage of approximately 30.86 Mgal/d in 1995 to 46.67 Mgal/d in 2020 (Table 5-9). Public Supply is the county's largest water use category, accounting for approximately 21.19 Mgal/d in 1995 and increasing to 32.55 Mgal/d in 2020. Water use in Santa Rosa County is projected to increase by approximately 65 percent from an average usage of approximately 20.21 Mgal/d in 1995 and 33.25 Mgal/d in 2020 (Table 5-10). Public Supply is Santa Rosa County's largest water use category, accounting for 11.50 Mgal/d in 1995 and 21.06 Mgal/d in 2020. Although accounting for only a small percentage of total regional water use, Walton County water use is projected to almost double between 1995 (7.79 Mgal/d) and 2020 (13 Mgal/d) (Table 5-11). The county's largest water use is Public Supply, accounting for 4.35 Mgal/d in 1995 and increasing to 7.91 Mgal/d in 2020.

Figure 5-17
Region II: Total Average Water Use by County

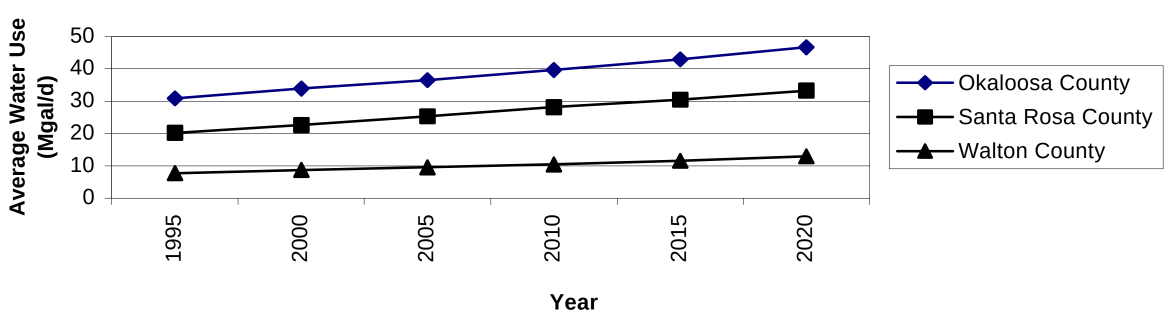


Table 5-8 Region II: Estimated (1995) & Projected (2000-2020) Average Water Demand By Category (Mgal/d)

	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	37.03	41.61	46.39	51.38	56.39	61.52
Domestic SS/Small Public SS	3.14	3.63	3.73	3.94	4.73	6.11
Commercial-Industrial SS	11.77	13.43	14.11	14.79	15.51	16.26
Recreational Irrigation	5.43	6.06	6.51	6.96	7.68	8.23
Agricultural Irrigation	1.49	0.59	0.63	0.69	0.74	0.80
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	58.86	65.32	71.37	77.76	85.05	92.92

Table 5-9 Okaloosa County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	21.18	23.19	25.38	27.71	30.03	32.55
Domestic SS/Small Public SS	1.86	2.13	2.12	2.58	3.01	3.80
Commercial-Industrial SS	3.97	5.63	5.81	5.99	6.16	6.34
Recreational Irrigation	2.62	2.80	2.98	3.16	3.53	3.71
Agricultural Irrigation	1.23	0.20	0.21	0.24	0.25	0.28
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	30.86	33.95	36.51	39.68	42.98	46.68
Average Daily Flow (Mgal/d)*	1995	2000	2005	2010	2015	2020
Area of Special Concern	24.60	28.20	30.19	32.51	35.20	38.12
Non Area of Special Concern	5.03	5.55	6.11	6.93	7.52	8.28
Total	29.63	33.75	36.30	39.44	42.72	46.40
Large Public Supply System Water Use	1995	2000	2005	2010	2015	2020
Total population served	149,665	158,482	172,701	184,220	195,747	205,438
Percent of total population	92	92	92	92	91	90
Per capita (gal/d)	142	146	147	150	153	158
Average Daily Flow of Large Public Supply Systems (Mgal/d)	1995	2000	2005	2010	2015	2020
Utility						
ASC						
Destin	2.83	3.14	3.52	3.95	4.43	4.96
Ft. Walton Beach	3.29	3.46	3.71	3.96	4.21	4.45
Niceville	2.80	3.15	3.56	3.98	4.40	4.82
Seminole Community	0.11	0.10	0.10	0.10	0.10	0.09
Valparaiso	0.62	0.63	0.64	0.64	0.64	0.64
Mary Esther	0.77	0.77	0.81	0.85	0.89	0.93
OCWS						
Main Water System	5.19	5.70	6.04	6.41	6.79	7.21
Bluewater-Raintree	1.03	1.19	1.27	1.36	1.44	1.52
Seashore Village/West	0.56	0.66	0.72	0.79	0.86	0.93
NonASC						
Auburn	1.11	1.21	1.42	1.66	1.80	2.03
Baker	0.16	0.18	0.20	0.22	0.24	0.26
Crestview	2.04	2.14	2.39	2.64	2.89	3.14
Holt	0.09	0.09	0.11	0.12	0.13	0.14
Mid-County	0.33	0.46	0.52	0.59	0.68	0.78
Milligan	0.14	0.16	0.21	0.27	0.35	0.45
Laural Hill	0.13	0.14	0.16	0.17	0.18	0.19
Total	21.19	23.18	25.38	27.71	30.03	32.55

** Agricultural Irrigation is not broken down between ASC and NonASC and therefore is not included in this table.*

Table 5-10 Santa Rosa County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	11.50	13.31	15.20	17.71	19.17	21.06
Domestic SS/Small Public SS	0.76	0.90	0.98	0.63	0.79	0.90
Commercial-Industrial SS	6.20	6.20	6.70	7.20	7.70	8.20
Recreational Irrigation	1.54	1.90	2.08	2.26	2.44	2.62
Agricultural Irrigation	0.21	0.34	0.36	0.40	0.43	0.47
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	20.21	22.65	25.32	20.20	30.53	33.25
Average Daily Flow (Mgal/d)*						
	1995	2000	2005	2010	2015	2020
Area of Special Concern	5.27	6.55	5.72	6.52	7.35	8.20
Non Area of Special Concern	14.72	15.77	17.75	19.30	21.16	22.85
Total	19.99	22.32	23.47	25.82	28.51	31.05
Large Public Supply System Water Use						
	1995	2000	2005	2010	2015	2020
Total population served	90,247	110,805	118,511	130,912	143,353	155,826
Percent of total population	94	94	94	96	96	96
Per capita (gal/d)	127	120	128	131	134	135
Average Daily Flow of Large Public Supply Systems (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Utility						
ASC						
Gulf Breeze	0.79	0.90	0.95	1.00	1.06	1.11
Holly Navarre	1.48	1.89	2.35	2.81	3.27	3.73
Midway	0.71	0.81	0.94	1.09	1.27	1.47
South Santa Rosa	0.79	0.98	1.10	1.21	1.33	1.44
Navarre Beach	0.27	0.37	0.38	0.40	0.42	0.43
NonASC	0.00	0.00	0.00	0.00	0.00	0.00
Bagdad/Garron	0.39	0.45	0.51	0.57	0.63	0.70
Berrydale	0.21	0.25	0.30	0.34	0.39	0.43
Chumuckla	0.27	0.29	0.34	0.41	0.50	0.43
East Milton	0.77	0.97	1.19	1.41	1.63	1.85
Jay	0.28	0.27	0.27	0.27	0.27	0.27
Milton	1.98	2.07	2.21	2.35	2.49	2.64
Moore Creek/Mt. Carmel	0.31	0.33	0.36	0.45	0.53	0.62
Pace	2.59	2.96	3.39	3.82	4.25	4.68
Point Baker	0.66	0.78	0.90	1.01	1.12	1.24
Total	11.50	13.31	15.20	17.17	19.17	21.06

* *Agricultural Irrigation is not broken down between ASC and NonASC and therefore is not included in this table.*

Table 5-11 Walton County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	4.35	5.10	5.81	6.50	7.20	7.91
Domestic SS/Small Public SS	0.52	0.60	0.63	0.73	0.92	1.42
Commercial-Industrial SS	1.60	1.60	1.60	1.60	1.65	1.71
Recreational Irrigation	1.27	1.36	1.45	1.54	1.72	1.90
Agricultural Irrigation	0.05	0.05	0.05	0.05	0.05	0.06
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	7.79	8.71	9.54	10.42	11.54	13.00
Average Daily Flow (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Area of Special Concern	4.69	5.46	5.16	6.93	7.89	9.11
Non Area of Special Concern	3.05	3.20	3.32	3.43	3.60	3.84
Total	7.74	8.66	8.48	10.36	11.49	12.95
Large Public Supply System Water Use						
	1995	2000	2005	2010	2015	2020
Total population served	29,799	31,788	34,680	37,353	39,80	42,310
Percent of total population	89	90	90	90	88	84
Per capita (gal/d)	146	161	167	174	180	187
Average Daily Flow of Large Public Supply Systems (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Utility						
ASC						
Freeport	0.29	0.32	0.39	0.46	0.53	0.60
Inlet Beach	0.07	0.09	0.12	0.15	0.19	0.24
Regional Utilities	0.72	1.06	1.34	1.61	1.89	2.16
Smith Water Company	0.12	0.13	0.14	0.15	0.16	0.17
South Walton	1.80	2.03	2.32	2.61	2.90	3.18
NonASC	0.00	0.00	0.00	0.00	0.00	0.00
Argyle	0.06	0.08	0.08	0.08	0.08	0.08
DeFuniak Springs	1.00	1.11	1.13	1.14	1.14	1.14
Mossy Head	0.08	0.10	0.11	0.12	0.13	0.15
Paxton	0.20	0.18	0.18	0.18	0.18	0.18
Total	4.35	5.10	5.81	6.50	7.20	7.91

- *Agricultural Irrigation is not broken down between ASC and NonASC and therefore is not included in this table.*

Source Evaluation

Within Region II, ground water is the principal source of supply for virtually all uses. Further, the vast majority of ground water is obtained from the Floridan Aquifer System. In 1995, ground water from the Floridan Aquifer System accounted for roughly 65 percent of the fresh water used within the region. Ground water from the Sand-and-Gravel Aquifer System supplied the remainder. It is reasonable to anticipate that exclusive reliance on ground water will continue through the year 2020. Accordingly, the water source evaluation presented here emphasizes the characterization of ground water availability.

Historically, Region II has been dependent on ground water for virtually all uses of water. Groundwater withdrawals began in earnest in the late 1930s, with the construction of a Floridan Aquifer wellfield to supply water to Eglin Air Force Base (AFB). Subsequently, there was a significant surge in growth in southern Okaloosa County. In 1940, ground water use was about 1.5 Mgal/d in Okaloosa County alone. Floridan Aquifer withdrawals grew to about 11.8 Mgal/d in 1968 (Trapp et al. 1977). In 1995, approximately 37 Mgal/d were being withdrawn from the Floridan Aquifer System across the region (Figure 5-18). The coastal portion of the region accounted for

Figure 5-18
Region II Magnitude of 1995 Permitted Average Daily Rates (ADR) Greater Than 0.1 Million Gallons Per Day (Mgal/d)

2.6 to 6.25 Mgal/d ADR (5 permits)
.76 to 2.5 Mgal/d ADR (17 permits)
0.1 to .75 Mgal/d ADR (24 permits)

N

0 10 20 Miles

Each of these Permittees obtains at least part of their water from the Floridan Aquifer

07-07-07

approximately 80 percent of the total regional water use from the Floridan Aquifer System in 1995.

As a result of this pumping, the potentiometric surface of the Floridan Aquifer has been substantially depressed over much of the region. Water levels in the vicinity of the City of Fort Walton Beach are presently as much as 110 ft below sea level. This represents a head loss from pre-development times of about 160 ft. Water levels in the vicinity of Crestview are presently about 50 ft above sea level. This area has lost about 70 ft of head since pre-development. The Milton area has also lost about 70 ft of head. Only in eastern Walton and the extreme northern part of all three counties are Floridan Aquifer heads only slightly affected by pumping.

In the early 1980s, the NWFWMD developed a water supply needs and sources assessment for major coastal communities. The study culminated in November 1982 with the release of the RWSDP. The purpose of the plan was to identify alternatives for meeting the future water supply needs of the study area and to evaluate and rank the alternatives based on engineering and financial feasibility. For water supply planning purposes, the area was subdivided into nine planning units based on the location, source of supply, and utility company service area.

The RWSDP provided specific recommendations for water supply development in each of the nine planning units. In several of the areas, the existing supply was considered sufficient to meet the needs of the area through the year 2020. In other areas where future needs were expected to be greater than available sources, recommendations regarding alternatives to supplement the existing source of supply were included. The area identified as the highest priorities for needs and sources planning and the development of alternative supplies was the southern part of Walton, Okaloosa, and Santa Rosa counties. Recommendations for future water supply for these areas were to: 1) pursue the development of a regional wellfield on Eglin AFB to serve the western portion of this subregion; and 2) pursue other inland wellfields in the eastern subregion.

The District subsequently worked with the West Florida Regional Planning Council (WFRPC), the Florida Department of Environmental Regulation (FDER), and the local governments to develop an interlocal agreement establishing the Walton/Okaloosa/Santa Rosa Regional Utility Authority (RUA). The RUA was granted FDER approval pursuant to Section 373.1962, F.S., in October 1986. The RUA includes Walton, Okaloosa, and Santa Rosa counties and the cities of Freeport, Destin, Fort Walton Beach, Gulf Breeze, and Mary Esther.

In 1988, the District updated the portions of the RWSDP which were applicable to the RUA. This update was in the form of an addendum to the RWSDP. The recommended implementation strategies from the addendum included: 1) designing and implementing an exploratory test well program for the Sand-and-Gravel Aquifer in southern Santa Rosa County; 2) evaluating the feasibility of a western subregional wellfield on Eglin AFB for purposes of serving southern Santa Rosa County and southwest Okaloosa County; and 3) evaluating the feasibility of an eastern subregional inland water supply utilizing the upper part of the Floridan Aquifer and/or desalination for south Walton County and southeast Okaloosa County (Destin area).

In the ten years since the RWSDP addendum was prepared, significant work has been completed on implementing alternate water supplies for coastal Santa Rosa, Okaloosa and Walton counties. At this writing, a consortium of private utilities and local government is pursuing the permitting of a Sand-and-Gravel Aquifer wellfield in central Santa Rosa County, between the Blackwater and Yellow rivers and north of Eglin AFB. Recently, Okaloosa County obtained a consumptive use permit for expansion of its mid-county wellfield. Part of the water obtained from the wellfield expansion will be sent to southern Okaloosa County. Private utilities recently completed an exploration of the lower Floridan Aquifer as a source of reverse osmosis (RO) water in the Destin area. For the present, pursuit of the RO option was deemed infeasible. Several entities are pursuing Floridan Aquifer wellfield options in central and southern Walton County on the north side of Choctawhatchee Bay.

Overview of Hydrologic System

Ground Water Hydrology

Four hydrostratigraphic units define the regional ground water flow system. In descending order from land surface, these units are the Sand-and-Gravel Aquifer, the Intermediate System, the Floridan Aquifer System and the Sub-Floridan System.

The Sand-and-Gravel Aquifer and the Floridan Aquifer System are composed of moderate to highly permeable sediments, capable of transmitting and storing large quantities of water. Both of these units form regionally-significant aquifers. The Intermediate System and the Sub-Floridan System are primarily composed of low-permeability sediments and form regionally-extensive confining units. In coastal Walton County, the permeability of the Intermediate System is sufficiently high to form a minor aquifer system.

The Sand-and-Gravel Aquifer consists of unconsolidated quartz sand, gravel, silt, and clay. Sand, along with some gravel, is the dominant lithology of this hydrogeologic unit. Silt and clay form discontinuous layers within the Sand-and-Gravel Aquifer. Ground water within the Sand-and-Gravel Aquifer exists under unconfined to semi-confined conditions. The water table marks the top of the Sand-and-Gravel Aquifer. The discontinuous layers of silt and clay typically provide for semi-confined conditions in the lower portions of the aquifer.

Regionally, the thickness of the Sand-and-Gravel Aquifer increases to the west. Thickness ranges from less than 50 ft in Walton County to more than 400 ft in Santa Rosa County. Considerable local variation in the thickness of the Sand-and-Gravel Aquifer occurs due to local topography and the somewhat irregular surface of the Intermediate System.

Underlying the Sand-and-Gravel Aquifer is the Intermediate System. This unit consists primarily of fine-grained clastic sediments along with clayey limestone and shells. The Intermediate System forms an effective confining unit, restricting the vertical flow of water between the overlying Sand-and-Gravel Aquifer and the underlying Floridan Aquifer System. The top of the Intermediate System is marked by the uppermost, regionally persistent occurrence of low-permeability sediments. The top of the Intermediate System ranges in elevation from approximately 150 ft above sea level in the northeast to more than 300 ft below sea level in the southwest (Pratt et al. 1996).

Across the region, the permeability of the Intermediate System varies with the lithology. Regionally, the sediments become finer grained and exhibit lower permeabilities in the western and southwestern portions of the region. In the eastern portion of the region, the clayey sand and clayey limestone lithology causes the permeability of the Intermediate System to be relatively high compared to further west, where the Intermediate System is composed of silt and clay.

The Intermediate System dips and thickens toward the southwest. Figure 5-19 shows a northeast to southwest hydrogeologic section through the region. The thickness of the Intermediate System ranges from approximately 50 ft in northeast Walton County to over 1,000 ft in southwestern Santa Rosa County. The combination of the thickening of the Intermediate System to the southwest and the lithology of the Intermediate System becoming finer grained to the west and southwest result in the Intermediate System becoming a more effective confining unit in the southwest portion of this region.

Underlying the Intermediate System is the Floridan Aquifer System. It consists of a thick sequence of carbonate sediments of varying permeability and a regionally extensive clay confining unit. Locally, minor amounts of clay and sand also occur within the carbonate portion of the Floridan Aquifer System. The top of the Floridan Aquifer System dips from the northeast to the southwest with the elevation of the top of the Floridan Aquifer System ranging from approximately 100 ft above sea level to more than 1,200 ft below sea level.

Figure 5-19 Cross-Section of the Floridan Aquifer

In Santa Rosa County and the western and coastal portions of Okaloosa County, the Floridan Aquifer System is split into the upper and lower Floridan Aquifer by the Bucatunna Clay. The Bucatunna Clay is a highly effective confining unit that extends to the southwest and is present in adjacent areas of Escambia County and the Gulf of Mexico. The upper Floridan Aquifer is situated just above the Bucatunna Clay while the lower Floridan Aquifer lies beneath the Bucatunna Clay. To the east, where the Bucatunna Clay pinches out and is not present, the Floridan Aquifer is one undifferentiated hydraulic unit as shown in Figure 5-19.

The upper Floridan Aquifer, where the Bucatunna is present, thickens from about 50 ft in northern Santa Rosa County to more than 400 ft in southern Okaloosa and Walton counties. In the southeastern portion of Walton County, where the Bucatunna is absent, the undifferentiated Floridan Aquifer reaches a total thickness of over 700 ft.

Throughout Region II the hydraulic conductivity of the Floridan Aquifer is quite variable. Limited field data show transmissivities to range from 2,000 ft^2/day to 25,000 ft^2/day.

The Sub-Floridan System underlies and confines the Floridan Aquifer System. The Sub-Floridan System forms the base of the Floridan Aquifer System. Due to a lack of data, little is known of the hydraulic character of this unit. However, the hydraulic conductivity of this unit is believed to be considerably lower than that of the overlying Floridan Aquifer.

Ground Water Recharge and Discharge

Recharge to the ground water flow system originates as rainfall. Depending on soil types, slope of the land surface and vegetative cover, a portion of this rainfall percolates through the unsaturated sediments into the Sand-and-Gravel Aquifer and serves to recharge the Sand-and-Gravel Aquifer. Based on hydrograph separation techniques applied to nine streams with at least ten years of continuous flow records, recharge to the Sand-and-Gravel Aquifer in and around Okaloosa County averages approximately 20 in/yr. (Vecchioli et al. 1990).

The Sand-and-Gravel Aquifer is in close hydraulic communication with the local streams and wetlands. Due to the effectiveness of the Intermediate System as a confining unit, most of the recharge to the Sand-and-Gravel Aquifer flows in a lateral, downgradient direction and discharges to the many local streams. This ground water discharge forms the base flow component of the region's streams. Stream base flow in this region is substantial and generally exceeds 1 cfs/mi^2 (Vecchioli et al. 1990). The Sand-and-Gravel Aquifer also discharges to the bays and Gulf of Mexico. In addition, water is discharged by wells that tap the Sand-and-Gravel Aquifer.

Santa Rosa County has a land area of 1,015 mi^2. Assuming a 20 in/yr recharge rate over the entire county, this equates to Sand-and-Gravel Aquifer recharge of about 970 Mgal/d. Similar assumptions for Okaloosa and Walton counties yield Sand-and-Gravel Aquifer recharge estimates of 890 Mgal/d and 1,000 Mgal/d, respectively. Obviously, there is some uncertainty in such a generalized estimation approach. Regardless, a workable Sand-and-Gravel Aquifer recharge estimate for the entirety of Region II should be on the order of 3,000 Mgal/d.

A small portion of the rainfall, which recharges the Sand-and-Gravel Aquifer, eventually recharges the Floridan Aquifer. The actual rate of recharge to the Floridan Aquifer is dependent on the thickness and hydraulic conductivity of the Intermediate System, and on the head difference between the overlying Sand-and-Gravel Aquifer and the underlying Floridan Aquifer. Where the water level in the Sand-and-Gravel Aquifer is greater than that of the Floridan Aquifer, recharge to the Floridan Aquifer occurs. Where water levels in the Floridan Aquifer are greater than the water levels in the Sand-and-Gravel Aquifer, ground water discharges from the Floridan Aquifer through the Intermediate System into the Sand-and-Gravel Aquifer.

Prior to development of the Floridan Aquifer ground water resources in this region, recharge occurred over inland areas of higher elevation with discharge primarily occurring in coastal areas. Under current pumping conditions, water levels in the Floridan Aquifer have declined below sea level over much of the coastal area. This has resulted in much of the coastal area, which was once a discharge area for the Floridan Aquifer, now serving as a recharge area for the Floridan Aquifer.

Due to the thickness and relatively low hydraulic conductivity of the Intermediate System in this region, the flow of water between the Sand-and-Gravel Aquifer and the Floridan Aquifer is very limited. Results of a numerical ground water model (Richards 1993) showed Floridan Aquifer recharge and discharge rates over most of the region to be generally less than one-half in/yr. Slightly higher recharge rates, up to three in/yr, were indicated in northern and eastern Walton County where the Intermediate System is relatively thin. Likewise, discharge rates up to three in/yr are indicated for the southeastern portion of Walton County in the vicinity of Choctawhatchee Bay and the lower Choctawhatchee River. In this area, the Intermediate System hydraulic conductivity is sufficiently high for the unit to form a minor aquifer.

AQUIFER YIELD CHARACTERISTICS

In Santa Rosa County, the Sand-and-Gravel Aquifer System is relatively thick and forms a regionally-significant aquifer. For all but the southeastern coastal area of Santa Rosa County, the Sand-and-Gravel Aquifer is the primary source of potable and industrial water supply. Pace Water System, Sterling Fibers, Inc., East Milton Water System, Air Products and Chemicals, and the City of Milton are each permitted to withdraw more than one Mgal/d from the Sand-and-Gravel Aquifer. In total, the 14 largest users of the Sand-and-Gravel Aquifer System in Santa Rosa County are permitted to withdraw 6.69 billion gallons of water per year. These withdrawals take place with little impact to the resource due to high Sand-and-Gravel Aquifer recharge rates and adequate well spacing. In Santa Rosa County, no regional water level declines are believed to have occurred in the Sand-and-Gravel Aquifer as a result of this pumping. Drawdown impacts are limited to the immediate vicinity of individual pumping wells due to the leaky nature of the aquifer system.

Sand-and-Gravel Aquifer wells in Santa Rosa County yield as much as 1,440 gpm. Specific capacities of the major supply wells range up to 83 gpm/ft, with typical values ranging between 20 and 40 gpm/ft. East of Santa Rosa County, as the Sand-and-Gravel Aquifer thins, it becomes a less productive aquifer and is generally utilized for nonpotable purposes. Specific capacities up to 45 gpm/ft have been reported in southern Okaloosa County, with numerous reports of specific capacities ranging between 15 and 20 gpm/ft. In coastal Walton County, specific capacities up to 20 gpm/ft have been recorded.

The Sand-and-Gravel Aquifer in Santa Rosa County is an extremely productive aquifer system and is, due to its high rate of recharge, capable of providing regionally-significant quantities of water. In southern Okaloosa and Walton counties, the Sand-and-Gravel Aquifer is a significant source of ground water and is certainly capable of meeting a portion of the growing local demand. The high degree of hydraulic communication between the Sand-and-Gravel Aquifer and the local streams and wetlands does require careful planning and analysis of proposed withdrawals in order to avoid significant impacts to wetlands.

Groundwater withdrawal from the Intermediate System is mostly limited to the coastal area of southeastern Walton County. Few wells currently tap this unit, and well yields are quite low with specific capacities of approximately two gpm/ft. Use of this unit has traditionally been limited to domestic supply, but it has recently been tapped for low-volume Public Supply needs. Although not as productive as the major aquifers of the region, the Intermediate System in this area is capable of contributing to the local water supply needs.

The Floridan Aquifer System is the primary water supply source for all of Okaloosa and Walton counties. In addition, the upper Floridan Aquifer is also the primary aquifer utilized in southeast Santa Rosa County. Due to excessive mineralization, neither the upper nor the lower Floridan Aquifer is utilized in southwestern Santa Rosa County. Elsewhere in Santa Rosa County, the Floridan Aquifer is generally not utilized due to the presence of the very productive Sand-and-Gravel Aquifer.

Floridan Aquifer well yields are highly variable in the region. The most productive areas include the central portions of Okaloosa and Walton counties. Good well yields are also noted in the Midway area of Santa Rosa County and in the immediate vicinity of Destin. While some wells yield in excess of 1,000 gpm, other wells in the immediate vicinity are substantially less productive due to the extreme heterogeneity exhibited by the Floridan Aquifer. Elsewhere, well yields and specific capacities are considerably less. Particularly poor well yields are noted in some of the immediate coastal fringe areas of Okaloosa and Walton counties.

Floridan Aquifer System Water Levels

The Floridan Aquifer System's zone of contribution, within which Region II lies, extends north and west into Alabama. In northwest Walton County, the potentiometric surface of the Floridan Aquifer reaches its regional maximum elevation of approximately 210 ft above sea level. From this high, water levels decline in all directions throughout the region. Under non-pumping, pre-development conditions, ground water flowed downgradient to natural discharge areas in southern Okaloosa and Walton counties as well as discharging to the Choctawhatchee River. Prior to development, Floridan Aquifer water levels in the Fort Walton Beach area were approximately 50 ft above sea level. Figure 5-20 shows the estimated pre-development potentiometric surface map for the region.

As a result of increased regional pumping over the last 50 years, a significant cone of depression has formed in the Floridan Aquifer. Much of the Floridan Aquifer ground water which once discharged naturally to either the Sand-and-Gravel Aquifer, to the bay system along the coast, or to the Gulf of Mexico is now captured by the pumping wells. Under current withdrawal rates, Floridan Aquifer water levels have dropped to as much as 110 ft below sea level in the Fort Walton

Beach area. Figure 5-21 shows the potentiometric surface of the Floridan Aquifer as of 1995. Hydrographs for six wells are presented in Figure 5-22 to depict long-term trends in Floridan Aquifer water levels. Data are presented for wells at Paxton, Camp Henderson, Navarre Cement Plant, Okaloosa County School Board, First American Farms and Freeport.

The Paxton well is located in northern Walton County on the region's potentiometric high. The Paxton well shows no detectable long-term head loss. This well is not affected by the coastal pumpage occurring approximately 40 miles to the south. In this area of northern Walton County, recharge rates are expected to be somewhat greater than elsewhere in the region due to the Intermediate System being relatively thin.

By contrast, the Camp Henderson well, located approximately 40 miles due west in Santa Rosa County and slightly further from the coastal pumping center, lost approximately 15 ft of head between 1961 and the present. As is the case with the Paxton well, essentially no pumping from the Floridan Aquifer occurs in this area. Effects of coastal pumping have propagated nearly 40 miles to the state line, due to the presence of a thick, effective confining unit and low rate of Floridan Aquifer recharge in Santa Rosa County.

The rate of water level decline in the coastal area in the western part of the region is illustrated by the Navarre Cement Plant well located in southeast Santa Rosa County, just west of the center of the cone of depression. This well lost approximately 100 ft of head between 1961 and 1989, when monitoring was discontinued.

The Okaloosa County School Board well located in Fort Walton near the center of the cone of depression lost approximately 160 ft of head between 1936 and present. Throughout its period of record, the Okaloosa County School Board well exhibits fairly large seasonal fluctuations in water levels indicative of seasonal water use patterns of the tourism-driven communities around Fort Walton Beach.

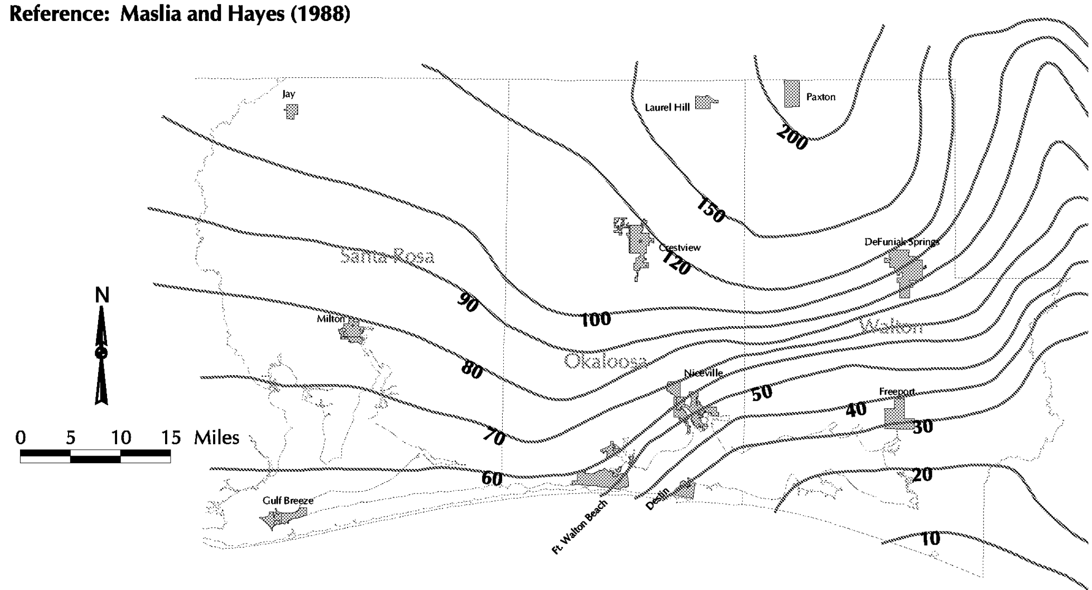
Although the First American Farms well in central Walton County shows no appreciable long-term head loss, seasonal fluctuations attributed to large-scale agricultural irrigation at the farm during the 1960s and 1970s are dramatic. This agricultural pumpage is also reflected in the Freeport well approximately five miles to the south. As the farm's pumping drastically decreased in the 1980s and 1990s, the extreme seasonal fluctuation of water levels in the Freeport well ceased.

However, the long-term decline in water levels due to the pumpage concentrated in coastal Okaloosa County remain evident in the Freeport area. Since 1947, approximately 20 ft of head has been lost in the Floridan Aquifer System at this well location.

The water level declines illustrated in the above hydrographs are indicative of an areally-distributed decline that has occurred over the entire region. The extent of that decline from pre-development conditions is presented in Figures 5-20 and 5-21. As water levels have declined across the region, the cone of depression has propagated laterally. Figure 5-23 illustrates the lateral, outward propagation of the potentiometric surface zero contour line. The area within which heads were lower than sea level in 1974 covered approximately 224 mi^2, mostly confined to southern Okaloosa County. In 1995, the area within which heads were depressed below sea level had spread across all three counties, until it encompassed approximately 685 mi^2. This represents a tripling of the onshore areal extent of the area within the zero contour over a 21-year period. In addition, the cone of depression extends over an unknown area offshore beneath the Gulf of Mexico.

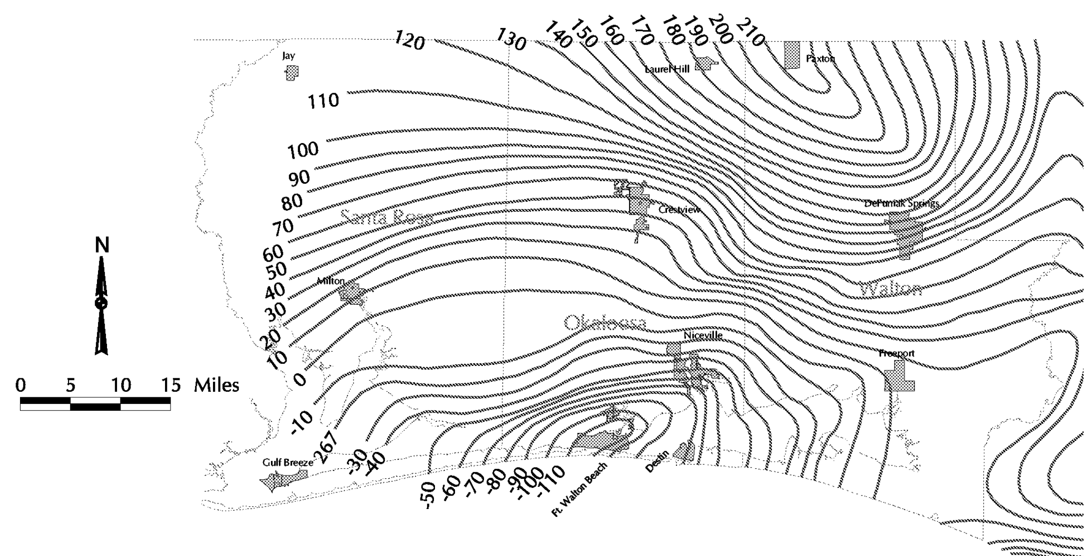
Figure 5-20
Pre-development Potentiometric Surface of the Floridan Aquifer System in Region II

Reference: Maslia and Hayes (1988)



— 10 — Potentiometric Contour — Shows altitude at which water level would have stood in tightly cased wells. Contour interval is irregular. Datum is sea level.

Figure 5-21
Potentiometric Surface of the Floridan Aquifer System in Region II, July 1995



● Control Well Locations

— 10 — Potentiometric Contour — Shows altitude at which water level would have stood in tightly cased wells. Contour interval is 10 feet. Datum is sea level.

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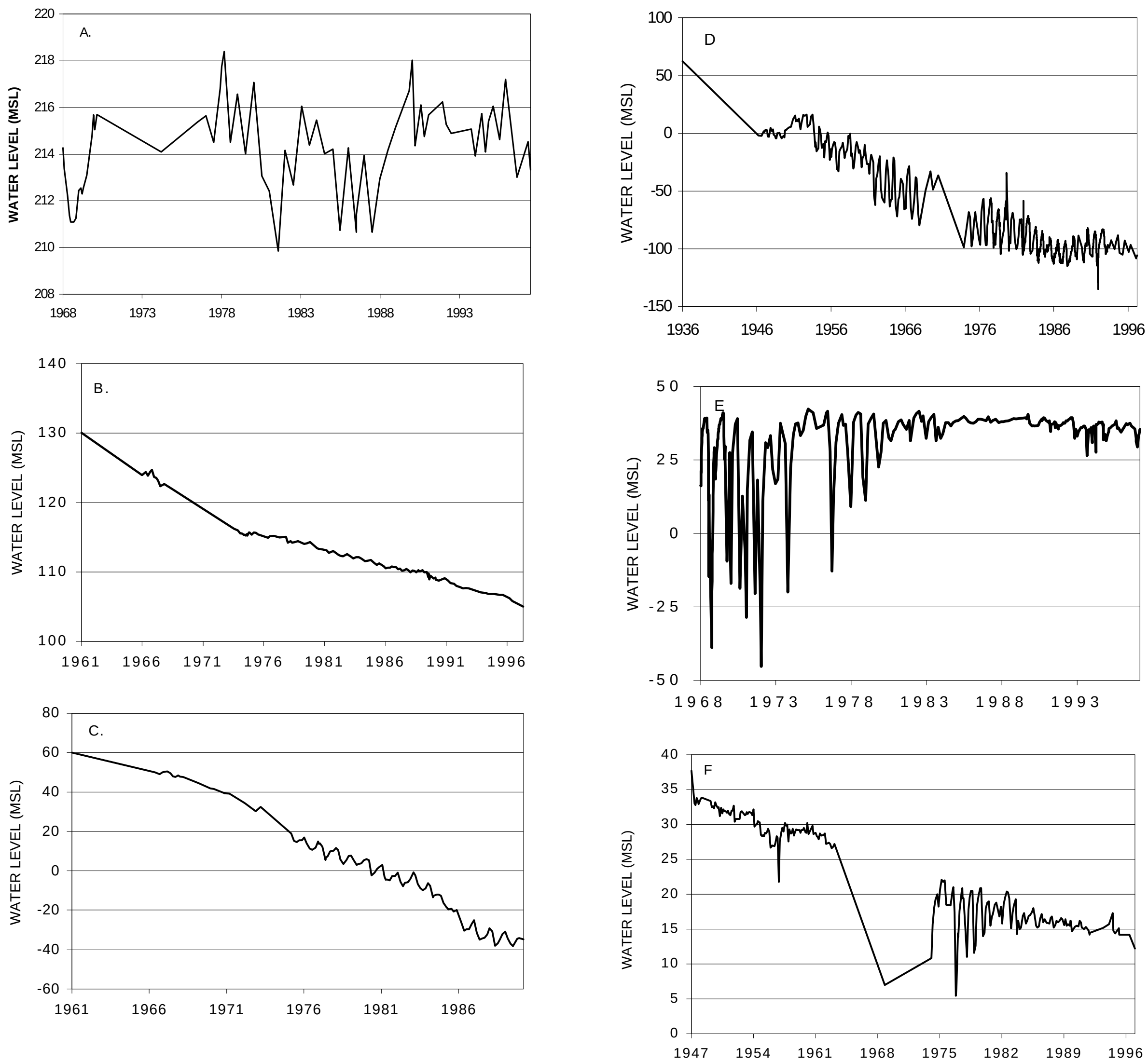


Figure 5-22 Hydrographs of the A) Paxton, B) Camp Henderson, C) Navarre Cement Plant, D) Okaloosa County School Board, E) First American Farms, and F) Freeport Floridan Aquifer Wells

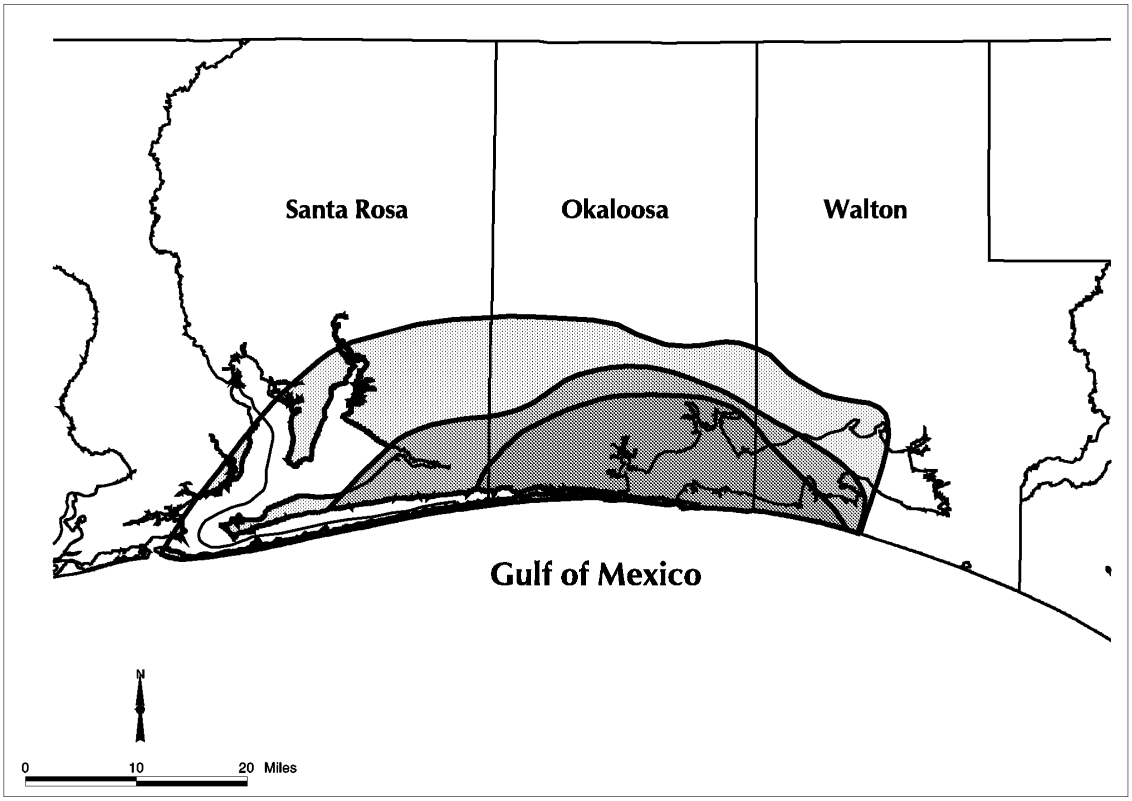
Floridan Aquifer System Water Quality

Over most of Region II, the quality of ground water in the Sand-and-Gravel Aquifer, the Intermediate System and the Floridan Aquifer System is suitable for most uses. By tradition, the vast majority of ground water used in the region is obtained from the Floridan Aquifer. Virtually all of the potable ground water for Okaloosa, Walton and southeasternmost Santa Rosa counties is obtained from the Floridan Aquifer. Elsewhere in Santa Rosa County, the Sand-and-Gravel Aquifer supplies virtually all ground water used.

Water quality data from the Floridan Aquifer in the interior of the region (away from bays and the gulf) show low concentrations of dissolved constituents. Away from the immediate vicinity of the coastline, sodium concentrations are typically less than 100 mg/L (Sprinkle, 1989, Maddox et al. 1992). Chloride concentrations in the same area are typically less than 100 mg/L as well (Maddox et al. 1992). TDS concentrations away from the shoreline are typically less than 350 mg/L (Maddox et al. 1992). In the northernmost parts of the region, both sodium and chloride concentrations are in the single digits.

Figure 5-23

Growth of Region II Floridan Aquifer Potentiometric Surface Cone of Depression between 1974 and 1995



07-07-06

Within this area, aquifer head was at or below sea level in 1974. Source: Water Levels in the Floridan Aquifer May - July 1974. Unpublished Data of the U.S. Geological Survey.

Within this area, aquifer head dropped below sea level between 1974 and 1985. Source: Rosenau, J.C. and P.E. Meadows, 1986. Potentiometric Surface of the Floridan Aquifer System in the Northwest Florida Water Management District, May 1985. U.S.G.S. Water Resources Investigations Report 86-4183.

Within this area, aquifer head dropped below sea level between 1985 and 1995.

Figure 5-24 Coastal Cross Section of Floridan Aquifer System Chloride and Sodium Concentration Data

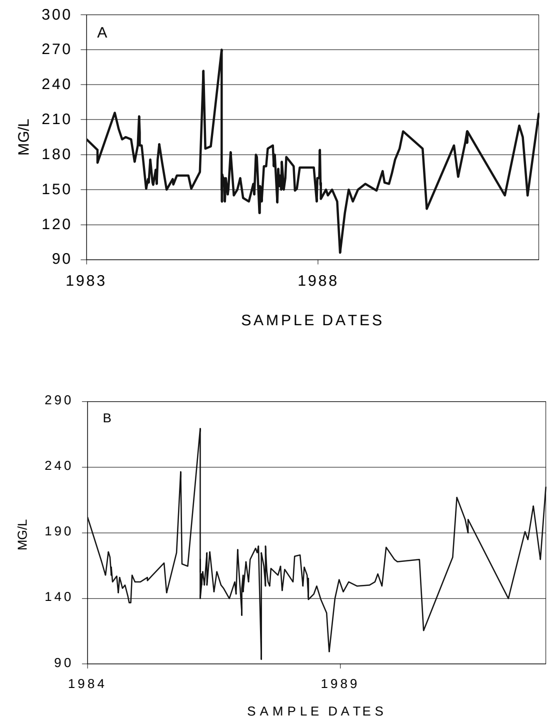
Within the area in which the Floridan Aquifer is used for water supply, water quality concerns are limited to the general vicinity of the Gulf of Mexico shoreline (and associated estuarine systems). This consists of southeast Santa Rosa County (Navarre Beach), south Walton County and the coastal strip in between these two areas. Figure 5-24 shows a west-east cross-section of the Floridan Aquifer System between southeast Santa Rosa County and south Walton County. This figure presents average chloride and sodium concentration data for Public Supply wells along the coastal strip. Concentration data were collected during the 1990s.

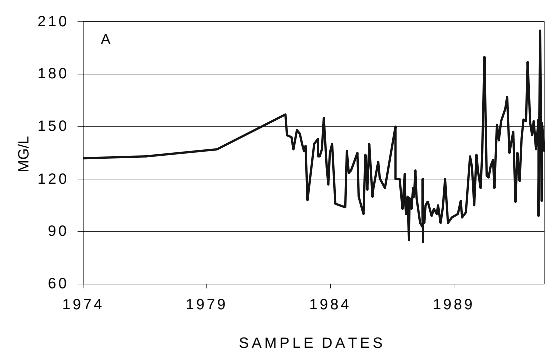
Regionally, there is a pronounced deterioration of Floridan Aquifer water quality in a southwesterly direction. Floridan Aquifer water in south Santa Rosa and south Escambia counties becomes much more mineralized than elsewhere in the region. It begins to exceed drinking water standards in the vicinity of Navarre Beach (southeast Santa Rosa County). Historically, Navarre Beach relied on a system of three Floridan Aquifer wells for its public water supply. Those wells had chronic problems with sodium concentrations that exceeded the 160 mg/L primary drinking water standard. Recent sodium and chloride data for these wells (submitted as a Consumptive Use Permit condition) are given in Figures 5-25 and 5-26. Chloride data from both wells appear to show a trend of increasing concentrations from about 1989 forward. Further, water from this area is somewhat enriched with sodium, having a sodium chloride concentration ratio of about one. Seawater has a sodium/chloride concentration ratio of 0.55.

In order to address this problem, Navarre Beach is presently awaiting completion of a pipeline to provide water from inland sources. Use of the island wells for Public Supply will cease, and the wells will be maintained in standby condition for emergency backup and fire-flow purposes only.

Moving east, the quality of water in the Floridan Aquifer improves. East of the Santa Rosa/Okaloosa County line and in public supply wells, chloride concentrations are typically less than 100 mg/L; sodium is typically less than 140 mg/L. Sodium/chloride ratios are typically one or greater. A time series plot of chloride data is available for Mary Esther #2 (Figure 5-27) and illustrates, at this site, the constancy of chloride concentration with time.

Figure 5-25 Sodium Concentrations with Time for A) Navarre Beach #2 and B) Navarre Beach #3 Floridan Aquifer Wells





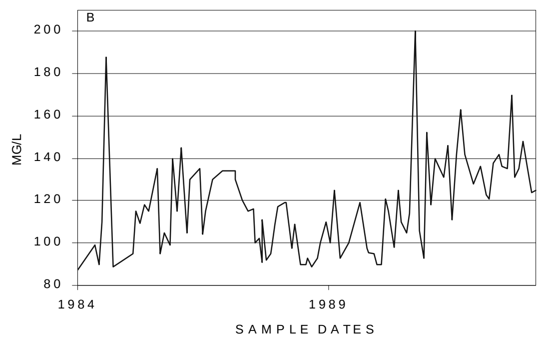
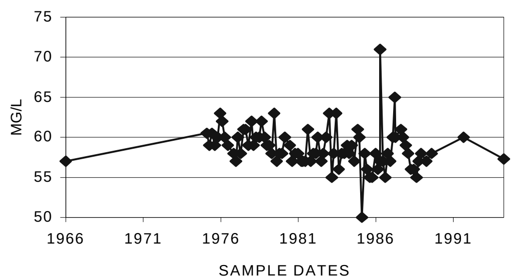


Figure 5-27 Chloride Concentrations with Time for Mary Esther #2 Floridan Aquifer Well



Further east (in the Destin area), water quality continues to be good. In the Destin Water Users service area, chloride concentrations are typically less than 50 mg/L with sodium less that 100 mg/L. Sodium/chloride ratios in the Destin area range from about two to about four, indicating an enrichment of the water with sodium.

The one noteworthy exception is Destin #5. Destin #5 has recently had chloride as high as 135 mg/L, sodium as high as 159 mg/L, and a sodium/chloride ratio around 1.2. These values represent an increase over historical concentrations. At the time the well was constructed, it had chloride around 50 mg/L, sodium around 100 mg/L and a sodium/chloride ratio around two (Pratt et al. 1996). This well may have experienced upconing of poor water quality from below. Due to the sodium concentration presently being at or near the drinking water standard, the well is infrequently used.

Along the coastal fringe, the best quality of water in the Floridan Aquifer is found in the South Walton Utility Company service area. In this area, chloride concentrations are typically less than 60 mg/L and sodium is typically less than 50 mg/L. Sodium/chloride ratios typically range between one and two.

Immediately east of South Walton Utility Company #5, Floridan Aquifer water quality deteriorates. This area of naturally-occurring poor quality water is extensive, covering much of coastal Walton County and the eastern end of Choctawhatchee Bay. Both sodium and chloride concentrations in the shallow portion of the Floridan Aquifer are at or over their respective drinking water standards (Pascale 1974; Barr et al. 1981; Pratt et al. 1996). In this area, the sodium/chloride ratio is typically near that of seawater (0.55), and the water quality deteriorates further with increasing depth.

In early 1998, Florida Community Services Corporation, Inc., which provides water to coastal Walton County, identified its wells #4, #11, and the Saddlebrook well as having water quality problems due to elevated sodium and chloride concentrations. The utility has experienced problems with water quality in these wells periodically exceeding drinking water standards for some time. Previously, the wells would be taken off line until concentrations abated. Loss of full use of these wells renders the utility unable to meet its peak demand and has necessitated obtaining water from additional, low volume wells in coastal Walton County and from the north side of Choctawhatchee Bay.

Reduction of the potentiometric surface of the Floridan Aquifer below sea level creates concerns regarding saline water intrusion and the long-term sustainability of current withdrawals. Of particular concern is lateral intrusion of saline water, induced recharge of saline water from overlying units and upconing of poor quality water from depth.

The danger of induced saltwater recharge is greatest in the Choctawhatchee Bay area of Walton County. Due to the relatively thin, relatively permeable Intermediate System in south-central Walton County, this area appears to currently provide a greater amount of recharge to the Floridan Aquifer compared to other coastal areas in Okaloosa and Santa Rosa counties. The asymmetrical growth of the regional cone of depression (Figure 5-23) and attenuation of drawdown in this area indicate that greater recharge is occurring in the area. Much of the area in which this induced recharge is occurring is overlain by saline water. Significant induced recharge in coastal 'saltwater' areas will eventually have adverse effects on the ground water resources.

Although lateral saltwater intrusion and upconing are a concern throughout the coastal area, these concerns are greatest for areas nearest to locations where poor quality water is known to exist. These areas are the extreme western and eastern flanks of the potentiometric surface depression, specifically southeast Santa Rosa County and coastal Walton County.

LOWER FLORIDAN AQUIFER WATER QUALITY AT DESTIN

In July 1997, a lower Floridan Aquifer monitoring well was constructed in Destin for the purpose of determining the feasibility of reverse osmosis treatment of water from the lower Floridan for potable use. The well was drilled to a total depth of 1,460 ft, and water quality samples were taken from the lower Floridan at 11 intervals between 928 ft to 1,422 ft. Just below the Bucatunna, a sodium concentration of 690 mg/L and a chloride concentration of 1,200 mg/L yielded a sodium/chloride ratio of 0.58, approximately that of sea water (0.55). Water in this well became progressively more mineralized with depth, but the sodium/chloride ratio remained between 0.50 and 0.71.

Table 5-12 WRP Reverse Osmosis Monitoring Well Water Quality Data

Depth	Sodium	Chloride	Na/Cl Ratio
928 – 968 ft	690	1200	0.58
960 – 1000 ft	975	1590	0.61
1000 – 1040 ft	1580	2240	0.71
1040 – 1080 ft	2020	2930	0.69
1055 – 1095 ft	2240	3860	0.58
1090 – 1130 ft	3420	6370	0.54
1130 – 1170 ft	3930	7280	0.54
1165 – 1205 ft	4400	7790	0.56
1200 – 1240 ft	4580	8600	0.53
1300 – 1340 ft	5530	9580	0.58
1382 – 1422 ft	8500	16900	0.50

Source: Baskerville-Donovan, Inc. 1997

Ground Water Budget

In Region II, the primary source utilized to meet the water supply demands is the Floridan Aquifer. To aid in assessing whether the Floridan Aquifer will meet the projected regional demands through 2020, a regional scale ground water budget was prepared. The water budget represents an order-of-magnitude approximation of the major Floridan Aquifer sources and discharges for the region.

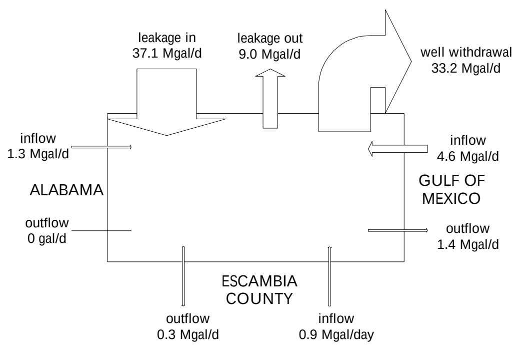
The Floridan Aquifer ground water flow system components for Region II were calculated using output from a regional, steady-state, two-dimensional ground water flow model. The model was developed by the NWFWMD to evaluate the impact of a proposed upper Floridan Aquifer wellfield on regional ground water flow in the Floridan Aquifer System (Richards, 1993). The model domain extended to the north and west into Alabama, south into the Gulf of Mexico, and included all of Region II except for the easternmost portion of Walton County where the ground water primarily flows toward and discharges to the Choctawhatchee River. The model is calibrated to conditions as they occurred in May 1990. A detailed description of the model can be found in Richards (1993). Although a calibrated steady-state flow model does not account for seasonal or annual variations in flow, the model does provide the means to estimate the relative magnitude of the various inflows to and outflow from the Floridan Aquifer ground water flow system.

In order to estimate water budget components for the region, the computer program ZONEBUDGET (Harbaugh 1990) was used to analyze output obtained from the ground water flow model. ZONEBUDGET allows the user to define a subregion within a model domain and to calculate all simulated Floridan Aquifer ground water flow into and out of the subregion. The subregion specified in the ZONEBUDGET analysis includes most of Region II (all of Santa Rosa and Okaloosa counties, and all but the easternmost portion of Walton County). To the south, the subregion extends to the Gulf of Mexico coastline.

As represented in the model, ground water flow into and out of the subregion occurs as leakage through the overlying Intermediate System, subsurface inflow/outflow from adjacent areas and well pumpage. The subsurface inflow/outflow component was segregated to specifically identify individual inflow/outflow components for Alabama, Escambia County, Florida and the Gulf of Mexico. The eastern limit of the model domain coincided with a streamline and was designated as a no-flow boundary. Therefore, no water was allowed to flow into or out of the region along this eastern model boundary.

Figure 5-28 illustrates the specific flow components analyzed and shows the magnitude and importance of that component to the overall Region II flow system. For the calibration period, downward leakage into the Floridan Aquifer was estimated to be 37.1 Mgal/d. Subsurface inflow from Alabama, Escambia County, Florida and the Gulf of Mexico was estimated to be 1.3 Mgal/d, 0.9 Mgal/d, and 4.6 Mgal/d, respectively. The total simulated regional inflow for Region II for the May 1990 calibration period is estimated to be 43.9 Mgal/d.

Figure 5-28 Region II: Floridan Aquifer Ground Water Budget for 1990 Calibration Period.



Subregional ground water discharge includes upward leakage through the Intermediate System, subsurface outflow to adjacent areas of Escambia County and the Gulf of Mexico and ground water withdrawal via wells. Based on model results, the subregional upward leakage through the Intermediate System is estimated to be 9.0 Mgal/d. The subsurface outflow to Escambia County and the Gulf of Mexico is estimated to be 0.3 Mgal/d and 0.9 Mgal/d, respectively. Floridan Aquifer simulated discharge via pumping wells was 33.2 Mgal/d. This pumping rate represents the average daily pumping rate for the year 1990. Given the steady-state nature of the flow model, the Region II ground water outflow is equal to the inflow of 43.9 Mgal/d.

The Region II, simulated, 1990 Floridan Aquifer ground water budget shows the aquifer to be heavily utilized. The water budget indicates approximately 75 percent of the ground water flowing into the Floridan Aquifer in Region II was being withdrawn by wells.

Of particular concern is inflow from beneath the Gulf of Mexico. Although the exact distribution of salt water in the Floridan Aquifer beneath the Gulf of Mexico is uncertain, salt water is certainly present in the aquifer beneath the Gulf of Mexico. The simulated inflow of 4.6 Mgal/d can potentially have a significant effect on the quality of ground water withdrawn from the aquifer, and raises concerns regarding the sustainability of current withdrawal practices.

Also of concern is that a portion of the 37.1 Mgal/d leakage into the aquifer through the Intermediate System is likely to have induced saltwater recharge. This is of greatest concern in the Choctawhatchee Bay area of Walton County. Although this induced saltwater recharge is only expected to be a small fraction of the total leakage into the aquifer, this inflow also has the potential to degrade the quality of water being withdrawn.

Although region-scale numerical flow modeling of the Sand-and-Gravel Aquifer has not been performed, an estimate of the water budget for the Sand-and-Gravel Aquifer was prepared. For the Sand-and-Gravel Aquifer, the local streams and rivers are, by far, the primary discharge areas. Assuming minimal pumpage in the basins analyzed, the net recharge rate to the Sand-and-Gravel Aquifer is essentially equal to the base flow of the streams normalized to the area of the drainage basin.

Base flow of selected streams within the region was determined utilizing stream flow data and hydrograph separation techniques and shows recharge to the Sand-and-Gravel Aquifer to be approximately 20 in/yr (Vecchioli et al. 1990). Assuming a recharge rate of 20 in/yr and given the area of Santa Rosa, Okaloosa and Walton counties, an estimated 3,000 Mgal/d recharge the Sand-and-Gravel Aquifer. This is approximately ten times the volume of water flowing through the Floridan Aquifer.

Assessment Criteria Used

Two criteria were used to assess impacts on ground water resources; long-term depression of the potentiometric surface of the Floridan Aquifer system and attendant alteration of ground water quality.

Impacts to Water Resources and Related Natural Systems

Presently, ground water from the Floridan Aquifer constitutes virtually all of the fresh water used in Region II. That use, concentrated in the coastal fringe, has resulted in the formation of a significant cone of depression in the Floridan Aquifer. The cone of depression is presently centered under Fort Walton Beach and results from a region-wide Floridan Aquifer System withdrawal of about 30 Mgal/d in the coastal area. Heads within the cone of depression are drawn down as much as 110 ft below sea level. This feature has deepened and spread dramatically over the past 50 years as water use demands have increased. It will persist as long as ground water is produced at current rates within the current ground water production footprint.

Coupled with concerns about the potentiometric surface decline are concerns about the quality of Floridan Aquifer water used for potable supply along the Gulf Coast. Historic and recent water quality data for users along the region's coast indicate increasing concentrations of sodium and chloride in Floridan Aquifer ground water. Continued utilization of Floridan Aquifer ground water at current levels and in the current spatial distribution will result in the continued alteration of ground water quality.

Adequacy of Regional Sources

In Region II, the existing and reasonably-anticipated water sources are not considered adequate to meet the requirements of existing legal users or reasonably-anticipated future water supply needs of the region (projected 2020 demands). The hydrologic system, especially in the coastal area in Region II, has been heavily affected by withdrawals. Although no serious problems have developed, aside from those scattered cases which were mentioned, the potential for long-term impacts are undeniable. The depression of the potentiometric surface below sea level, changes in water quality, and the simple mathematical results of the water budget indicate this potential is significant. The proximity of poorer quality water to the areas of greatest drawdown only exacerbates the likelihood of eventual problems. These problems may not be overriding in the near-term but, as long as the present level of pumpage is sustained in the current locations, the system will equilibrate itself as best it can by pulling water from above, below and from adjacent areas. In coastal Santa Rosa, Okaloosa and Walton counties, these "source" areas contain saline water.

Given concerns about the sustainability of Floridan Aquifer ground water production along the coastline, alternate water sources are needed. Potential alternate sources include the use of surface water, expanded use of the Sand-and-Gravel Aquifer, and reverse osmosis treatment of poorer quality water to limit use of the Floridan Aquifer System. Additional strategies include shifting ground water pumpage away from the coastline and implementing stringent reuse and conservation measures. A more thorough investigation of future water demands in the region is also needed to allow for closer examination of use types and various demand management alternatives.

In summary, existing and reasonably-anticipated sources of water and conservation efforts are not adequate to supply water for all existing legal uses and reasonably-anticipated future demands and to sustain the water resources and related natural systems in portions of this region. For these reasons, **development of a "Regional Water Supply Plan" pursuant to Section 373.0361, Florida Statutes, is recommended for Water Supply Planning Region II**.

Level-of-Certainty

Using the methodology described in Section IV, water demand during drought conditions was estimated for Region II through the year 2020 (Table 5-13). On a regional basis, the amount of water available within this region is sufficient to meet all of the projected average and drought condition demands through the year 2020, while sustaining water resources and related natural systems. However, for some utilities in this region, the amount of water available from traditional sources is insufficient to meet all of the projected average and drought condition demands through the year 2020, while sustaining water resources and related natural systems.

Reuse and Conservation

Within Region II, most of the wastewater treatment plants (WWTPs) dispose of effluent in a manner that meets the Department of Environmental Protection definition of reuse. Table 5-14 denotes that 20.74 Mgal/d (over 54 percent) of the 38.40 Mgal/d of wastewater effluent generated in 1995 was disposed of as reuse water. Although most of the WWTPs in the region have water reuse systems, less than half of the total reuse flow is used in a manner that substantially reduces water consumption. Reuse water that is used for land application (sprayfields), ground water recharge or wetlands creation, restoration or enhancement does not reduce water consumption as effectively as reuse water used for Golf Course Irrigation and other Landscape Irrigation applications. For example, in its effort to reduce local demands on the Floridan Aquifer, Destin Water Users has implemented a program that provides reuse water for Golf Course and Landscape Irrigation. This program has been well received and has resulted in the abandonment of a number of Floridan Aquifer wells that were previously used for irrigation purposes.

The resource constraints in the southern portion of Region II warrant full consideration of reuse water as a replacement source for most, if not all, nonpotable uses. The District's Consumptive Uses of Water permitting program currently imposes permit conditions that require implementation of reuse on the larger water suppliers in the WRCA. All utilities should aggressively implement the types of reuse programs that are most effective towards reducing Floridan Aquifer withdrawals in the WRCA.

According to information collected by the USGS (1998), most of the utilities in the region are implementing conservation strategies to reduce potable water demands. The conditioning of consumptive use permits to require implementation of comprehensive water conservation and efficiency programs will help to further reduce present and future demands. The strategies employed by the utilities include conservation-oriented rate structures, landscape irrigation restrictions, low-volume plumbing building codes, xeriscape landscaping ordinances, leak detection programs, public education, water shortage plans, and other similar techniques.

It is not possible to accurately quantify the effectiveness of conservation programs with the data currently available, but it is apparent that considerable water savings should be realized from the present and planned programs being implemented in Region II. Determining the likely effectiveness of additional conservation measures should be tasks undertaken as part of the recommended Regional Water Supply Plan.

Table 5-13 Region II: Estimated Water Demand During Drought Conditions (Mgal/d)

	2000	2005	2010	2015	2020
Water Use Category					
Public Supply	44.11	49.17	54.46	59.77	65.21
Domestic SS/Small Public Supply Systems	3.85	3.95	4.18	5.01	6.48
Commercial-Industrial Self-Supply	13.43	14.11	14.79	15.51	16.26
Recreational Irrigation	7.27	7.81	8.36	9.21	9.87
Agricultural Irrigation	1.66	1.76	1.93	2.07	2.27
Power Generation	0.00	0.00	0.00	0.00	0.00
Total	70.31	76.81	83.72	91.58	100.09
Increase Over Average Daily Demand	4.99	5.44	5.96	6.53	7.16

Table 5-14 Reuse of Domestic Wastewater in Region II in 1997

Domestic Wastewater Facility Name	Total Plant Capacity (Mgal/d)	Total Plant Flow (Mgal/d)	Reuse Capacity (Mgal/d)	Reuse Flow (Mgal/d)	Reuse Required
Okaloosa County					
Crestview Industrial Park	00.10	00.03	00.10	00.03	N
City of Crestview	02.10	01.30	02.10	01.30	N
Destin Water Users	05.00	02.18	05.00	01.43	Y
Eglin AFB Auxiliary Field #3	00.13	00.02	00.13	00.02	N
Eglin AFB Main BSE	01.00	00.56	01.00	00.56	N
Eglin AFB Plew	01.50	00.83	01.50	00.86	N
Ft. Walton Beach	04.65	02.77	04.65	02.77	Y
Town of Mary Esther	01.10	00.66	01.10	00.66	Y
Niceville – Valparaiso Reg.	03.72	02.64	03.72	02.64	N
Okaloosa Correctional Inst.	00.23	00.13	00.23	00.13	N
Okaloosa Co. Water & Sewer	06.50	04.54	06.50	04.54	Y
Russel, F. W. Stevenson	01.00	00.43	01.00	00.43	N/A
USAF Hurlburt Field	01.00	00.64	01.00	00.64	Y
County Total	28.03	16.76	28.03	16.01	5
Santa Rosa County					
Holley-Navarre WW System	00.50	00.48	00.50	00.46	N
City of Milton	02.50	01.36	00.00	00.00	N
Moors	00.10	00.01	00.00	00.00	N/A
Pace Water System	01.00	00.45	01.00	00.45	Y
Santa Villa Subdivision	00.12	N/D	00.12	N/D	N
South Santa Rosa Utilities	02.00	01.09	02.00	01.22	N/A
Whiting Field NAS	00.87	00.21	00.00	00.00	N
Navarre Beach	00.93	00.17	00.93	00.01	Y
County Total	08.02	03.77	04.65	02.60	2
Walton County					
City of DeFuniak Springs	00.75	00.53	00.00	00.00	N
Freeport	00.15	00.11	00.15	00.11	N
Point Washington (FCS)	00.57	00.26	00.57	00.26	N
Sandestin	01.20	00.71	01.20	00.71	Y
South Walton Utility Company	03.62	00.91	03.62	00.91	Y
Walton Correctional Institute	00.27	00.11	00.27	00.11	N/A
County Total	06.56	02.74	05.72	02.13	2
Region II Total	42.61	23.27	38.40	20.74	9

Source: NWFWMD 1997 Annual Reuse Report (ND = No Data)

REGION III: BAY COUNTY

Region-at-a-Glance	1995	2020
Population:	139,200	186,960
Avg. Water Use (Mgal/d):	56.56	72.08
Primary Source:	Deer Point Lake	
Regional Water Supply Plan Recommendation:	No Plan needed	

Demand Assessment Overview

Water Supply Planning Region III consists of Bay County. The region's population is most dense and fastest growing along the coast of the Gulf of Mexico in the Panama City Beach area. Tyndall Air Force Base, tourism, and forestry are important parts of the regional economy, with the largest employment sectors being services and retail trade.

Deer Point Lake reservoir, a surface water source, supplies the majority of fresh water used within the region, most of which is consumed for Commercial Industrial Self-Supply use and Public Supply. The reservoir supplies potable water to approximately two-thirds of the region's population. Ground water supplies about one-quarter of all water used in the region and is used for Public Supply, Domestic Self-Supply and Small Public Supply Systems, and Recreational Irrigation.

The Deer Point Lake reservoir discharges into the North Bay portion of the St. Andrews Bay estuarine system. As is the case for all of the large estuaries in northwest Florida, the ecological health of the St. Andrews Bay system is related to continued delivery of clean fresh water.

The Panama City Beach area, in the southern portion of the region, has been identified by the District as an Area of Special Concern (ASC) for water supply planning (Figure 5-29). This designation was established as part of the Water Supply Assessment (WSA) for areas where the potential for future water supply problems exists and close examination of both regional demand projections and locally-available water resources is warranted. The District currently monitors ground water in the vicinity of Panama City through its Very Intensive Study Area (VISA) network.

In recent years, the District has been active in water resource development and protection in this region. The District purchased approximately 8,000 acres along the Econfina Creek corridor that are critical to water quality. In December of 1997, the District purchased approximately 29,000 acres in the Sand Hill Lakes area that provides vital water recharge protection for Deer Point Lake. With an average recharge rate of approximately 30 inches a year, this is one of the highest recharge areas in the district.

Existing Water Use (1995)

Table 5-15 contains Region III (Bay County) water use figures by category for 1995 and Figure 5-29 illustrates the location of permitted water withdrawals within the region that are greater than 0.1 Mgal/d.

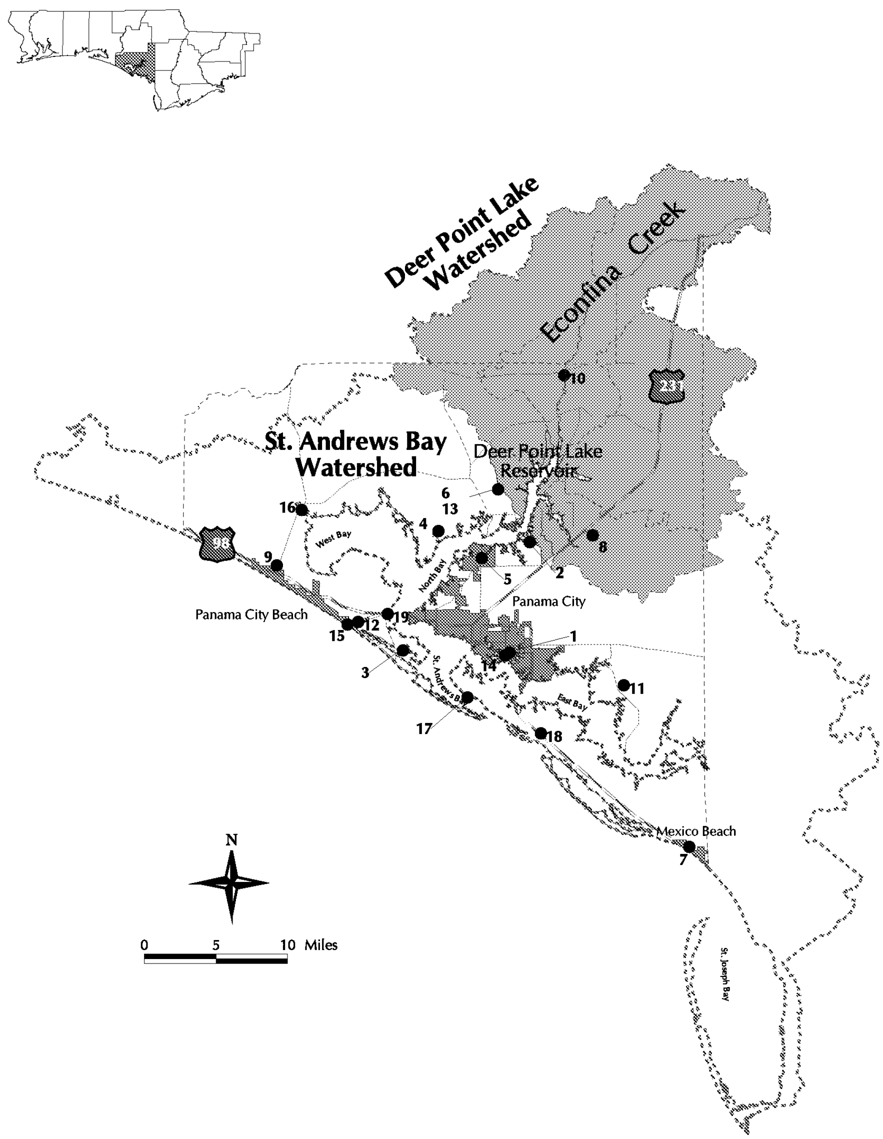
Public Supply

Public Supply accounted for approximately 40 percent (24.32 Mgal/d) of average regional water use in 1995. Panama City Beach located within the Area of Special Concern (ASC) and Bay county Public Utilities located outside of the ASC are by far the largest public water suppliers in the region, with average withdrawals in 1995 of 9.65 Mgal/d and 9.69 Mgal/d, respectively.

Table 5-15 Region III: 1995 Water Use (Mgal/d)

	Bay County
Public Supply	24.32
Domestic SS/Small Public Supply Systems	2.24
Commercial-Industrial SS	27.69
Recreational Irrigation	1.90
Agricultural Irrigation	0.00
Power Generation	0.41
Total	56.56

Figure 5-29
Region III



This map is for planning purposes only.
Withdrawal locations are approximate.

07-07-08

1995 Permitted Average Daily Rates (ADR) Greater Than 0.1 Mgal/d

(See following Page for Map Key)

Figure 5-29 Map Key

Index #	Permit #	Name	Primary Use*	Permitted ADR (gal/d)	Aquifer/Surface Water	Source*
1	880005	Arizona Chemical Company	IN	600,000	Floridan	GW
2	910142	Bay County Commission	PS	69,500,000	Deer Point Lake	SW
3	842561	Bay Point Yacht & Country Club	GI	169000	Floridan/Storage Pond	GW/SW
4	850073	Gulf Power Company	PP	265,300,000**	Floridan/North Bay	GW/SW
5	920038	City of Lynn Haven	PS	2,100,000	Floridan	GW
6	860209	McCall Sod Farm	NI	189,370	Floridan	GW
7	840084	City of Mexico Beach	PS	505,000	Floridan/Intermediate	GW
8	850252	Bay County Commission	PP	350,000	Floridan	GW
9	870158	City of Panama City Beach	PS	5,000,000	Floridan	GW
10	860027	Johnny and Jimmy Patronis	AI	427,142	Floridan	GW
11	890063	Sandy Creek Utilities	PS	119,420	Floridan	GW
12	842693	Signal Hill Golf Course	GI	255,000	Floridan/Surficial	GW/SW
13	860209	Donald P. Simmons	AI	506,565	Floridan	GW
14	841896	Stone Container Corporation	PS	256,575**	Floridan	GW
15	830032	Sunbird Condo Owner's Assoc.	HS	384,000	Floridan/Surficial	GW
16	960003	Department of Transportation	AR	144,000	Surficial	GW
17	850311	Tyndall Air Force Base	LA	400,000	Floridan/Surficial	GW
18	850313	Tyndall Air Force Base	PS	1,049,000	Floridan	GW
19	830026	United States Navy	HS	100,000	Floridan	GW

AI= Agricultural Irrigation, AR = Aquifer Recharge, GI = Golf Course Irrigation, HS = Heat Pump Supply, IN = Industrial, LA = Landscape Irrigation, NI = Nursery Irrigation, PP = Power Production, PS = Public Supply, WR = Water-based Recreation, AQ = Aquaculture, GW = Ground Water, SW = Surface Water
**Virtually all water returned to the source.

Domestic Self-Supply and Small Public Supply Systems

Water use by Domestic Self-Supply and Small Public Supply Systems accounted for approximately four percent of the region's total average water use (2.24 Mgal/d) in 1995. Approximately 8.4 percent of the region's population (11,638 people) utilized Domestic Self-Supply and Small Public Supply Systems in 1995.

Commercial-Industrial Self-Supplied

The Commercial-Industrial Self-Supplied water use category accounts for the most water used within the region, with approximately 52 percent of total average regional water use (27.69) being attributed to this category in 1995. Some of the largest water users in this category are Stone Container Corporation, Arizona Chemical Division of International Paper, and Tyndall Air Force Base. All Commercial-Industrial Self-Supplied water use is located outside of the region's ASC, and the Deer Point Lake reservoir is the source for the majority of this water.

Recreational Irrigation

Recreational Irrigation water use accounts for a small percentage of the region's total average water use. In 1995 only an average of 1.90 Mgal/d (three percent of the regional average water use) was used for Recreational Irrigation. Golf courses are the major users of water in this category.

Agricultural Irrigation

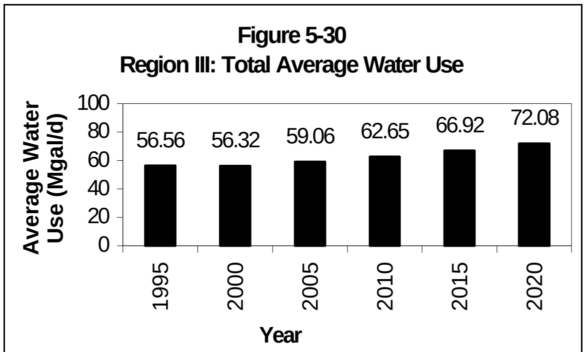
Although there is some permitted Agricultural Irrigation in the region (less than 1 Mgal/d in 1995) the amount of water used is so minimal that it has not been included in this assessment.

Power Generation

In 1995, water consumed by Power Generation accounted for less than one percent of the region's total average water use. The region's only user of water for Power Generation is Gulf Power Company's Smith Power Plant located outside of the ASC of Bay County. The Smith Power Plant withdrew approximately 259 Mgal/d in 1995. However, because the majority of the water withdrawn was used for once-through cooling and returned to North Bay, it is estimated that only 0.41 Mgal/d was actually consumed for Power Generation.

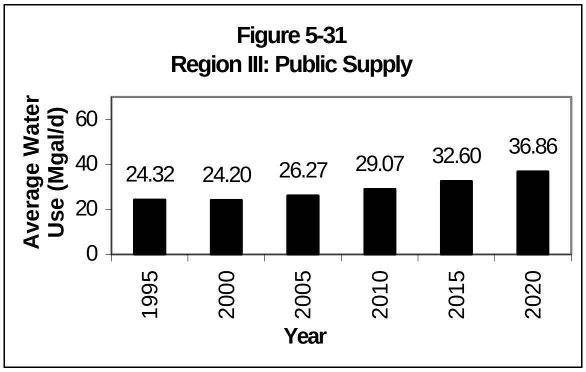
Reasonably Anticipated Future Needs for Each Water Use Category Through 2020

Average regional water use is projected to increase from approximately 56.56 Mgal/d in 1995 to 72.08 Mgal/d in the year 2020, an increase of approximately 26 percent (Figure 5-30 and 5-35). Although the Domestic Self-Supply and Small Public Supply Systems category is expected to have the largest percentage increase between 1995 and 2020 the majority of the region's population will remain dependent upon Public Supply (Table 5-16). Public Supply is expected to become the largest water use category in the region by 2020. The growth in Public Supply water use is projected to occur, almost entirely in the Panama City Beach area.



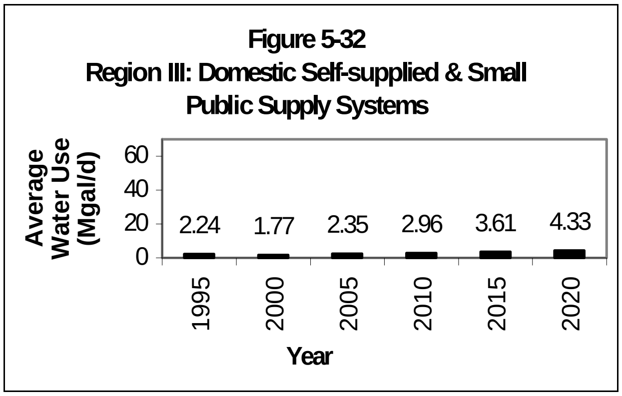
Public Supply

Water use projections (Figure 5-31) indicate that Public Supply will become the predominant water use category in Region III by 2020. The projections indicate that use will increase by approximately 36 percent from an average of 24.32 Mgal/d in 1995 to 36.86 Mgal/d in 2020.



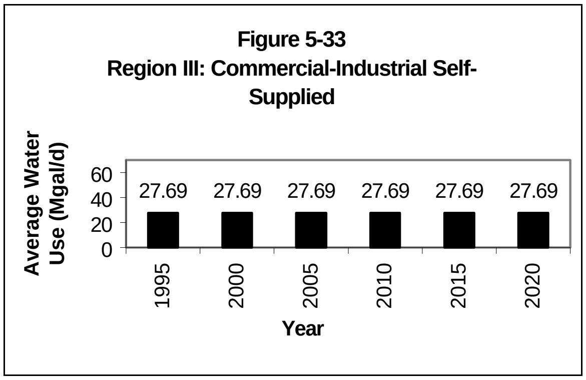
Domestic Self-Supply and Small Public Supply Systems

This water use category is expected to increase by the largest percentage between 1995 and the year 2020 (Figure 5-32). It is projected that Bay County population utilizing Domestic Self-Supply and Small Public Supply Systems will increase from eight percent of the population in 1995 to 11 percent of the population in 2020. The amount of water used by this category is projected to increase from 2.24 Mgal/d in 1995 to 4.33 Mgal/d in 2020.



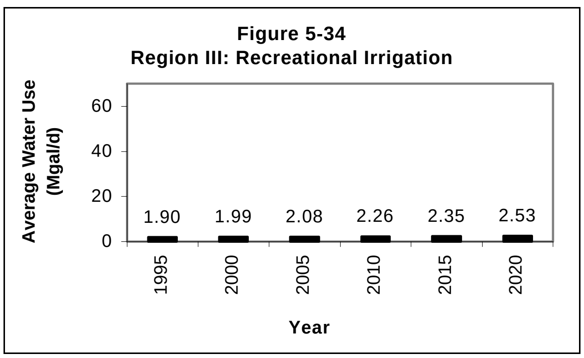
Commercial-Industrial Self-Supplied

Commercial-Industrial Self-Supplied water use accounted for approximately 52 percent of average regional water use in 1995. Water use in this category is projected to remain constant at approximately 27.69 Mgal/d between 1995 and 2020 (Figure 5-33). By the year 2020 this will no longer be the largest water use category due to a projected increase in the amount of water used for Public Supply.



Recreational Irrigation

Recreational Irrigation includes water used for golf course irrigation and accounts for only a small percentage of the region's total average water use. Water use in this category is expected to increase by approximately 32 percent from 1.90 Mgal/d in 1995 to 2.53 Mgal/d in 2020 (Figure 5-34).



Agricultural Irrigation

Projections indicate that the amount of water used in Bay County for Agricultural Irrigation will remain extremely small through 2020.

Power Generation

Water withdrawal for Power Generation use in Region III was approximately 259 Mgal/d in 1995 and projected to increase slightly by the year 2020 (271 Mgal/d). However, because this report considers impacts to the resource, the figures reported here are for water that is actually *consumed* by Power Generation. For planning purposes, water is considered consumed when it is withdrawn and either not returned to the source or not returned in the same location where it was withdrawn. Many power plants utilize water for once-through cooling, returning virtually all of the water to the point of withdrawal. Water use by Gulf Power Company's Smith Power Plant is projected to increase from approximately 0.41 Mgal/d in 1995 to approximately 0.67 Mgal/d in 2020.

Source Evaluation

Within Region III and for virtually all uses, surface water is the principal source of supply. In 1995, surface water accounted for roughly 75 percent of the fresh water used within the region. Ground water supplied the remaining 25 percent. These percentages are likely to shift toward greater surface water use in the future.

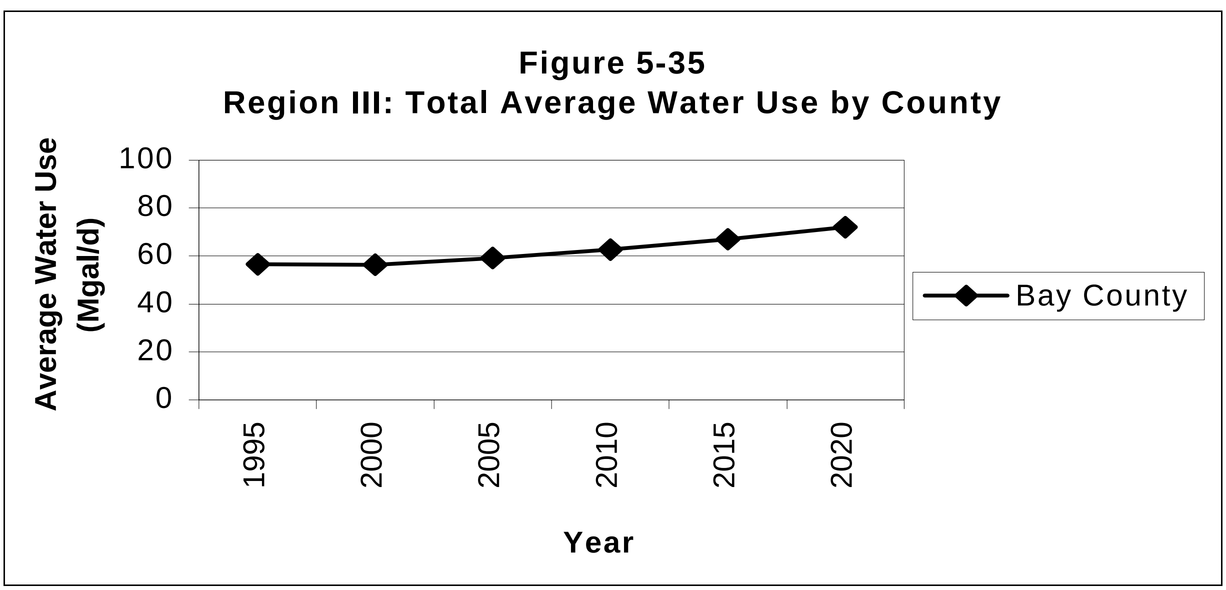


Table 5-16 Bay County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	24.32	24.20	26.27	29.07	32.60	36.86
Domestic SS/Small Public SS	2.24	1.77	2.35	2.96	3.61	4.33
Commercial-Industrial SS	27.69	27.69	27.69	27.69	27.69	27.69
Recreational Irrigation	1.90	1.99	2.08	2.26	2.35	2.53
Agricultural Irrigation	0.00	0.00	0.00	0.00	0.00	0.00
Power Generation	0.41	0.67	0.67	0.67	0.67	0.67
Total	56.56	56.32	59.06	62.65	66.92	72.08
Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Area of Special Concern	11.48	12.17	13.54	15.94	17.75	19.64
Non Area of Special Concern	45.07	44.14	45.52	47.81	50.98	55.05
Total	56.55	56.31	59.06	63.75	68.73	74.69
Large Public Supply System Water Use	1995	2000	2005	2010	2015	2020
Total population served	127,562	135,829	134,247	139,919	145,680	151,559
Percent of total population	92	93	92	91	90	89
Per capita (gal/d)	191	178	183	192	205	221
Average Daily Flow of Large Public Supply Systems (Mgal/d)	1995	2000	2005	2010	2015	2020
Utility						
ASC						
Panama City Beach	9.65	10.39	11.37	12.36	13.34	14.32
NonASC						
Bay Co. Public Utility	12.65	11.71	12.63	14.29	16.67	19.79
Lynn Haven	1.55	1.65	1.81	1.97	2.12	2.28
Mexico Beach	0.42	0.40	0.40	0.40	0.41	0.41
Sandy Creek Utilities	0.05	0.05	0.05	0.06	0.06	0.06
Total	24.32	24.20	26.27	29.07	32.60	36.86

The projected increase in water use for the region from 1995 to 2020 is 15.5 Mgal/d (total of 72.1 Mgal/d). The public supply demand increase is the majority of the total (12.5 Mgal/d). Assuming that by 2020 the entire Panama City Beach demand is shifted to surface water, surface water will account for about 90 percent of the total region freshwater demand. Ground water will shrink to ten percent of the total. The traditional source for ground water is the Floridan Aquifer. Given the high availability of water from Deer Point Lake, surface water is anticipated to remain the principal source of supply for all freshwater uses through 2020.

Historically, Bay County was dependent on ground water for public and industrial supplies of water. Ground water withdrawals began in earnest in the 1930s, with the construction of a combined Floridan and Surficial Aquifer wellfield in Panama City to supply water to the International Paper Company mill (Musgrove et al. 1965). Subsequent to this, Floridan Aquifer wells were constructed to supply water to Panama City and Tyndall AFB. In the late-1940s, ground water use was about 8.5 Mgal/d. By the early 1960s, withdrawals had grown to about 25 Mgal/d. Most of this water was obtained from the Floridan Aquifer.

As a result of this pumping, the potentiometric surface of the Floridan Aquifer was substantially depressed around Panama City. Water levels in the vicinity of the International Paper cone of depression were as much as 115 ft below sea level through the 1950s and into the early 1960s (Musgrove et al. 1965). In recognition that continued reliance on ground water posed a threat of saltwater intrusion, work on an alternate water supply was completed in 1961. This work culminated in the construction of the Deer Point Lake reservoir. In February 1964, International Paper began to receive 30 Mgal/d from the reservoir. By late 1967, the City of Panama City and Tyndall AFB began to obtain public supply water from the reservoir as well. With the large-scale reduction in Floridan Aquifer ground water usage, water levels quickly rebounded.

Overview of Hydrologic System

The principal surface water features within Region III are the St. Andrews Bay system and Deer Point Lake and its tributaries. The St. Andrews Bay system consists of West, North, East and St. Andrews bays and has a surface area of approximately 90 mi^2. It lies immediately behind the Gulf of Mexico shoreline throughout coastal Bay County. In 1961, part of North Bay was impounded to form Deer Point Lake. This surface impoundment is the principal source of industrial and potable water in Region III. Tributaries to Deer Point Lake contribute, on average, about 620 Mgal/d to the lake (Musgrove et al. 1965). Present water use from the reservoir is about 45 Mgal/d.

Ground water is of significance from two perspectives. First, a significant fraction of the surface water discharged into the Deer Point Lake reservoir originates as discharge from the Floridan Aquifer. This discharge is conveyed to Deer Point Lake via Econfina Creek. Second, ground water use in Region III amounts to about 13 Mgal/d. Panama City Beach gets about one-third of its average daily demand (approximately 3.5 Mgal/d) from the Floridan Aquifer.

Surface Water Hydrology

Climate in the Deer Point Lake region is humid and subtropical. Average summer temperature is 82° F and the winter average temperature is 53° F (Schmidt and Clark 1980). Streamflow runoff averages about 60 in/yr from the upper portions of the basin; ground water contributions made up the majority of the flow in the lower portions of the basin. July, August and September are generally the wettest months. Weather fronts cause most of the winter rainfall, whereas thundershowers and tropical depressions account for most of the rain in other seasons.

Deer Point Lake Tributaries

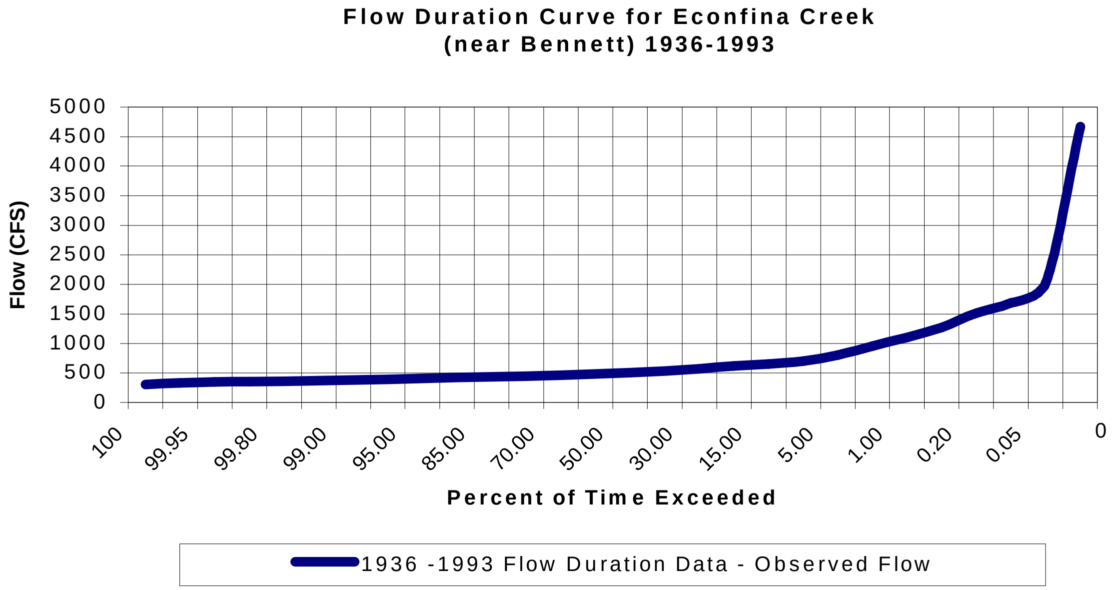
Deer Point Lake, a man-made impoundment, has four principal tributaries, Econfina, Bear, Bayou George and Big Cedar creeks. Of the four, Econfina Creek is, by far, the most significant. Its importance derives from its role as the largest contributor of stream inflow (approximately 58 percent) to the lake under average flow conditions (Richards 1997). Under low flow conditions (Q_{90} flows, which indicate flows that are not expected to be exceeded ten percent of the time), Econfina Creek contributes an even larger share of the total stream inflow (approximately 72 percent). The large streamflow and base flow contributions derive, in part, from the significant Floridan Aquifer discharge occurring along the middle Econfina Creek. Given the watershed characteristics of the Econfina basin, ground and surface waters derived from the watershed are presently of high quality.

ECONFINA CREEK

Econfina Creek is centrally located in Region III and is the major tributary to Deer Point Lake. Above Highway 388, Econfina Creek has a drainage area of 129 mi^2. The drainage basin lies within two major physiographic regions: the Coastal Lowlands and the Dougherty Karst. That portion of the watershed that lies within the Dougherty Karst includes parts of the Sand Hills and Sand Hill Lakes subregions. The Sand Hills, located in the northern portion of the basin, are comprised of the remnants of higher marine terraces. The Sand Hills Lakes subregion lies along the middle Econfina Creek on the west side of the creek. Sinks, karst lakes and internal drainage characterize this area. The excessively drained, deep sandy soils, combined with the internal drainage associated with closed karst basins, facilitate recharge to the Floridan Aquifer. In turn, this gives rise to a high base-flow rate for Econfina Creek. Poorly drained flatwood forests lie upon the Coastal Lowlands found in the southern portion of the basin.

Econfina Creek at Highway 388 has the following streamflow statistics: annual mean flow of 350 Mgal/d (541 cfs); Q_{90} flow of 260 Mgal/d; an observed seven-day minimum flow of 199 Mgal/d (U.S. Geological Survey 1993). The 7Q10 flow is 228.4 Mgal/d (353.6cfs). These statistics are based on a 1936 through

Figure 5-36 Flow Duration Analysis for Econfina Creek (Near Bennett)



1993 period of record. Based on an annual mean discharge of 541 cfs, Econfina Creek above Highway 388 has an annual mean unit discharge of 4.43 cfs/mi^2. By regional standards, this value is high and is attributable to the significant springflow component of streamflow. Along Highway 20, a number of Floridan Aquifer springs discharge to the creek, including first-magnitude Gainer Springs. In this area of the creek the Floridan Aquifer is exposed, resulting in the formation of numerous springs. Gainer is the largest of the springs along the Econfina and typically has a discharge greater than 100 cfs (64.6 Mgal/d). Base-flow rates along the upper Econfina Creek (above Walsingham Bridge) are more typical for northwest Florida. In this area, base flow is the result of diffuse discharge from the Surficial Aquifer System (Figure 5-36).

Bear Creek

Bear Creek is the second largest tributary to Deer Point Lake. This creek drains a region to the east and northeast of the lake that has a large amount of poorly drained swampy areas. The watershed area is 128 mi^2. Based on continuous discharge records from 1962 to 1965, the creek has an average flow of 226 Mgal/d and an estimated Q_{90} of 103.4 Mgal/d. This creek is typical of the blackwater streams common in northwest Florida. It has a number of organic-bottom tributary streams that come together to form the sand-bottomed main channel known as Bear Creek. These tributaries originate in swamps and bogs common in the Gulf Coastal Lowlands. The waters are slightly acidic and increases in color are typical following rainy periods due to flushing of organic materials from the adjacent swampy areas.

Bayou George Creek

Bayou George Creek is located to the south of Bear Creek and directly east of Deer Point Lake. It has a drainage area of 51 mi^2. Based on periodic discharge measurements between 1962 and 1965, the creek has an average flow of 26 Mgal/d (Musgrove et al. 1965). This creek, like Bear Creek, drains low-lying swampy areas within the Gulf Coastal Lowlands and may be characterized as a blackwater stream. The mouth of this creek was inundated when Deer Point Lake was formed and is now a drowned stream valley referred to as Bayou George.

Big Cedar Creek

Big Cedar Creek has the lowest flow of any of Deer Point Lake's tributaries. Based on periodic discharge measurements between 1962 and 1965, the creek has an average flow of 12 Mgal/d

(Musgrove et al. 1965). It is located to the west of Econfina Creek and northwest of the lake, draining an area of 62 mi^2 (Musgrove et al. 1965). This creek originates from Court Martial Lake within the well-drained sandhill region of southern Washington County and the western part of Bay County. This creek may also be characterized as a blackwater stream and has similar characteristics to Bear Creek and Bayou George Creek.

The four described tributary streams contribute an average flow of approximately 620 Mgal/d (960 cfs) to Deer Point Lake (Musgrove et al. 1965). With a drainage area of 370 mi^2, (total lake drainage area is 442 mi^2) these tributaries contribute an average unit discharge of 1.68 cfs/mi^2 to the lake. During low flow periods (Q_{90} flows), the streams continue to produce approximately 363 Mgal/d (563.2 cfs, 1.52 cfs/mi^2). The lake supplies, on average, 45 Mgal/d of water to various supply and industrial water systems in Bay County (Richards 1997).

Deer Point Lake Reservoir Characteristics

Deer Point Lake was created in 1961 following construction of a low-head causeway dam across North Bay at Deer Point, northeast of Panama City. The impounded area was once part of the North Bay-Bayou George estuarine system and an arm of the larger St. Andrews Bay system. The impoundment of fresh water in Deer Point Lake commenced with the closure of the causeway dam on November 17, 1961. Water began spilling over the dam on November 28th. The resultant reservoir has approximately 4,698 surface acres, a total drainage area of 442 mi^2, and 285 miles of shoreline. The lake's watershed includes portions of Bay, Washington, Jackson, Gulf and Calhoun counties. Inflow is primarily provided by four tributary streams; Econfina, Bear, Big Cedar, and Bayou George creeks. Econfina Creek is the major freshwater source, contributing over 500 cfs. At an elevation of 4.5 ft above sea level (top of spillway elevation), the storage capacity of Deer Point Lake is 32,000 acre-feet. The lake usually maintains a stage of about 5 ft, with extreme stages being a maximum of 7.81 ft (1975) and a minimum of 4.82 ft (1968).

The major surface waters within the Deer Point Lake drainage basin are all Class I waters and have been so designated according to their eventual use as a public water supply. Other waters in the basin would generally be classified as Class III waters, with the primary use being recreation-propagation and management of fish and wildlife. The discharge from the lake enters Class II waters in North Bay and St. Andrews Bay, classified as such for usage as shellfish harvesting waters. The lake and many surface water features within the watershed are of additional regional and statewide significance as recreational resources and as valuable habitat for many significant species.

St. Andrews Bay Tributaries

Deer Point Lake is the largest contributor of fresh water to the St. Andrews Bay estuary system, although not the only one. Together with Deer Point Lake, five other streams contribute, on average, an estimated 818 Mgal/d (1,266 cfs) of fresh water to the estuarine system (Musgrove et al. 1965).

Wetappo Creek, which with a drainage area of 77 mi^2, delivers an average flow of 80 Mgal/d (124 cfs) to the eastern edge of East Bay (period of record 1936, and 1962 through 1964), with an instantaneous low flow of six Mgal/d (9.3 cfs). The drainage basin can contribute 1.6 cfs/mi^2 during average flow conditions and 0.12 cfs/mi^2 during the instantaneous low flow condition.

Sandy Creek, west of Wetappo Creek, also discharges into East Bay. Its drainage basin is 60 mi^2, and it discharges 70 Mgal/d (108 cfs) under average conditions, with an instantaneous low flow of ten Mgal/d (15.5 cfs) (period of record 1962 through 1965). The drainage basin can contribute 1.8 cfs/mi^2 during average flow conditions and 0.28 cfs/mi^2 during the instantaneous low flow condition.

Callaway Creek likewise discharges to East Bay, and with a drainage basin of 13 mi^2, discharges nine Mgal/d (14 cfs) to the estuary system during average conditions, with an instantaneous low flow of 0.6 Mgal/d (0.93 cfs) (period of record 1962 through 1964). The drainage basin can contribute 1.1 cfs/mi^2 during average flow conditions and 0.07 cfs/mi^2 during the instantaneous low flow condition.

Burnt Mill Creek discharges an average of 23 Mgal/d (36 cfs), (8 Mgal/d, 12.4 cfs) instantaneous low flow) into West Bay from its 45 square mile drainage basin. The drainage basin can contribute 0.8 cfs/mi^2 during average flow conditions and 0.27 cfs/mi^2 during the instantaneous low flow condition (period of record 1962 through 1964).

Crooked Creek also discharges into West Bay, contributing an average flow of 17 Mgal/d (26 cfs), with an instantaneous low flow condition of six Mgal/d (9.3 cfs) from a watershed area of 22 mi^2. The drainage basin can contribute 1.2 cfs/mi^2 during average flow conditions and 0.42 cfs/mi^2 during the instantaneous low flow period (period of record 1962 through 1964).

Ground Water Hydrology

Three hydrostratigraphic systems define the regional ground water-flow system; a thin Surficial Aquifer System, a moderately thick Intermediate System, and a thick Floridan Aquifer System (Figure 5-37). The Surficial Aquifer System and the Floridan Aquifer System are composed of moderately to highly-permeable sediments, capable of transmitting and storing large quantities of water. The Intermediate System is primarily composed of low-permeability sediments and forms a regionally-extensive confining unit. Along the coastline, the permeability of the Intermediate System is sufficiently high to form a locally significant aquifer system.

The Surficial Aquifer System typically consists of unconsolidated quartz sand. Ground water within the Surficial Aquifer System exists, for the most part, under unconfined conditions. The thickness of the Surficial Aquifer ranges between 40 ft and 80 ft in coastal Bay County. In the inland parts of the county, its thickness is typically 40 ft or less. In low-lying areas along the Econfina Creek, the Surficial Aquifer is absent. Along the coastal fringe, the saturated thickness and permeability of the surficial sands are sufficient to form a locally important source of ground water.

The International Paper Company mill in Panama City had 12 Surficial Aquifer supply wells, some of which were constructed as early as the 1930s. Yields were as high as 500 gpm and specific capacities were as high as 18 gpm/ft. Elsewhere in coastal Bay County, Surficial Aquifer well yields are as high 200 gpm, with specific capacities as high as 20 gpm/ft. Clearly, the Surficial Aquifer in coastal Bay County is capable of meeting some of the local water use needs, particularly for nonpotable uses. In order to utilize this resource, well depths less than 100 ft are sufficient.

Underlying the Surficial Aquifer is the Intermediate System. This unit consists primarily of fine-grained clastic sediments that typically have lower permeability than either the overlying Surficial Aquifer System or the underlying Floridan Aquifer System. In central and northern Bay County, the thickness of the Intermediate System is typically 100 ft or less. In coastal Bay County, carbonate beds and/or coarse-grained clastic sediments are of sufficient thickness to form a locally important aquifer within the Intermediate System. In this area, the Intermediate System reaches a thickness of 200 to 300 ft. Because of its relatively high hydraulic conductivity along the coast, the Intermediate System behaves as a leaky confining unit. In pre-development times, water in the Floridan Aquifer, having higher hydraulic head, discharged upward through the Intermediate System into the overlying Surficial Aquifer. The coastal fringe of Bay County, including West, East, North and St. Andrews bays was, therefore, a significant discharge area for the Floridan Aquifer. Recently, pumpage has reversed this discharge condition in much of coastal Region III.

The City of Panama City had two Intermediate System wells (Millville Plant wells). These wells were constructed in the 1930s and had specific capacities of 6.5 and 4.7 gpm/ft, respectively. Yields were on the order of 200 to 300 gpm. In extreme southeast Bay County, the City of Mexico Beach has a pair of Intermediate System wells used for Public Supply. Specific capacities for these wells are nine and 11.5 gpm/ft, respectively. Both wells yield about 300 gpm. Finally, the community of Inlet Beach, in southeast Walton County (adjacent to the Bay County line), has a single Intermediate System public supply well. This well has a specific capacity of 2.4 gpm/ft and a yield of 210 gpm. Although not as productive as the overlying Surficial Aquifer System, the Intermediate System in coastal Bay County is capable of yielding economically-significant quantities of water.

Underlying the Intermediate System is the Floridan Aquifer System. The Floridan Aquifer System is the source of most of the ground water pumped in Region III. It consists of a thick sequence of carbonate sediments of varying

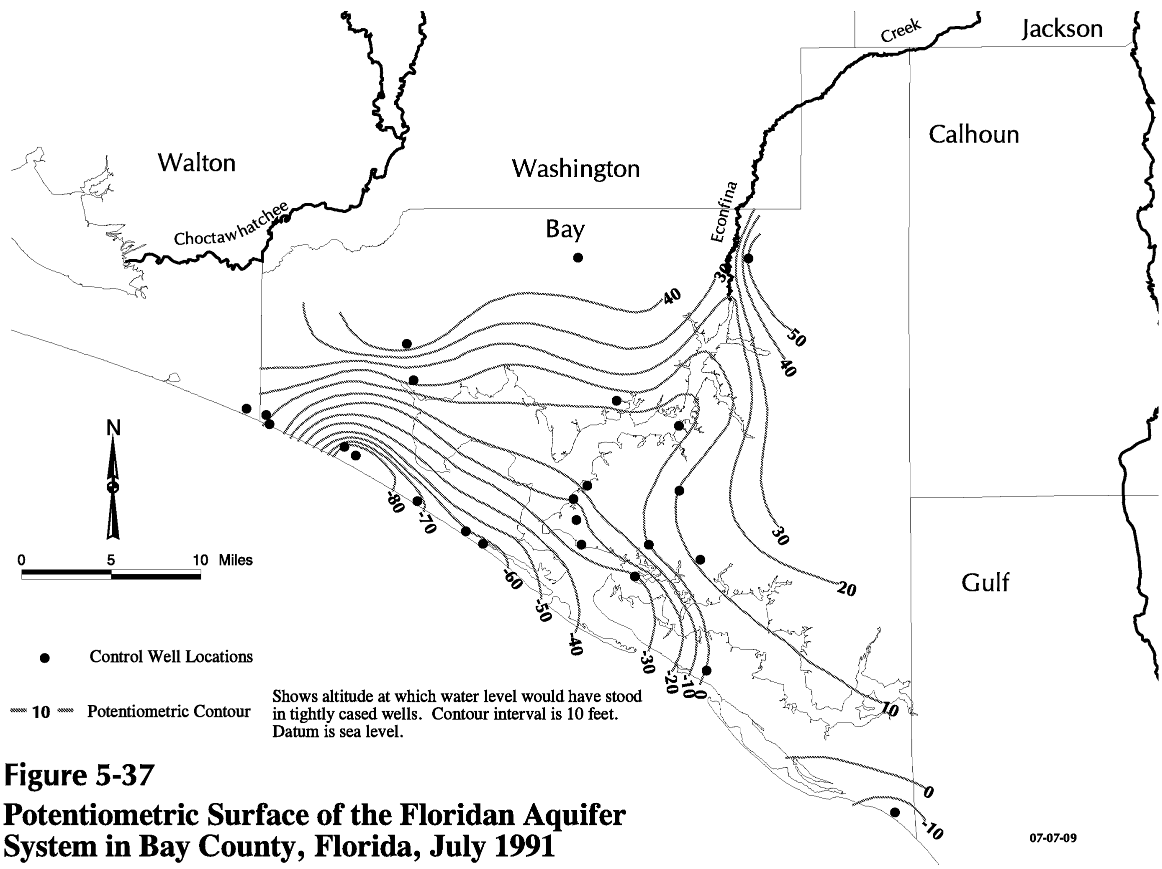


Figure 5-37
Potentiometric Surface of the Floridan Aquifer System in Bay County, Florida, July 1991

permeability. The aquifer thickness ranges from about 600 ft in northeast Bay County to more that 1,400 ft in the extreme southeast part of the county.

Throughout Region III the hydraulic conductivity of the Floridan Aquifer is quite variable. Through poorly substantiated by field data, hydraulic conductivities are believed to be highest along the Washington-Bay County line. This area is the southernmost extension of the Dougherty Karst Plain, an area of active recharge, flow and dissolution of the Floridan Aquifer System. In the coastal part of the county, hydraulic conductivities are much lower. Here measured transmissivities are on the order of 1,000 to 5,000 ft^2/day. The Sub-Floridan System underlies and confines the Floridan Aquifer System. Due to a lack of data, little is known of the hydraulic character of this unit.

Floridan Aquifer System Water Levels

The Floridan Aquifer System's zone of contribution, within which Region III lies, extends into southern Washington, and eastern Calhoun and Gulf counties (Richards 1997). On the east side of Econfina Creek and in the Bay County panhandle, the potentiometric surface of the Floridan Aquifer reaches a maximum elevation of approximately 130 ft above sea level. From this high, water levels decline in all directions (including north into Jackson County). On the west side of Econfina Creek (along the Washington-Bay County line), the potentiometric surface stands lower; reaching a maximum elevation of about 45 ft above sea level. From these potentiometric surface highs, water levels decline toward the Gulf of Mexico.

Hydrographs for three wells are presented to depict long-term trends in Floridan Aquifer water levels (Figure 5-38). Data are presented for a well at Tyndall AFB (Tyndall #7), for a well near the Panama City Airport (Fannin Airport well), and for a well in Panama City Beach (Argonaut Street well). All three wells show regional water level impacts due to pumping. The Fannin Airport and

Tyndall wells have comparable periods of record. Both depict water level declines in the early to late 1960s that were attributable to the International Paper, Panama City and Tyndall AFB Floridan Aquifer pumping. With the cessation of significant Floridan Aquifer pumping by these entities, water levels in both wells rebounded.

Subsequent to this recovery in 1967, Floridan Aquifer water levels almost immediately began to drift down again. This downward trend is most evident in the Fannin well and probably represents an increase in ground water withdrawals occurring in Panama City Beach. As a result of pumping in Panama City Beach, a significant cone of depression has formed in the Floridan Aquifer. Water levels in the cone are depressed as much as 80 ft below sea level.

Panama City Beach constructed four wells in the 1960s and five wells in the 1970s. Beginning around 1980, the Fannin well exhibits fairly large seasonal fluctuations in water levels indicative of water use in a tourism-driven community such as Panama City Beach. By the late 1980s, water levels in the Fannin well were seasonally below where they had been in the late 1960s.

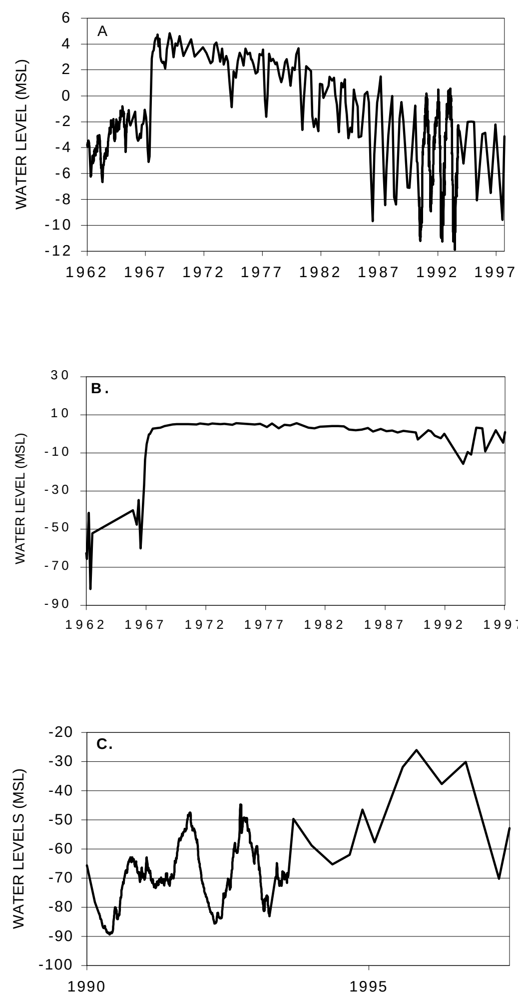
Water level data is also available from Panama City Beach proper, beginning in 1990. Argonaut Street well water levels have ranged between 90 and 30 ft below sea level. This well also shows evidence of fairly large seasonal fluctuations in water levels. The Argonaut Street hydrograph indicates that the Panama City Beach cone of depression has existed since at least 1990. Likely, it has existed for much longer than that.

Floridan Aquifer System Water Quality

Over most of Region III, the quality of ground water in all three aquifer systems is suitable for most uses. By tradition, potable ground water has been obtained from the Floridan Aquifer System. Some potable water is presently being obtained from the Intermediate System (e.g. Mexico Beach and Inlet Beach). Typically, the Surficial Aquifer is used for nonpotable uses (e.g. Recreational Irrigation).

Water quality data from the Floridan Aquifer in the interior of the region (away from bays and the gulf) show low concentrations of sodium, chloride and total dissolved solids (TDS). Data from seven wells sampled between 1986 and 1994 had the following mean concentrations: sodium—4.8 mg/L (n = 19); chloride—3.8 mg/L (n = 16); TDS—175 mg/L (n = 10).

Figure 5-38: Hydrographs of the A) Fannin Airport, B) Tyndall #7, and C) Argonaut Street Floridan Aquifer Wells



Along the coastline, the Floridan Aquifer contains water with elevated (relative to the region's interior) concentrations of sodium, chloride and TDS. Data (1986 to 1994) from five wells located in proximity to a saline surface waterbody had the following mean concentrations: sodium—87 mg/L (n = 12); chloride—124 mg/L (n = 9); TDS—530 mg/L (n = 5).

Panama City Beach presently has a total of 13 Floridan Aquifer public supply wells. Recent data from these wells (submitted as a Consumptive Use Permit condition) also show similar, elevated levels of sodium, chloride and TDS. Based on data collected between 1989 and 1998, Panama City Beach wells have the following mean concentrations: sodium—79 mg/L (n = 127); chloride—151 mg/L (n = 118); TDS—444 mg/L (n = 127).

Since 1993, six wells (#1, #2, #4, #5, #11 and #12) have had one or more TDS analyses exceeding the secondary drinking water standard of 500 mg/L. During the same period, well #1 had two chloride analyses exceeding the secondary drinking water standard of 250 mg/L. Well #2 had both sodium (three of 10 analyses) and chloride (seven of nine analyses) standards exceedances. Sodium has a primary drinking water standard of 160 mg/L. Well #8 also had sodium, chloride and TDS standards exceedances. Presently this well and well #7 are not in use.

Historical chloride concentration data are available for individual Panama City Beach wells (Table 5-3). These data were compared with more recent data to determine if chloride concentrations have increased with time. For wells #1 through #10 (except well #6), a single chloride value is available for 1977 (Barr and Wagner 1981). For wells #1 through #13, chloride data for the period 1993 through 1998 are also available (NWFWMD Consumptive Use Permit files).

The 1977 chloride data were compared with data collected from the same wells during 1993-1998 to ascertain if the 1977 data significantly differed from the latter data set. Non-parametric prediction intervals were used to decide if a well's 1977 chloride observation fell outside the prediction interval, at the five percent significance level. Prediction intervals are more appropriate than confidence intervals for testing whether or not a single observation belongs to a data set. Further, unlike confidence intervals, prediction intervals do not assume a priori that data conform to any particular distribution (e.g. normal or log normal).

Up to three sets of prediction intervals were calculated: one without the assumption that the data conformed to a given distribution (i.e. non-parametric); and up to two sets based on the assumption of either a normal or log normal distribution (depending on the form of the data histogram). All three methods tended to give similar limits. The non-parametric method was selected to make the comparison between the 1977 and the 1993-1998 data.

Based on this analysis, all the 1977 data was either within the prediction interval or fell below the lower prediction interval limit. In no instance did 1977 data lie above the upper prediction interval limit. Data from five wells (#2, #4, #7, #8 and #10) was below the lower prediction interval limit at the five-percent significance level. Therefore, the 1993-1998 means were higher than the 1977 values in these five wells, leading to the conclusion that chloride concentrations have increased as a function of time. The 1993-1998 mean concentrations for these wells are given in bold in Table 5-17.

Table 5-17 Chloride Concentration Data for Panama City Beach Wells

Well #	Chloride in 1977 (mg/L)	Mean Chloride (1993-1998)* (mg/L)	n
1	189	187	9
2	112	**263**	9
3	105	141	9
4	102	**155**	9
5	214	202	10
6	no 1977 data	80	9
7	11	**93**	6
8	15	**243**	7
9	115	123	9
10	83	**115**	8
11	no 1977 data	182	9
12	no 1977 data	135	9
13	no 1977 data	80	15

notes:*
Well #13 mean is based on data back to 1989.
1977 data are from Barr and Wagner (1981).

Using data from the period 1989-1998, sodium concentrations were statistically analyzed for the presence of temporal trends. These data were examined to test the hypothesis that the slope of a linear regression model fitted to the data was significantly different from zero. Sodium data from all thirteen wells were analyzed.

A significant positive time trend was found in the sodium data from 10 of 13 wells (excepting #1, #2 and #10). Significance was tested using the Student's t statistic and the null hypothesis that the slope of the fitted regression line is zero. A five percent confidence interval was utilized. Examples of the sodium data with the fitted regression lines are given in Figure 5-39.

Regression analysis statistics for all 13 wells are given in Table 5-17. For those wells with a significant positive regression line slope, the year in which regression line intercepts the 160 mg/L sodium primary drinking water standard is also given. Wells in Table 5-18 are ordered on the basis of these dates.

Table 5-18 Regression Statistics for Sodium Data from Panama City Beach Wells

Well #	n	R^2	Slope (mg/L/year)	Year	Significant Slope (>0)
8	7	0.9	27.3	1997	yes
5	10	0.707	9.49	2001	yes
7	7	0.944	12.8	2004	yes
4	10	0.846	8.65	2004	yes
11	10	0.532	6.57	2005	yes
12	9	0.556	4.38	2015	yes
3	9	0.679	4.34	2016	yes
9	10	0.557	3.98	2020	yes
6	10	0.546	3.80	2027	yes
13	16	0.5	3.03	2032	yes
1	9	0.002	0.99		no
2	10	0.09	-3.50		no
10	10	0.443	3.39		no

Ground Water Budget

In order to assess the role that Floridan Aquifer ground water may play in Region III water supply through 2020, a region-scale ground water budget was prepared (Figure 5-40). As presented here, the ground water budget is intended to present an order-of-magnitude approximation of the major Floridan Aquifer System sources and discharges for the region. It was prepared using output from a calibrated flow model. Although a calibrated steady-state model does not account for seasonal or annual variation in flow, the model does provide a means to estimate the relative magnitude of the various inflows to and outflows from the aquifer.

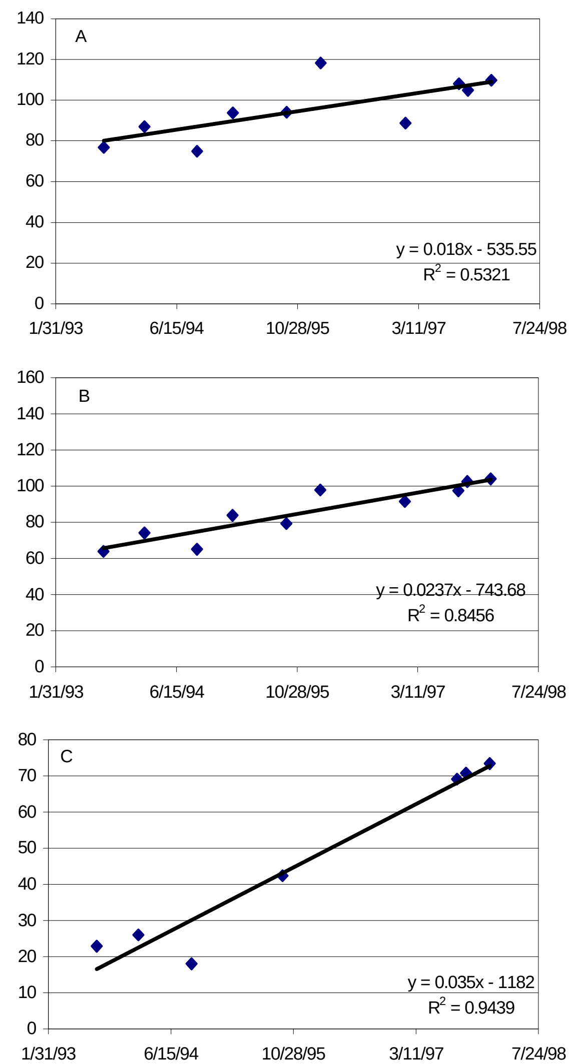
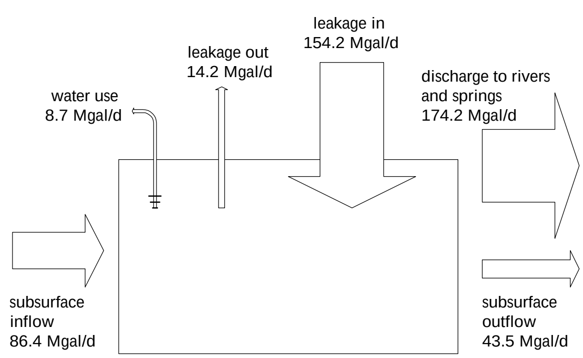


Figure 5-39 Sodium Concentration Data for Panama City Beach Wells A) Well #11, B) Well #4, C) Well #7

Figure 5-40 Region III Floridan Aquifer Ground Water Budget for 1996 Calibration Period



The flow system components were estimated using output from a steady state, two-dimensional ground water flow model (Richards 1997). The model was calibrated to measured water levels from over 130 wells completed in the Floridan Aquifer and 19 stream flow measurements. All measurements were recorded during August 1996 and the model calibrated to conditions as they occurred at that time. Nine of the stream flow measurements were recorded along the length of the Econfina Creek. The model showed Floridan Aquifer discharge rates to be properly distributed along the length of Econfina Creek and generally within ten percent of measured flow. Region III lies entirely within the domain of the Richards 1997 model.

In order to estimate water budget components for just the region, the computer program ZONEBUDGET (Harbaugh 1990) was to analyze the model output of Richards. ZONEBUDGET allows the user to define a subregion within a MODFLOW model domain and to calculate the inflow and outflow to that subregion. In this way, a subregion corresponding to Region III was defined and appropriate inflows and outflows calculated.

The Floridan Aquifer System, within the region, is overlain by the Intermediate System. The Intermediate System at the regional scale behaves as leaky confining unit and allows ground water to flow between the Surficial and Floridan aquifers. Major regional ground water sources for the Floridan Aquifer are 1) downward leakage through the overlying Intermediate System, and 2) subsurface inflow from areas hydraulically upgradient. Downward leakage through the Intermediate System was an estimated 154.2 Mgal/d. This recharge rate equates to an annual recharge of approximately 3.6 in/yr over the region. Subsurface inflow contributed an estimated 86.4 Mgal/d. Thus, the 1996 Region III steady-state ground water inflow to the Floridan Aquifer is estimated to be 240.6 Mgal/d.

Major regional ground water discharges for the Floridan Aquifer are 1) discharge to rivers and springs; 2) subsurface outflow to areas hydraulically downgradient; 3) upward leakage through the Intermediate System; and 4) ground water withdrawal via wells. During the 1996 calibration period, discharge to rivers and springs within Region III contributed an estimated 174.2 Mgal/d to the water budget. Econfina Creek is the major point of discharge for this water budget component. Subsurface outflow contributed an estimated 43.5 Mgal/d. Upward leakage into the Intermediate System was an estimated 14.2 Mgal/d. This upward leakage occurs along the bays and the Gulf of Mexico, where pumpage has not reversed the predevelopment upward hydraulic gradient between the Floridan and Surficial aquifers.

Only major pumping centers were represented in the model. Pumpage for approximately 150 pemitted users authorized to pump less than 75,000 gal/d was not included in the model. The Region III model-simulated pumpage for all uses was the smallest component of the budget, estimated at 8.7 Mgal/d. Given the steady-state nature of the model, the 1996 Region III ground water outflow is equal to the estimated inflow (240.6 Mgal/d).

Approximately half of the simulated 43.5 Mgal/d of subsurface outflow occurs along the western edge of the Bay County panhandle. Ground water (23 Mgal/d) flows downgradient from a regional potentiometric surface high centered on the panhandle, westward across the county line into Washington County. Another area of significant outflow occurs along the north-northwest boundary of Bay County. Ground water (approximately 19 Mgal/d) flows westward Walton County to discharge into the lower Choctawhatchee River. Model results indicate that the cone of depression in the vicinity of Panama City Beach has resulted in a net regional inflow of approximately 1 Mgal/d from the Gulf of Mexico.

The total ground water withdrawal represented in the model (8.7 Mgal/day) is approximately 62 percent of the 1995 Floridan Aquifer water use summarized by the USGS (Marella et al. 1998). The reported 1995 Floridan Aquifer water use value of 14 Mgal/d is six percent of the overall estimated ground water budget. The estimated 2020 Floridan Aquifer water demand (7.2 Mgal/d) represents three percent of the overall estimated Region III ground water budget. Thus, regional ground water resources could meet future needs without adverse impact. Local ground water quality concerns along the coast mean that needs cannot be met within the current and future demand footprint.

When analyzing the ground water budget, it is important to realize that the most active portion of the flow system is located in the northern part of the region, away from the coastline. This is the part of Region III lying on the southernmost edge of the Dougherty Karst Plain. It includes the extensive karst terrain found west of Econfina Creek in northern Bay and southern Washington counties. The Dougherty Karst Plain is significant for being both a recharge and a discharge area for the Floridan Aquifer. Recharge occurs within the karst terrain and discharge occurs into Econfina Creek. As a result, much of the inflow to and outflow from the Floridan Aquifer (as quantified in the above water budget) occurs in the northern half of Region III.

The southern half of the region, where the majority of ground water usage occurs, is relatively removed from the active part of the flow system. This has a negative implication regarding the vulnerability of the Floridan Aquifer to saltwater intrusion and upconing impacts from pumping. Being in a relatively sluggish, low-velocity, slowly flushed part of the flow system, with a natural background of elevated sodium, chloride and TDS concentrations, the coastal area is susceptible to both saltwater intrusion and upconing.

Assessment Criteria Used

Surface Water

The primary assessment criterion for surface water availability is the sustainability of surface water flow regime. For the purpose of water supply, the reduced availability of water during droughts or the increased probability of such is considered. Overall reductions in both surface and ground water relatively to historic discharges to sustain the bay environments are also a consideration.

Ground Water

Two criteria were used to assess impacts on ground water resources; long-term depression of the potentiometric surface of the Floridan Aquifer system and attendant alteration of ground water quality.

Impacts to Water Resources and Related Natural Systems

Surface Water

Presently, demands for surface water constitute the majority of fresh water used in Region III. Current demands are calculated to be, on the average, 45 Mgal/d from Deer Point Lake. As the four tributary streams deliver an average of 620 Mgal/d, the demands constitute about seven percent of the contributing flows. When demands are compared to the total freshwater flows into St. Andrews Bay, which amount to an average of 820 Mgal/d from the major sources, the demands account for approximately five percent of the total fresh water available. An analysis of the Q_{90} flows for Econfina Creek and Bear Creek, which contribute 94 percent of the average flow to Deer Point Lake, indicates that for the Q_{90} drought event, the current demands may consume up to 11.5 percent of the lake's inflow and up to 7.6 percent of the total Q_{90} flow to St. Andrews Bay. This indicates there is currently only a minimal impact to surface water resources by freshwater demands.

Future surface water demands for the region are estimated to be 64 Mgal/d in the year 2020. On average, this demand would be 7.8 percent of the total flow into St. Andrews Bay. This projected demand may consume up to 12 percent of a Q_{90} low flow condition into the lake and up to 10.8 percent of the total Q_{90} flows to St. Andrews Bay. Currently permitted demand allocations of 69 Mgal/d consume 8.4 percent of the average total freshwater inputs to the bay. They may consume up to 16 percent of a Q_{90} low flow condition to the lake, and up to 11 percent of the total Q_{90} flows to St. Andrews Bay. These flows are further buffered by ground water seepage into the bay and the storage effect of Deer Point Lake.

Ground Water

Presently, ground water from the Floridan Aquifer constitutes a relatively small percentage of the fresh water used in Region III. That use, concentrated in the coastal fringe, has resulted in the formation of a significant cone of depression in the Floridan Aquifer. The cone of depression is presently centered beneath Panama City Beach and results from a region-wide withdrawal of about 14 Mgal/d. Panama City Beach itself uses about 3.54 Mgal/d (1994-1997 data) from the Floridan Aquifer. Heads within the cone of depression are drawn down as much as 80 ft below sea level. This feature has persisted, in more or less its present configuration for at least the past decade. It will persist as long as ground water is withdrawn at current rates within the current ground water production footprint.

Coupled with concerns about the potentiometric surface decline are concerns about the quality of Floridan Aquifer water used for potable supply along the Gulf Coast. Historic and recent water quality data for the Panama City Beach system indicate increasing concentrations of sodium and chloride in Floridan Aquifer ground water. Continued utilization of Floridan Aquifer ground water at current levels and in the current spatial distribution will result in the continued alteration of ground water quality.

Adequacy of Regional Sources

In Region III, the existing and reasonably anticipated water sources are considered adequate to meet the requirements of existing legal users and reasonably anticipated future water supply needs of the region (projected 2020 demands), while sustaining the water resource and related natural systems. Projected 2020 surface water demands on Deer Point Lake of 64 Mgal/d represent approximately 7.8 percent of the inflow to St. Andrews Bay and is within the currently permitted allocation of 69 Mgal/d. Based on all available information, no harm has been observed for the current withdrawal amount, and is not anticipated. Concerns regarding the sustainability of Floridan Aquifer ground water production along the coastline will require the development of alternate water sources which result in reduced pumping along the coastline. Recommended strategies to reduce coastal pumping include increasing the percentage of surface water used to supply the coastal area, shifting ground water production away from the coastline, and reuse and conservation.

Water Quality Constraints on Water Availability

Surface Water

Deer Point Lake and its tributary creeks have been classified as Class I Waters of the State as a result of its creation and designation for use as the major potable water supply for Bay County. This area, which has grown considerably since that time, is now solely dependent on Deer Point Lake for its water supply. Other areas within the watershed are also experiencing population demands which will not only increase the dependent populace, but also creates potential for land use activities that could adversely impact the system.

Water quality within the system has thus far been adequate for the designated uses; however, there have been numerous symptomatic indications of less than ideal water quality. There has been a history of problematic aquatic plant communities within Deer Point Lake proper (Hardin 1980, Kobylinski et al. 1980). These problems may be a result of nutrients within the system prior to the impoundment of fresh water and/or due to the addition of more nutrients associated with development within the watershed. The ongoing development is also being conducted for the most part without the benefit of centralized sewage treatment. The proliferation of individual septic systems leads to concern of even further water quality degradation. There have been some documented instances of violations of water quality standards that bear further scrutiny due to the sensitive nature of this system (Wolfe et al. unpublished). The concern for this system is not solely in excessive nutrient loading, but also in the presence of various other pollutants such as bacterial and viral contamination, as well as sedimentation. As a relatively shallow impounded system, Deer Point Lake is highly susceptible to sedimentation, to the point that too much accumulation could effectively remove the storage capacity necessary to function adequately as a major water supply. Areas of oxygen depletion and reduction in biological diversity have been noted within the impoundment, which also leads to concern over the overall health of the system (Young et al. 1987, Wolfe et al. 1988). Water clarity reductions and turbidity increases have been documented throughout the lake, but particularly within the Bayou George area (Hardin 1980).

Presently, the quality of ground and surface water derivative of the Deer Point Lake watershed is sufficiently high that the water can be used for potable and industrial supply with minimal treatment. Future land use changes have the potential to diminish the present good quality of water within the watershed. To the extent that either, the watershed land use does not change, or changes that do occur do not result in diminished surface or ground water quality, the quality of lake water should remain high. In order to safeguard the present condition of the lake, future land use changes in the watershed will have to be carefully managed.

Ground Water

Water availability from the Floridan Aquifer in coastal Bay County is presently constrained by water quality concerns. These concerns derive from the naturally-occurring marginal water quality along the coastal fringe. Data presented here indicated that pumping has degraded Floridan Aquifer water quality in the Panama City Beach area. It is likely that expanded, or possibly continued pumpage at present levels, in this area will result in further degradation. Significantly expanded ground water use in coastal Region III should not be anticipated.

Level-of-Certainty

Using the methodology described in Section 3, water demand during drought conditions was estimated for Region III through the year 2020 (Table 5-19). On a regional basis, the amount of water available from traditional sources within this region is sufficient to meet all of the projected average and drought condition demands through the year 2020 while sustaining natural resources.

It should be noted that the above determination is based upon an analysis of regional water sources. Locally, individual utilities' drought demands could place unacceptable stress on their current sources. This is especially the case for Panama City Beach, since virtually all demands above average are currently being met through increased pumpage from ground-water sources that are exhibiting signs of stress from current withdrawals. In these instances there is a need for increased reliance on available surface water supplies and related infrastructure improvements.

Reuse and Conservation

Within Bay County, almost three Mgal/d of wastewater treatment capacity existed in 1997; however, only 0.20 Mgal/d of wastewater treatment plant (WWTP) effluent was disposed of in a manner that meets the Department of Environmental Protection definition of reuse (Table 5-20). According to information collected in 1997 (Marella et al. 1998) only a few, limited in scope water conservation programs, have been implemented in the region. This assessment has identified problems resulting from Floridan Aquifer ground water withdrawals in Panama City Beach and recommends that the previously identified alternative sources be obtained to replace wells currently pumping from the Floridan Aquifer in the coastal area.

Based on existing information, it is difficult to fully evaluate the status and effectiveness of reuse and conservation programs. However, available information indicates that reuse and conservation programs are not being implemented to their full potential in Region III. It is likely that demands on the stressed ground water resources in southern Bay County can be substantially reduced through implementation of additional reuse and conservation programs.

Implementation of a water-conserving rate structure has resulted in water use reductions of approximately 30 percent for a utility in nearby Walton County. Recent publications indicate that indoor water use can be reduced by approximately one-third through technological improvements, such as increased plumbing efficiency and new water efficient appliances (Osann and Young 1998).

In addition to the reductions of ground water pumping that can be accomplished through these types of efforts, substantial cost savings on capital projects could also be realized when new water sources must be developed or procured to replace existing wells. Some cost savings related to reduced or avoided operating expenses can also be realized through implementation of aggressive conservation and reuse programs.

To reduce impacts to the Floridan Aquifer System and help ensure a sustainable resource, the District has required a number of users in coastal Bay County to implement water conservation and efficiency measures and pursue alternate water sources. Since about 1990, the City of Panama City Beach has reduced its ground water withdrawals by 1.56 million gallons (31 percent) a day, Stone Container by 530,000 gallons (71 percent), Arizona Chemical by 516,000 gallons

(48 percent), and Signal Hills Golf Course by 130,000 gallons. This equals a combined reduction by these users of approximately 2.7 million gallons per day. Further, Tyndall Air Force Base has been required through the conditioning of its consumptive use permit to completely eliminate its withdrawals from the Floridan Aquifer System for golf course irrigation by December 31, 1999. Tyndall will replace these withdrawals with reclaimed water from the soon-to-be upgraded Military Point Wastewater Treatment Plant. Upon implementation, this will represent an additional 400,000 gallons per day reduction in nonpotable ground water withdrawals from the Floridan Aquifer System.

As alternative water supply strategies are evaluated for Panama City Beach, the feasibility and potential effectiveness of additional reuse and conservation efforts should be fully examined. Such an analysis would need to include a quantification of the amount of Floridan Aquifer water currently being withdrawn for uses that could be replaced with reuse water**.** It should also examine the amounts of water that could be saved through a variety of conservation programs and the economic benefits associated with each conservation technique.

Table 5-19 Region III: Estimated Water Demand During Drought Conditions (Mgal/d)

	2000	2005	2010	2015	2020
Water Use Category					
Public Supply	25.65	27.85	30.81	34.56	39.07
Domestic SS/Small Public Supply Systems	1.88	2.49	3.14	3.83	4.59
Commercial-Industrial Self-Supply	27.69	27.69	27.69	27.69	27.69
Recreational Irrigation	2.39	2.50	2.71	2.82	3.04
Agricultural Irrigation	0.00	0.00	0.00	0.00	0.00
Power Generation	0.67	0.67	0.67	0.67	0.67
Total	58.27	61.19	65.02	69.56	75.06
Increase Over Average Daily Demand	1.95	2.13	2.37	2.64	2.98

Table 5-20 Reuse of Domestic Wastewater in Region III in 1997

Domestic Wastewater Facility Name	**Total Plant** Capacity (Mgal/d)	**Total Plant** Flow (Mgal/d)	**Reuse** Capacity (Mgal/d)	**Reuse** Flow (Mgal/d)	**Reuse** Reuse Required
Bay County					
Bay County WWTP	37.00	29.89	00.00	00.00	N
Bay Point	00.50	00.21	00.50	00.20	Y
City of Lynn Haven	02.50	N/D	02.50	N/D	Y
Military Point Regional	06.70	03.16	00.00	00.00	N
Panama City Beach	07.00	03.94	00.00	00.00	N
St. Andrews (Panama City)	05.00	03.12	00.00	00.00	N/A
USN Coastal Systems Center	00.20	00.14	00.00	00.00	N
County Total	58.90	40.46	03.00	00.20	2
Region III Total	58.90	40.46	03.00	00.20	2

Source: NWFWMD 1997 Annual Reuse Report (ND = No Data)

REGION IV: CALHOUN COUNTY, HOLMES COUNTY, JACKSON COUNTY, LIBERTY COUNTY, AND WASHINGTON COUNTY

Region-at-a-Glance		
	1995	2020
Population:	101,833	122,227
Avg. Water Use (Mgal/d):	31.83	48.37
Primary Source:	Floridan Aquifer	
Regional Water Supply Plan Recommendation:	No plan needed	

Overview

Water Supply Planning Region IV is comprised of Calhoun, Holmes, Jackson, Liberty and Washington counties. These are rural counties, with the majority of the population residing in unincorporated areas. Government, retail trade, service and manufacturing are the region's major employment sectors. The Florida Department of Health and Rehabilitative Services (HRS) and Florida Department of Transportation (FDOT) offices, as well as state correctional facilities account for a large portion of the region's government employment. A significant portion of land in the region is devoted to forestry and agriculture. Forestry is an important component of the regional economy, with lumber and wood products supplying most of the region's manufacturing jobs. Most of Liberty County lies within the Apalachicola National Forest.

Agricultural Irrigation and Domestic Self-Supply and Small Public Supply Systems account for the majority of freshwater use in Region IV. The small amount of surface water used is primarily for Agricultural Irrigation. Ground water withdrawn from the Floridan Aquifer supplies the vast majority of water used for Public Supply and for Domestic Self-Supply and Small Public Supply Systems. Over half of the water use in Region IV occurs in Jackson County, the majority of which is used for Agricultural Irrigation.

Existing Water Use (1995)

Region IV 1995 water use is shown by county and water use category in Table 5-21. In addition, Figure 5-41 depicts the locations of permitted water withdrawals greater than 0.1 Mgal/d within the region.

Public Supply

Public Supply water use within Region IV is relatively low due to the rural nature of the region. In 1995, Public Supply accounted for approximately 5.27 Mgal/d or 17 percent of total average regional water use. Marianna, in Jackson County, is the largest public supplier in the region using approximately 1.18 Mgal/d in 1995.

Domestic Self-Supply and Small Public Supply Systems

Throughout this rural region, Domestic Self-Supply and Small Public Supply Systems water use is more than twice as much as the Public Supply use. In 1995, Domestic Self-Supply and Small Public Supply Systems was the largest water use category, accounting for approximately 12.00 Mgal/d or 38 percent of the total average regional water use.

Commercial-Industrial Self-Supplied

Commercial-Industrial water use was approximately 1.90 Mgal/d or six percent of the total average regional water use. The largest water user in this category was the Florida Department of Corrections in Jackson County.

Recreational Irrigation

In 1995, approximately 0.70 Mgal/d was used for Recreational Irrigation. The majority of this water was used to irrigate golf courses in Holmes, Jackson and Washington counties.

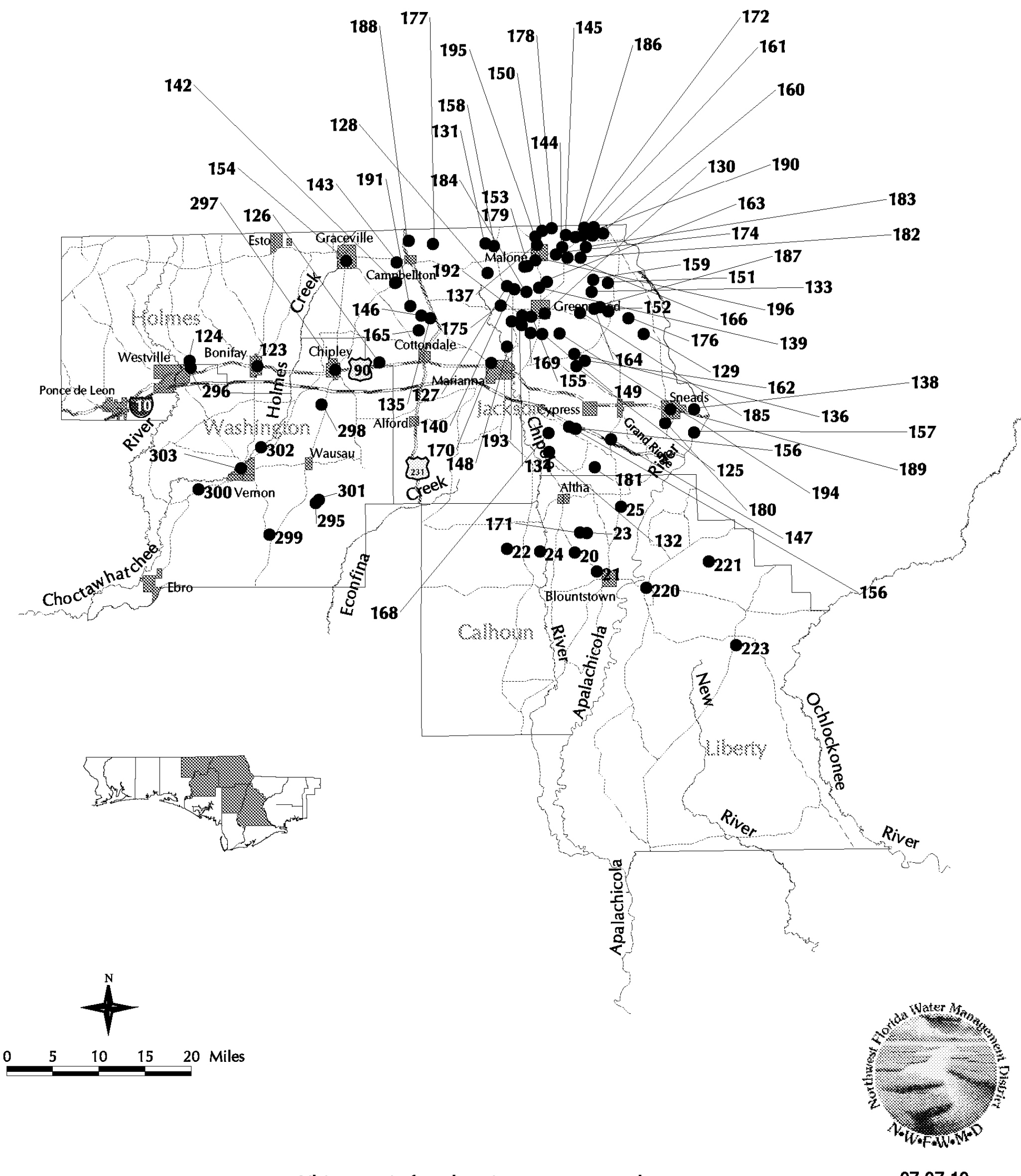
Agricultural Irrigation

Agricultural Irrigation is a major water user in the region, accounting for approximately 35 percent of total average regional water use or 11.29 Mgal/d in 1995. A significant amount of land in the region is devoted to agriculture with peanuts, cotton, corn, vegetables and nurseries being the dominant crops. The majority of agricultural irrigation occurs in Jackson County.

Figure 5-41

Region IV

1995 Permitted Average Daily Rate (ADR) Greater Than 0.1 Mgal/d



1995 Permitted Average Daily Rates (ADR) Greater Than 0.1 Mgal/d

(See following Page for Map Key)

Figure 5-41 Map Key

Index #	Permit #	Name	Primary Use*	Permitted ADR (gal/d)	Aquifer/ Surface Water	Source*
20	900008	Apalachee River Basin Ag. Pk. Auth.	PS	146,350	Floridan/Surficial	GW
21	830040	City of Blountstown	PS	529,000	Floridan	GW
22	920057	Hartford Farms	AI	643,000	Mayo Mill Br/Trib. to Ten Mile Cr.	SW
23	830062	Rutsel	AI	1,093,761	Floridan	GW
24	910069	Scott's Gladiolus Farms	AI	115,000	Ten Mile Creek	SW
25	940053	University of Florida	AQ	138,000	Floridan	GW
123	830022	City of Bonifay	PS	882,000	Floridan/Claiborne	GW
124	920046	Gulf Power Company	AI	416,000	Floridan	GW
125	920065	L. H. Alford	AI	118,000	Floridan	GW
126	840138	Art Aukema	AI	495,422	Floridan	GW
127	880062	Edwin L. Averett	AI	836,597	Floridan	GW
128	920083	Ted L. Baxter	AI	162,000	Floridan	GW
129	880141	Don Baxter	AI	714,200	Floridan	GW
130	830071	R. D. Bennett	AI	134,000	Floridan	GW
131	840242	Margurette B. Bridger	AI	178,000	Floridan	GW
132	830111	C. Charles Brown, Jr.	AI	162,400	Floridan	GW
133	900031	Ted E. Bruner	AI	380,000	Floridan	GW
134	840111	Circle Bar M Farm	AI	568,000	Floridan	GW/SW
135	930012	Mary E. and Glenn L. Clark	AI	120,000	Floridan	GW
136	920053	Conner Brothers Farm	AI	338,000	Floridan	GW
137	900020	Department of Corrections	PS	200,000	Floridan	GW
138	830038	Department of Corrections	PS	401,000	Floridan	GW
139	920073	Jeff Crawford, Jr.	AI	214,000	Floridan	GW
140	840115	Billy W. Croft	AI	107,630	Floridan	GW
141	841679	Arthur Dietrich	AI	130,000	Floridan	GW
142	920021	Dietrich Farms	AI	121,000	Floridan	GW
143	840137	Dietrich Farms	AI	526,191	Floridan	GW
144	920088	Thomas Ditty	AI	232,000	Floridan	GW
145	841324	Jimmy Ditty	AI	874,000	Floridan	GW
146	920102	Douglas Agro	AI	144,000	Floridan	GW
147	840240	Pete Durden	AI	139,520	Floridan	GW
148	940065	Dept. of Environmental Protection	PS	184,000	Floridan	GW
149	920049	Florida Foundation Seed	AI	321,000	Floridan	GW
150	920032	Larry Ford	AI	309,000	Floridan	GW
151	840044	Forrester Farms	AI	122,760	Floridan	GW
152	950023	Forrester Farms	AI	141,000	Floridan	GW
153	840113	John Garrett	AI	394,400	Floridan	GW
154	830011	City of Graceville	PS	816,000	Floridan	GW
155	920068	Town of Greenwood	PS	117,000	Floridan	GW
156	830081	Greetings	AI	702,685	Floridan	GW
157	850072	Gulf Power Company	PP	101,200,000**	Floridan	GW/SW
158	920074	Ben Hall	AI	110,000	Floridan	GW
159	910076	David Hall	AI	510,000	Floridan	GW
160	842602	Walter Hasty	AI	469,000	Floridan	GW
161	920100	Jimmy Hasty	AI	492,000	Floridan	GW
162	920052	A.W. Hatcher	AI	318,000	Floridan	GW
163	930018	Larry S. King	AI	152,000	Floridan	GW
164	930033	John W. Lawrence	AI	103,000	Floridan	GW

165	920095	Little Star Ranch	AI	469,000	Floridan	GW

Figure 5-41 Map Key (continued)

Index #	Permit #	Name	Primary Use*	Permitted ADR (gal/d)	Aquifer/ Surface Water	Source*
166	920108	Chris Long	AI	218000	Floridan	GW
167	830082	Luneta	AI	272,856	Floridan	GW
168	930025	Malloy Farms	AI	124,000	Floridan	SW
169	870045	City of Marianna	PS	610,000	Floridan	GW
170	830079	City of Marianna	PS	1,043,400	Floridan	GW
171	920024	Jimmy R. McArthur	AI	134,900	Floridan	GW
172	920025	Jimmy R. McArthur	AI	134,900	Floridan	GW
173	920026	Jimmy R. McArthur	AI	134,900	Floridan	GW
174	920027	Jimmy R. McArthur	AI	189,600	Floridan	GW
175	920048	Jimmy R. McArthur	AI	411,000	Floridan	GW/SW
176	880187	L. E. McMullian, Jr.	AI	279,000	Floridan	GW
177	920114	James E. Miles	AI	217,000	Floridan	GW
178	930024	Andrew Mixon	AI	106,000	Floridan	GW
179	920075	Edwin L. Mozley	AI	161,000	Floridan	GW
180	920034	Nelaz Ranch Corporation	AI	197,000	Floridan	GW
181	930041	Ollie Norris	AI	300,000	Floridan	GW
182	910084	North American Farms	AI	4770,000	Floridan	GW
183	910110	Charles Olive	AI	399,000	Floridan	GW
184	840241	Robert Pender	AI	866,200	Floridan	GW
185	910077	J. W. Powell	AI	262,000	Floridan	GW
186	830072	Earl Robinson	AI	151,000	Floridan	GW
187	840123	Herbert L. Rogers	AI	162,400	Floridan	GW
188	930028	J. L. Smith	AI	166,000	Floridan	GW
189	850214	Town of Sneads	PS	260,000	Floridan	GW/SW
190	920120	W. R. Stephens	AI	175,000	Floridan	GW
191	840114	Nimit Talvanna	AI	693,615	Floridan	GW
192	890145	Taylor Made Farm	AI	144,000	Floridan	GW
193	920079	Torbett's Dairy	AI	431,000	Floridan	GW
194	910080	James W. Westbrook	AI	206,000	Floridan	GW
195	920071	James O. Williams	AI	282,000	Floridan	GW
196	920117	Barton Willoughby	AI	120,600	Floridan	GW
220	850146	City of Bristol	PS	184,000	Floridan	GW
221	890014	Department of Corrections	PS	159,000	Floridan	GW
223	850115	Timber Energy Resources	PP	850,000	Floridan	GW
295	930019	C & B Holub	GI	387,000	Floridan	GW
296	920105	Town of Caryville	PS	105,000	Floridan	GW
297	830033	City of Chipley	PS	910,000	Floridan	GW
298	920119	James A. Clark	AI	224,876	Floridan	GW
299	940014	Department of Corrections	PS	432,000	Floridan	GW
300	940056	Coy W. Dyson	AI	560,000	Floridan	GW
301	842730	Florida Water Services Corporation	PS	255,000	Floridan	GW
302	930043	Jack Morris	AI	117,000	Holmes Creek	SW
303	920076	City of Vernon	PS	143,000	Floridan	GW

* AI= Agricultural Irrigation, AR = Aquifer Recharge, GI = Golf Course Irrigation, HS = Heat Pump Supply, IN = Industrial, LA = Landscape Irrigation, NI = Nursery Irrigation, PP = Power Production, PS = Public Supply, AQ = Aquaculture, GW = Ground Water, SW = Surface Water

** Virtually all water is returned to the source.

Table 5-21 Region IV: 1995 Water Use (Mgal/d)

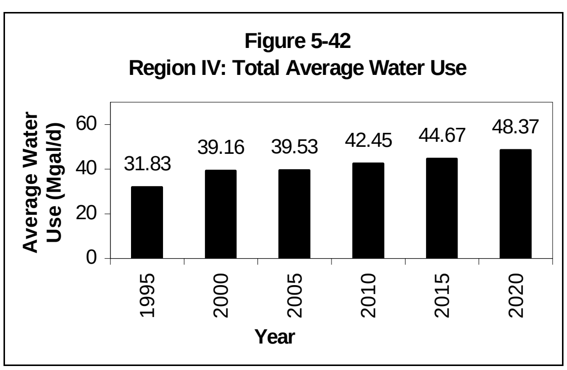
	Calhoun County	Holmes County	Jackson County	Liberty County	Washington County	Total
Public Supply	0.68	1.01	2.19	0.29	1.10	5.27
Domestic SS/Small Public Supply Systems	1.15	3.52	4.68	0.70	1.95	12.00
Commercial-Industrial SS	0.00	0.00	1.55	0.24	0.11	1.90
Recreational Irrigation	0.00	0.25	0.25	0.00	0.19	0.70
Agricultural Irrigation	2.09	0.00	8.30	0.00	0.89	11.29
Power Generation	0.00	0.00	0.29	0.39	0.00	0.68

Power Generation

In 1995, water used for Power Generation accounted for less than one percent of the region's average water use. The Scholtz Power Plant in Jackson County withdrew an average of 50.31 Mgal/d of water, the majority of which was used for direct, once-through cooling and returned to the Apalachicola River (approximately 50.02 Mgal/d). For planning purposes, only water not returned to the resource (approximately 0.29 Mgal/d) is considered consumed. In Liberty County, Timber Energy Resources Inc. consumed approximately 0.39 Mgal/d in 1995.

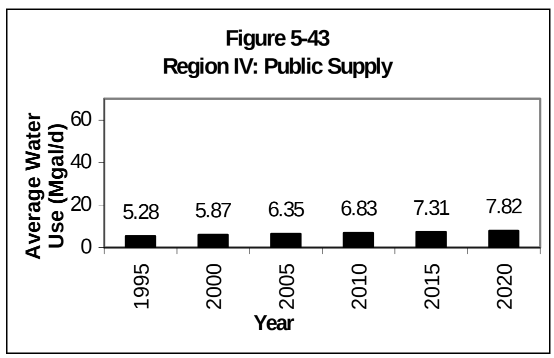
Reasonably-Anticipated Future Needs for Each Water Use Category Through 2020

Average water use is projected to increase from approximately 31.83 Mgal/d in 1995 to 48.37 Mgal/d in 2020 (Figure 5-42 and Table 5-22). Agricultural Irrigation will continue to be the largest water use category, using approximately 20.64 Mgal/d in 2020.



Public Supply

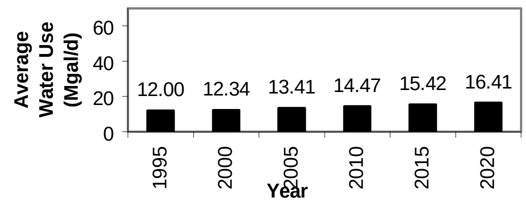
Regional Public Supply projections indicate that use will increase approximately 48 percent from an average of 5.28 Mgal/d in 1995 to 7.82 Mgal/d in 2020. Population, as well as the percent of households using Public Supply, is projected to increase between 1995 and 2020. Using approximately 2.80 Mgal/d in 2020, Jackson County is projected to continue to account for the majority of Public Supply water use in the region (Table 5-25).



Domestic Self-Supply and Small Public Supply Systems

Projections of future water demands indicate that the Domestic Self-Supply and Small Public Supply Systems will remain a predominant water use category in Region IV through 2020. The amount of water used in this category is projected to increase approximately 37 percent from 12.00 Mgal/d in 1995 and 16.41 Mgal/d in 2020 (Figure 5-44).

Figure 5-44
Region IV: Domestic Self-Supplied & Small Public Supply Systems

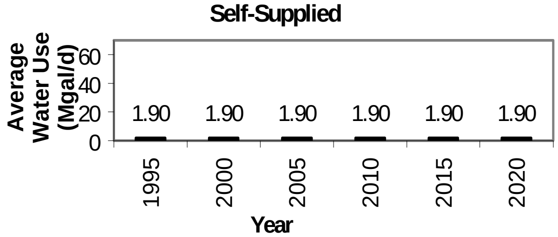


Although a majority of the regional population will remain dependent upon this water use category, the percentage will decrease slightly from 69 percent in 1995 to 64 percent in 2020.

Commercial-Industrial Self-Supplied

Commercial-Industrial water use is anticipated to remain constant at 1.90 Mgal/d through 2020 (Figure 5-45). The Florida Department of Corrections is expected to remain the major water user in this category.

Figure 5-45
Region IV: Commercial-Industrial Self-Supplied



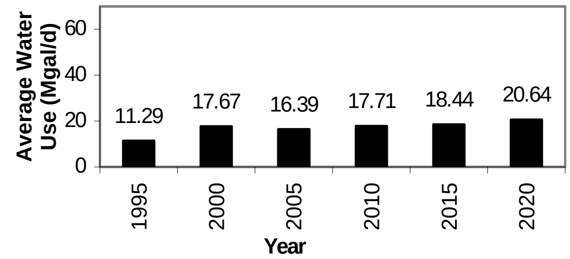
Recreational Irrigation

Recreational Irrigation is anticipated to increase from 0.70 Mgal/d in 1995 to approximately 0.82 Mgal/d by 2020.

Agricultural Irrigation

Agricultural Irrigation is projected to be the largest water use category in Region IV. Use is expected to increase approximately 83 percent from 11.29 Mgal/d in 1995 to 20.64 Mgal/d in 2020 (Figure 5-46). It is anticipated that Jackson County will continue to account for a majority of the region's Agricultural Irrigation.

Figure 5-46
Region IV: Agricultural Irrigation



Power Generation

Water withdrawn for Power Generation water use in Region IV was approximately 50.87 Mgal/d in 1995 and is anticipated to increase to approximately 90.95 Mgal/d of water in 2020. However, because this report considers impacts to the resource the figures reported here are for water that is actually consumed by Power Generation. For planning purposes, water is considered consumed when it is withdrawn and either not returned to the resource or not returned in the same location where it was withdrawn. Gulf Power Company's Scholtz Power Plant in Jackson County utilizes surface water for once-through cooling, returning virtually all of the water to the Apalachicola River. In Liberty County, Timber Energy Resources Inc.'s water consumption is projected to remain at 0.56 Mgal/d through 2020. Water consumption by Power Generation is anticipated to increase by approximately 12 percent from 0.85 Mgal/d in 1995 to 0.95 Mgal/d in 2020.

Reasonably-Anticipated Future Needs by County Through 2020

Figure 5-47 illustrates projected total average water use by county through 2020. Water use in Calhoun County is projected to almost double between 1995 (3.92 Mgal/d) and 2020 (7.64 Mgal/d) (Table 5-23). Agricultural Irrigation is the county's largest water use category, accounting for approximately 2.09 Mgal/d in 1995 and increasing to 4.54 Mgal/d in 2020. Water use in Holmes County is projected to increase from 4.78 Mgal/d in 1995 to 6.64 Mgal/d in 2020 (Table 5-24). The majority of water use in the county can be attributed to Public Supply and Domestic Self-Supply and Small Public Supply Systems. Jackson County accounts for most of the water use within Region IV, with total average usage of approximately 17.01 Mgal/d in 1995 and a projection of 24.28 Mgal/d in 2020 (Table 5-25). Agricultural Irrigation is Jackson County's largest water use category, accounting for 8.30 Mgal/d in 1995 and 14.38 Mgal/d in 2020. Liberty County accounts for only a small percentage of total regional water use; approximately 1.79 Mgal/d in 1995 and 3.04 Mgal/d in 2020 (Table 5-26). The category of Domestic Self-Supply and Small Public Supply Systems accounts for the majority of the county's water use and is projected to more than double by 2020. Washington County water use is projected to increase from 3.94 Mgal/d in 1995 to 5.42 Mgal/d in 2020 (Table 5-27). The county's largest water use category, Domestic Self-Supply and Small Public Supply Systems, is projected to increase from 1.95 Mgal/d in 1995 to 2.03 Mgal/d in 2020.

Figure 5-47
Region IV Total Average Water Use by County

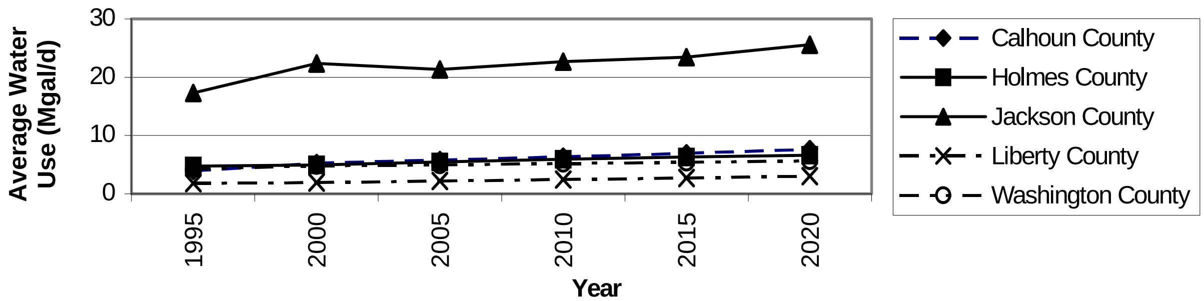


Table 5-22 Region IV: Estimated (1995) & Projected (2000-2020) Average Water Demand by Category (Mgal/d)

Water Use Category	1995	2000	2005	2010	2015	2020
Public Supply	5.28	5.87	6.35	6.83	7.31	7.82
Domestic SS/Small Public SS	12.00	12.34	13.41	14.47	15.42	16.41
Commercial-Industrial SS	1.90	1.90	1.90	1.90	1.90	1.90
Recreational Irrigation	0.70	0.70	0.70	0.76	0.82	0.82
Agricultural Irrigation	11.29	17.67	16.39	17.71	18.44	20.64
Power Generation	0.68	0.68	0.78	0.78	0.78	0.78
Total	31.85	39.16	39.53	42.45	44.67	48.37

Table 5-23 Calhoun County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	0.68	0.72	0.83	0.94	1.05	1.16
Domestic SS/Small Public SS	1.15	1.24	1.40	1.58	1.75	1.94

Commercial-Industrial SS	0.00	0.00	0.00	0.00	0.00	0.00
Recreational Irrigation	0.00	0.00	0.00	0.00	0.00	0.00
Agricultural Irrigation	2.09	3.31	3.53	3.86	4.15	4.54
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.92	5.27	5.76	6.38	6.95	7.64
Large Public Supply System Water Use						
	1995	2000	2005	2010	2015	2020
Total population served	4,455	4,382	4,689	5,003	5,324	5,637
Percent of total population	37	37	37	37	37	37
Per capita (gal/d)	153	164	177	187	197	205
Average Daily Flow of Large Public Supply Systems (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Utility						
Blountstown	0.58	0.61	0.69	0.78	0.87	0.95
Altha	0.10	0.11	0.14	0.16	0.18	0.20
Total	0.68	0.72	0.83	0.94	1.05	1.16

Table 5-24 Holmes County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	1.01	1.07	1.13	1.17	1.19	1.21
Domestic SS/Small Public SS	3.52	3.64	4.05	4.42	4.76	5.09
Commercial-Industrial SS	0.00	0.00	0.00	0.00	0.00	0.00
Recreational Irrigation	0.25	0.25	0.25	0.32	0.32	0.32
Agricultural Irrigation	0.00	0.00	0.00	0.02	0.02	0.02
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.78	4.96	5.43	5.93	6.29	6.64
Large Public Supply System Water Use	1995	2000	2005	2010	2015	2020
Total population served	3,817	4,943	5,516	6,091	6,664	7,237
Percent of total population	22	28	30	31	32	33
Per capita (gal/d)	264	221	213	203	192	182
Average Daily Flow of Large Public Supply Systems (Mgal/d)	1995	2000	2005	2010	2015	2020
Utility						
City of Bonifay	0.94	1.00	1.07	1.11	1.14	1.16
City of Ponce de Leon	0.07	0.09	0.11	0.12	0.14	0.15
Total	1.01	1.09	1.18	1.24	1.28	1.32

Table 5-25 Jackson County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	2.19	2.48	2.68	2.89	3.11	3.36
Domestic SS/Small Public SS	4.68	4.68	4.94	5.23	5.44	5.63
Commercial-Industrial SS	1.55	1.55	1.55	1.55	1.55	1.55
Recreational Irrigation	0.25	0.25	0.25	0.25	0.25	0.25
Agricultural Irrigation	8.30	13.12	11.54	12.37	12.72	14.38
Power Generation	0.29	0.29	0.39	0.39	0.39	0.39
Total	17.26	22.37	21.35	22.68	23.46	25.56
Large Public Supply System Water Use	1995	2000	2005	2010	2015	2020
Total population served	14,870	15,337	15,845	16,456	17,171	17,989
Percent of total population	32	34	35	35	35	36
Per capita (gal/d)	147	146	146	147	154	155
Average Daily Flow of Large Public Supply Systems (Mgal/d)	1995	2000	2005	2010	2015	2020
Utility						
Cottondale	0.15	0.16	0.17	0.17	0.17	0.18
Graceville	0.38	0.39	0.40	0.41	0.42	0.45
Grand Ridge	0.09	0.10	0.11	0.12	0.13	0.14
Greenwood	0.08	0.09	0.10	0.10	0.11	0.11

Malone	0.07	0.09	0.09	0.10	0.11	0.12
Marianna	1.18	1.37	1.55	1.72	1.89	2.06
Sneads	0.25	0.26	0.26	0.27	0.28	0.31
Total	2.19	2.46	2.68	2.89	3.11	3.37

Table 5-26 Liberty County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	0.29	0.33	0.38	0.43	0.47	0.52
Domestic SS/Small Public SS	0.70	0.81	1.01	1.22	1.46	1.72
Commercial-Industrial SS	0.24	0.24	0.24	0.24	0.24	0.24
Recreational Irrigation	0.00	0.00	0.00	0.00	0.00	0.00
Agricultural Irrigation	0.00	0.00	0.00	0.00	0.00	0.00
Power Generation	0.39	0.39	0.39	0.39	0.39	0.39
Total	1.62	1.77	2.02	2.28	2.56	2.87
Large Public Supply System Water Use						
	1995	2000	2005	2010	2015	2020
Total population served	2,020	1,971	2,057	2,152	2,255	2,370
Percent of total population	29	29	27	26	24	23
Per capita (gal/d)	145	169	185	198	209	219
Average Daily Flow of Large Public Supply Systems (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Utility						
City of Bristol	0.22	0.24	0.26	0.29	0.31	0.34
Hosford-Telogia	0.07	0.09	0.11	0.14	0.16	0.18
Total	0.29	0.33	0.37	0.43	0.47	0.52

Table 5-27 Washington County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	1.10	1.27	1.34	1.41	1.48	1.58
Domestic SS/Small Public SS	1.95	1.98	2.01	2.02	2.01	2.03
Commercial-Industrial SS	0.11	0.11	0.11	0.11	0.11	0.11
Recreational Irrigation	0.19	0.19	0.19	0.19	0.25	0.25
Agricultural Irrigation	0.89	1.24	1.32	1.45	1.56	1.70
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.24	4.79	4.97	5.18	5.41	5.67
Large Public Supply System Water Use						
	1995	2000	2005	2010	2015	2020
Total population served	6,875	7,523	8,248	9,077	10,015	11,056
Percent of total population	36	39	40	41	42	44
Per capita (gal/d)	160	169	163	155	148	143
Average Daily Flow of Large Public Supply Systems (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Utility						
Caryville	0.08	0.09	0.10	0.11	0.11	0.12
Chipley	0.74	0.89	0.95	1.02	1.08	1.15
Deltona	0.15	0.17	0.17	0.16	0.16	0.15
Vernon	0.13	0.12	0.12	0.13	0.13	0.16
Total	1.10	1.27	1.34	1.41	1.48	1.58

Source Evaluation

For virtually all uses within Region IV, ground water is the traditional source of supply. Further, the vast majority of ground water is obtained from the Floridan Aquifer System. Given the high availability of ground water from the Floridan Aquifer and its high quality, it is reasonable to anticipate that this use pattern will continue through the year 2020. Accordingly, the water source evaluation presented here emphasizes the characterization of ground water availability.

Overview of Hydrologic System

Two influences, the Dougherty Karst and the Apalachicola Embayment dominate the ground water hydrology of Region IV. Holmes, Washington, Jackson and northern Calhoun counties lie within the Dougherty Karst physiographic division. Southern Calhoun and Liberty counties lie within the Apalachicola Embayment.

An active ground water flow system, high ground water availability, a multitude of karst landforms, and a high degree of connection between ground and surface waters characterize the Dougherty Karst. Over this part of Region IV, the landscape has been substantially altered by karst landform development. The Intermediate System is either breached or removed over much of the Dougherty Karst. As a consequence, there is substantial ground water recharge to the Floridan Aquifer in this part of Region IV.

Due to secondary dissolution of the upper part of the carbonate sequence, the Floridan Aquifer within the Dougherty Karst exhibits a high capacity for transmitting water. Regional transmissivities are some of the highest in the panhandle. Ground water entering the Floridan Aquifer within this part of the region, either by downward leakage or by subsurface inflow from hydraulically upgradient areas, moves readily to the principal regional drains. These include the Choctawhatchee River, Holmes and Econfina creeks, and the Chipola and Apalachicola rivers. Along these regional drains, ground water is discharged via both springs and diffuse channel discharge. Some ground water is also passed on, as subsurface outflow, to downgradient areas in Gulf, Franklin, Bay, Leon and Wakulla counties.

Conditions in southern Calhoun and Liberty counties are typical of the embayment. Recharge rates are lower, the connection between ground and surface waters is diminished, ground water quality deteriorates with increasing depth, and ground water is generally less available, due primarily to lower transmissivities, compared to the Dougherty Karst.

Throughout Region IV, three hydrostratigraphic systems are present: a thin to absent Surficial Aquifer System, a moderately-thick to absent Intermediate System, and a moderately-thick to very thick Floridan Aquifer System. As a source of potable water, the Surficial Aquifer System is inconsequential. Its significance to the regional water supply derives from its role as a source of recharge water for underlying systems. Due to erosion and karst landform development, the Surficial Aquifer System is absent in portions of all five counties of the region.

Beneath the Surficial Aquifer System lies the Intermediate System. In most of the Dougherty Karst portion of Region IV, the Intermediate System is between 50 and 100 ft thick. In this area it is frequently breached by sinkholes, both recent and relict. In parts of the Dougherty Karst the Intermediate System is essentially absent, leaving the Floridan Aquifer at or near land surface. Within the Apalachicola Embayment, the Intermediate System is thicker and more competent. Here it attains a maximum thickness of about 200 ft and functions as an effective confining unit.

Lying beneath the Intermediate System (where it is present) or immediately beneath land surface (where the Intermediate System is absent) is the Floridan Aquifer System. This system consists of a carbonate sequence that is less than 100 ft thick in the northern part of the region and which thickens to the south. The system reaches a maximum thickness of approximately 2,000 ft in extreme southeastern Liberty County. Typically, only the upper several 100 ft of the aquifer are utilized for water supply anywhere in the region. In northern areas, this is the entire aquifer thickness. Elsewhere, this is only the upper fraction of the aquifer. Within the Apalachicola Embayment, water availability is depth limited, due to increasing mineralization of ground water with depth.

The Sub-Floridan System underlies and confines the Floridan Aquifer flow system. In the northern part of Region IV, the Sub-Floridan System contains the Claiborne Aquifer. Given the relatively limited availability of ground water on the northern, thinning edge of the Floridan Aquifer System, the Claiborne Aquifer is used for both Public Supply and Agricultural Irrigation.

Floridan Aquifer System Water Levels

The Floridan Aquifer System's zone of contribution, within which Region IV lies, extends north into southwest Georgia and southeast Alabama (Davis 1996). In northernmost Holmes County, the Floridan Aquifer potentiometric surface reaches a maximum elevation of approximately 160 ft above sea level. In northern Jackson County, the potentiometric surface reaches a maximum elevation of approximately 130 ft. From these highs, the potentiometric surface declines in the direction of the regional drains. Throughout the Dougherty Karst portion of the region, the shape of the Floridan Aquifer potentiometric surface is strongly influenced by the drain effect of springs, creeks and rivers. In the extreme southern parts of Washington and Liberty counties, the potentiometric surface declines to within 20 ft of sea level.

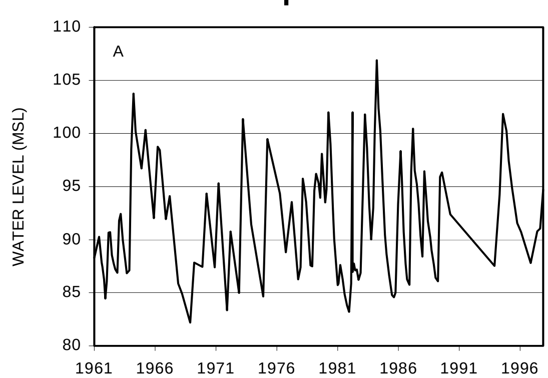
Hydrographs for three wells are presented to depict long-term trends in Floridan Aquifer water levels (Figure 5-48). Data are presented for a well located near Marianna, Florida (International Paper well), for a well located near Bristol, Florida (St. Joe well) and for a well located near Wausau, Florida (USGS 422A well). Between 1961 and 1997, water levels in these wells have fluctuated four to 21 ft, yet none show any demonstrable, long-term decline in water levels. Rather, water levels have risen and fallen through time in response to seasonal variations in rainfall.

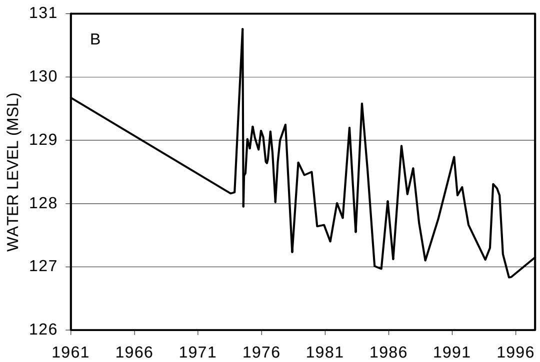
Within Region IV, Floridan Aquifer ground water use is so small, relative to ground water availability, that no adverse impacts to water levels have occurred as a result of ground water usage.

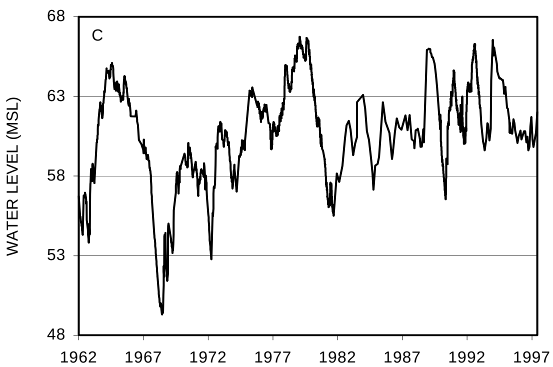
Floridan Aquifer System Water Quality

Within the Dougherty Karst portion of the region, the quality of ground water is generally suitable for all uses. Within the Apalachicola Embayment, water quality diminishes with increasing depth and hence, may not be suitable for all uses. Here the Intermediate System is fairly thick, and transmissivities in the Floridan Aquifer System tend to be on the order of 1,000 to 7,000 ft^2/day.

Figure 5-48 Hydrographs of the A) International Paper, the B) St. Joe and the C) USGS 422A Floridan Aquifer Wells







With the reduced recharge from above, secondary dissolution and flushing within the Floridan Aquifer System is limited. Users in the area typically utilize only the upper portion of the Floridan Aquifer System to avoid encountering highly mineralized water. As in Region VI to the northeast, highly mineralized connate water in the lower portion of the Floridan Aquifer System represents a potential problem for developing ground water sources throughout these two counties. This is particularly true in areas of low transmissivity. Water quality also declines rapidly once poor quality water is encountered.

For example, the City of Bristol recently drilled a test well to a total depth of 410 ft. This well had a specific capacity of two gpm/ft and a chloride concentration of 22 mg/L. In an effort to obtain a better yield, the city had the well deepened to a depth of 610 ft. The specific capacity of the well increased to approximately five gpm/ft, but the chloride concentration rose to 364 mg/L, which exceeded the drinking water standard of 250 mg/L. In order to provide a well which yielded water of acceptable quality, the City of Bristol had the well backfilled to a depth of 440 ft.

This type of water quality issue is common in the Calhoun and northern Liberty County areas. To minimize problems of this sort, excessive well depths should be avoided in these areas. It should also be noted that heavy or concentrated pumping from the aquifer may result in upconing of the poorer quality water.

Ground Water Budget

Ground water is the traditional and reasonably-anticipated future source of the vast majority of water used in Region IV. To assess whether ground water resources are adequate to meet projected needs through 2020, a region-scale ground water budget was prepared (Figure 5-49). Given the assumption that the Floridan Aquifer continues to be the principal regional ground water source over the next 20 years, a water budget-based assessment approach was deemed appropriate. The water budget presents an order-of-magnitude approximation of the major Floridan Aquifer System sources and discharges for the region.

The flow system components were estimated, in part, using output from two steady-state ground water flow models for the Floridan Aquifer System. The model domain of Davis (1996) covered the eastern part of Region IV and was calibrated to conditions as they occurred in October and November of 1991. The model of Richards (1997) covered the western part of the region and was calibrated to conditions as they occurred in August 1996. Although a calibrated steady-state model does not account for seasonal or annual variation in flow, the model does provide a means to estimate the relative magnitude of the various inflows to and outflows from the aquifer. In addition, the use of output from two separate models, calibrated to different time periods, was mandated by the fact that neither model covered the region in its entirety. Such an approach adds unavoidable uncertainty to the water budget generated from the two models.

In order to estimate water budget components for the region, the computer program ZONEBUDGET (Harbaugh 1990) was used to analyze output obtained by Davis (1996) and by Richards (1997). ZONEBUDGET allows the user to define a sub-region within a MODFLOW model domain and to calculate the inflow and outflow to that sub-region. A sub-region was defined for the portion of each model domain that included Region IV. A composite was made of the resulting sub-regions to create a single region for which the appropriate inflows and outflows were estimated.

Together, the domains of both the Davis (1996) and Richards (1997) models provided coverage for most of Region IV. Regional coverage of the two models did not include an approximate 170 mi^2 area in eastern Jackson County. To estimate the contribution of ground water flow to the water budget from this sub-region, a local recharge rate was quantified using net stream–aquifer flow rates. The stream-aquifer flow rates were computed by a regional numerical model for the lower Apalachicola-Chattahoochee-Flint River basin, which was developed by the U.S. Geological Survey (Torak and McDowell 1996) to evaluate ground water resources. The model was calibrated to conditions as they existed in October 1986.

The non-modeled sub-region is bounded on the west by a hydrologic divide. East of the divide, ground water in the upper Floridan Aquifer flows to the east towards the Chattahoochee and Apalachicola rivers. West of the divide, ground water flows to the west towards lower Cowarts Creek, the Chipola River and Blue Springs. Assuming a long-term, quasi-steady-state equilibrium between local recharge and discharge in the Dougherty Karst terrain, the contribution of stream-aquifer flow from the area located west of the divide is estimated to be approximately 303.8 Mgal/d. This equates to an annual recharge rate of 24 in/yr over the 264 mi^2 area. This rate closely compares to an estimate of 26 in/yr for the Chipola River watershed, which was determined from 53 years of discharge measurements recorded at a flow station near Altha, Florida (Roaza et al. 1989). Applying the 24 in/yr recharge rate to the non-modeled area results in a sub-regional inflow of 195 Mgal/d. Reflecting the steady-state nature of the water budget, the 195 Mgal/d leaves the region as discharge along the Chattahoochee and Apalachicola rivers. River discharge along a segment of the Apalachicola River between Chattahoochee, FL and Bristol, FL was simulated separately by Torak and McDowell (1996) and Davis (1996) to be 216 Mgal/d and 249 Mgal/d, respectively. This river segment is approximately six miles downgradient of the non-modeled sub-region. The local karst terrain and the direction of ground water flow in the sub-region justify the addition to the water budget of the non-modeled sub-regional inflow as aerial recharge and outflow as river discharge.

The major regional ground water sources to the Floridan Aquifer System in Region IV are 1) surface recharge, 2) leakage down through the Intermediate System and 3) subsurface inflow from areas hydraulically upgradient (Alabama and Walton, Bay and Gadsden counties). The surface recharge to the Floridan Aquifer System was estimated to be 209 Mgal/d for the region. Leakage through the Intermediate System into the Floridan Aquifer was estimated to be 1,069 Mgal/d. Subsurface inflow, from areas hydraulically upgradient of Region IV, was estimated to be 105 Mgal/d. Thus, the Region IV steady-state ground water inflow into the Floridan Aquifer is an estimated 1,383 Mgal/d.

The major regional discharges from the Floridan Aquifer System are 1) river and spring discharge, 2) leakage up through the Intermediate System, 3) subsurface outflow to areas hydraulically downgradient (Bay, Gulf, Franklin, Leon and Wakulla counties) and 4) ground water discharge via wells. Discharge to rivers and springs was estimated to be 1,194 Mgal/d. Leakage through the Intermediate System out of the Floridan Aquifer was estimated to be 38.2 Mgal/d. Subsurface outflow to areas hydraulically downgradient was estimated to be 146 Mgal/d. The simulated ground water use for Region IV was estimated to be 4.8 Mgal/d. Given the steady-state nature of the two flow models, the Region IV ground water outflow is equal to the estimated inflow (1,383 Mgal/d).

The region-wide recharge rate to the Floridan Aquifer (1,278 Mgal/d) equates to an annual recharge rate of approximately 7.9 in/yr over the region. The simulated ground water withdrawal represented in the two models (4.8 Mgal/day) reflects only a fraction of the 1995 water use summarized by the USGS (Marella et al. 1998). However, the reported 1995 water use value of 31.91 Mgal/d is 2.3 percent of the overall estimated ground water budget. The projected 2020 water demand (46.06 Mgal/d) represents less than five percent of the overall estimated Region IV ground water budget. Thus, regional water resources will adequately meet future needs without adverse impact.

Figure 5-49 Region IV Floridan Aquifer Ground Water Budget.

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As a check on the accuracy of the river and spring discharge component of the ground water budget, flow statistics for three of the five principal regional drains were examined. The examined drains include the Chipola and Choctawhatchee rivers and Holmes Creek. The Chipola River lies entirely within Region IV. The Altha station (period of record 1913 through 1997) has the following statistics, Q_{50}—730 Mgal/d, Q_{90}—405 Mgal/d. The Choctawhatchee River and Holmes Creek lie on the western edge of the region. Flow statistics are available for the Choctawhatchee River at Caryville (period of record 1930—1997) and at Bruce (period of record 1931—1997). The Choctawhatchee River receives considerable inflow from the Floridan Aquifer between these stations. Much of the Choctawhatchee River Floridan Aquifer inflow is conveyed by Holmes Creek, which drains only Region IV. Accordingly, its flow is included in the difference between the Caryville and Bruce statistics. The difference in the Q_{50} statistic between Caryville and Bruce is 880 Mgal/d. The difference in the Q_{90} statistic is 562 Mgal/d.

Assuming the Q_{90} statistic is a reasonable estimation of base flow, and assuming the majority of the difference in the Q_{90} statistic between Caryville and Bruce is accounted for by Floridan Aquifer discharge from Region IV, an estimate of the ground water discharge to these three drains about 1,000 Mgal/d. As an estimation of the total Region IV discharge to rivers and springs, 1,000 Mgal/d excludes discharge to Econfina Creek and to the Apalachicola River. However, these data are sufficient to indicate that the estimated Region IV ground water discharge component to rivers and streams of 1,194 Mgal/d is of the correct order-of-magnitude.

Assessment Criteria Used

Because of the difference in the hydrology of the ground water flow system in the Dougherty Karst and Apalachicola Embayment portions of Region IV, different assessment criteria are in order. Given the high hydraulic conductivities of the Floridan Aquifer System within the Dougherty Karst, pumpage has a minimal impact on the aquifer's potentiometric surface. At the projected 2020 demands, no significant regional potentiometric surface depression is anticipated. Rather, given the intimate connection between ground and surface waters over the Dougherty Karst portion of the aquifer, ground water use should be expected to reduce streamflow to the major surface water drains in an amount equal to pumpage. Therefore, the primary assessment criterion for this portion of the region is whether or not streamflow is significantly reduced by upgradient ground water withdrawals. Given the relative magnitudes of projected 2020 pumpage and the naturally-occurring ground water discharge to surfacewater features, adverse impacts are not expected.

Given the overall lower transmissivities and poor water quality found in the Apalachicola Embayment portion of Region IV, different assessment criteria are in order. Here, the criteria used to assess impacts on ground water resources are long-term depression of the potentiometric surface of the Floridan Aquifer system and attendant alteration of ground water quality. Given the modest magnitude of the projected 2020 demands for ground water in the Apalachicola Embayment portion of Region IV, adverse impacts to water resources are not expected.

Impacts to Water Resources and Related Natural Systems

Given the relative magnitude of projected 2020 demands when compared to ground water availability, impacts to water resources and related natural systems as a result of ground water withdrawals are not anticipated.

Adequacy of Regional Sources

In Region IV, the existing and reasonably-anticipated water sources are considered adequate to meet the requirements of existing legal users and reasonably-anticipated future water supply needs of the region (projected 2020 demands), while sustaining the water resource and related natural systems.

Water Quality Constraints on Water Availability

There exist two classes of water quality constraints on ground water availability in Region IV. First, there is the aforementioned concern associated with upconing of mineralized water in portions of Calhoun and Liberty counties. This can be caused by heavy or concentrated pumping, or by extraordinary depth of penetration. This problem is avoidable by using well-separated, low volume, relatively shallow wells to meet demands. The second concern in the area is that caused by agrichemical contamination in the Floridan Aquifer System in portions of Jackson County. As impacts, this type of contamination has affected much of northeastern Jackson County.

Level-of-Certainty

Using the methodology described in Section 3, water demand during drought conditions was estimated for Region IV through the year 2020 (Table 5-28). The amount of water available from traditional sources within this region should be sufficient to meet all of the projected average and drought condition demands through the year 2020, while sustaining natural resources.

Reuse and Conservation

Within Region IV, approximately one Mgal/d of wastewater treatment plant (WWTP) effluent out of the 1.25 Mgal/d of wastewater treatment capacity that existed in 1997 was disposed of in a manner that meets the Department of Environmental Protection definition of reuse (Table 5-29). According to information collected in 1997 (USGS 1998), few water conservation programs have been implemented in the region. As noted earlier, there are areas of Region IV (Calhoun and Liberty counties) that can experience limited water availability from the Floridan Aquifer. While the demands projected herein can be met under these conditions, any unanticipated large demands in these areas could face ground water availability constraints. If industrial development or other activities with potentially large water demands are considered in the future, reuse water should be considered as one of the source possibilities. While conservation should continue to be encouraged in the region by utilities, implementation of more aggressive conservation programs by the District is not warranted at this time.

Table 5-28 Region IV Estimated Water Demand During Drought Conditions (Mgal/d)

	2000	2005	2010	2015	2020
Water Use Category					
Public Supply	6.22	6.73	7.24	7.75	8.29
Domestic SS/Small Public Supply Systems	13.08	14.21	15.34	16.35	17.39
Commercial-Industrial Self-Supply	1.90	1.90	1.90	1.90	1.90
Recreational Irrigation	0.83	0.83	0.91	0.98	0.98
Agricultural Irrigation	38.52	37.56	40.27	42.62	48.03
Power Generation	0.85	0.95	0.95	0.95	0.95
Total	61.40	62.19	66.60	70.54	77.54
Increase Over Average Daily Demand	22.07	22.49	23.98	25.70	29.00

Table 5-29 Reuse of Domestic Wastewater in Region IV in 1997

Domestic Wastewater Facility Name	Total Plant Capacity (Mgal/d)	Total Plant Flow (Mgal/d)	Reuse Capacity (Mgal/d)	Reuse Flow (Mgal/d)	Reuse Required
Calhoun County					
City of Blountstown	00.60	00.67	00.00	00.00	N
County Total	00.60	00.67	00.00	00.00	0
Holmes County					
City of Bonifay	01.40	00.82	00.00	00.00	N
County Total	01.40	00.82	00.00	00.00	0
Jackson County					
Arthur Dozier School	00.10	00.02	00.00	00.00	N/A
City of Cottondale	00.13	00.11	00.00	00.00	N
City of Graceville	01.10	00.75	00.00	00.00	N
Jackson Correctional Institute	00.28	00.20	00.28	00.21	N
City of Marianna	02.70	01.95	00.00	00.00	N
Town of Sneads	00.50	00.57	00.50	00.57	N
County Total	04.81	03.60	00.78	00.78	0
Liberty County					
Liberty Correctional Institute	00.20	00.11	00.20	00.11	N
County Total	00.20	00.11	00.20	00.11	0
Washington County					
City of Chipley	01.20	01.60	00.00	00.00	N
City of Vernon	00.10	00.09	00.00	00.00	N
Washington Correctional Inst.	00.27	00.11	00.27	00.11	N
County Total	01.57	01.80	00.27	00.11	0
Region IV Total	08.58	07.00	01.25	01.00	0

Source: NWFWMD 1997 Annual Reuse Report (ND=No Data)

REGION V: GULF COUNTY AND FRANKLIN COUNTY

Region-at-a-Glance		
	1995	2020
Population:	23,507	39,558
Average Water Use (Mgal/d):	32.28	34.44
Primary Source:	Floridan and Surficial Aquifers; Chipola River	
Regional Water Supply Plan Recommendation:	No Plan Needed	

Overview

Water Supply Planning Region V is comprised of Gulf and Franklin counties. The region is predominantly rural, with approximately 50 percent of the population residing in unincorporated areas. Population and growth are concentrated in the region's coastal areas with tourism and seasonal visitors representing almost 25 percent of Franklin County's total population. The region's economy is highly dependent upon natural resources, with leading economic activities being forestry, paper production, farming, commercial and sport fishing, and seafood processing. The majority of people in Gulf County are employed in manufacturing associated with paper and allied products companies, while the majority of people in Franklin County are employed in the service sector.

Apalachicola River has the largest flow of all rivers in Florida. The water supply needs of the Apalachicola River and Bay are currently being negotiated through the Apalachicola-Chattahoochee-Flint River Basin Compact, which was enacted by the U.S. Congress and the states of Florida, Alabama and Georgia. Almost all of the water for these systems is derived from a large watershed area, with headwaters that extend well into and include foothills of the Appalachian Mountains north of Atlanta, Georgia.

Most water consumption in the region occurs in Gulf County, with the largest water use category in the region being Commercial-Industrial Self-supplied. Surface water (Chipola River via the Port St. Joe Canal) supplies the majority of fresh water used in Gulf County, most of which is used for Commercial-Industrial Self-Supplied. Franklin County depends upon the Floridan Aquifer for potable supplies, and the Surficial Aquifer is often used for Domestic Self-Supply and Small Public Supply Systems on the barrier islands.

The Port St. Joe area in Gulf County, and the coastal area of Franklin County, have been identified by the District as Areas of Special Concern (ASC) for water supply planning (Figure 5-50). This designation was established as part of the Water Supply Assessment (WSA) for areas where the potential for future water supply problems exists and close examination of both regional demand projections and locally-available water resources is warranted.

Table 5-30 Region V: Water Use (Mgal/d)

	Gulf County	Franklin County	Total
Public Supply	1.29	1.74	3.03
Domestic SS/Small Public Supply Systems	0.34	0.03	0.37
Commercial-Industrial SS	28.70	0.00	28.70
Recreational Irrigation	0.18	0.00	0.18
Agricultural Irrigation	0.00	0.00	0.00
Power	0.00	0.00	0.00

Existing Water Use (1995)

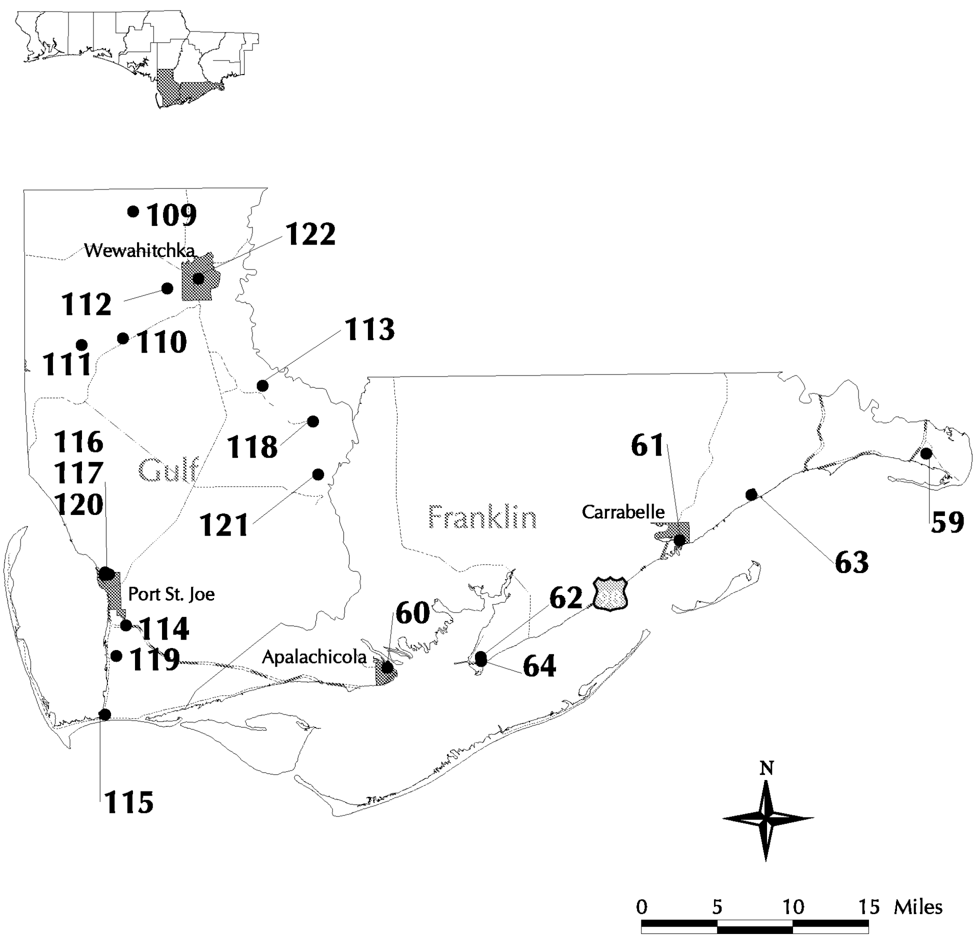
Table 5-30 contains 1995 water use for both counties in Region V, and Figure 5-50 depicts 1995 permitted water use greater than 0.1 Mgal/d.

Public Supply

Public Supply water use accounts for an average of approximately 3.03 Mgal/d or nine percent of the region's total average water use in 1995. The majority of Public Supply water was used along the Gulf coast in the region's ASCs, with the largest public supplier being the City of Port St. Joe (1.04 Mgal/d).

Figure 5-50

Region V



Northwest Florida Water Management District
N•W•F•W•M•D

07-07-11

This map is for planning purposes only.
Withdrawal locations are approximate.

1995 Permitted Average Daily Rates (ADR) Greater Than 0.1 Mgal/d

(See following page for map key)

Figure 5-50 Map Key

Index #	Permit #	Name	Primary Use*	Permitted ADR (gal/d)	Aquifer/ Surface Water	Source*
59	840008	Alligator Point Water District	PS	120,000	Floridan	GW
60	860066	City of Apalachicola	PS	638,000	Floridan	GW
61	840039	City of Carrabelle	PS	182,000	Floridan	GW
62	860180	Eastpoint Water & Sewer District	PS	192,000	Floridan	GW
63	830101	Lanark Village Water & Sewer District	PS	200,000	Floridan	GW
64	830074	St. George Island Utility Company	PS	414,000	Floridan	GW
109	910045	Department of Corrections	PS	268,000	Floridan	GW
110	870035	FICO Farms	AI	106,520	Little Creek	SW
111	840069	FICO Farms	AI	889,500	Floridan	GW
112	840067	FICO Farms	AI	476,000	Floridan	GW
113	830007	Florida Coast Paper Company	IN	48,000,000	Chipola River	SW
114	842709	General Chemical Corporation	IN	167,000	Floridan/Surficial	GW
115	830085	Lighthouse Utilities	PS	120,000	Floridan	GW
116	890148	City of Port St. Joe	ES	773,000	Floridan	GW
117	830039	City of Port St. Joe	PS	867,000	Floridan/Surficial	GW
118	920001	Prudential Insurance Company	AQ	8,581,000	Floridan/Apalachicola & Brothers Rivers	GW/SW
119	870202	St. Josephs Bay Country Club	GI	131,000	Floridan/Surficial	GW
120	910035	Sylvachem Corporation	IN	720,000	Floridan	GW
121	930052	Tachikawa International Corporation	AQ	820,000	Floridan	GW
122	840045	City of Wewahitchka	PS	291,000	Floridan	GW

* AI= Agricultural Irrigation, AR = Aquifer Recharge, GI = Golf Course Irrigation, HS = Heat Pump Supply, IN = Industrial, LA = Landscape Irrigation, NI = Nursery Irrigation, PP = Power Production, PS = Public Supply, WR = Water-based Recreation,
AQ = Aquaculture, GW = Ground Water, SW = Surface Water

Domestic Self-Supply and Small Public Supply Systems

In 1995, Domestic Self-Supply and Small Public Supply Systems water use accounted for an average of approximately 0.37 Mgal/d or one percent of the region's total water use. The majority of water used in this category is used in the Gulf County ASC (0.23 Mgal/d). In 1995, approximately 15 percent of the regional population were dependent upon Domestic-Self supply or Small Public Supply Systems.

Commercial-Industrial Self-Supplied

Commercial-Industrial Self-Supplied is the largest water use within Region V. This water use category accounted for an average of 28.70 Mgal/d or 89 percent of the region's total water use in 1995. All water users in this category are located in Gulf County, with Florida Coast Paper (27.98 Mgal/d) being the single largest water user in the region.

Recreational Irrigation

Recreational Irrigation accounts for an average of approximately 0.18 Mgal/d or less than one percent of the region's total water use. The St. Joe Bay Country Club, located in the Gulf County ASC, is the only user of water in this category in Region V.

Agricultural Irrigation

Although there is some permitted Agricultural Irrigation in the region, the amount of water used is so minimal that it has not been included in this assessment. In 1995, FICO Farms was the region's only permitted Agricultural Irrigation use.

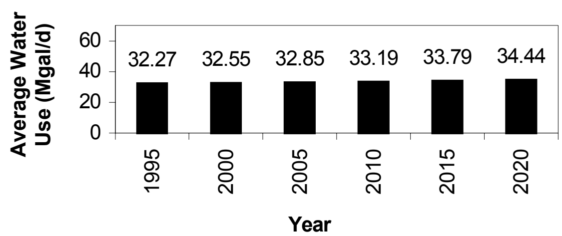
Power Generation

In 1995, no water was being used for Power Generation in Region V.

Reasonably-Anticipated Future Needs for Each Water Use Category Through 2020

Average regional water use is projected to increase from approximately 32.28 Mgal/d in 1995 to 34.44 Mgal/d in the year 2020, an increase of approximately seven percent (Figure 5-51 and 5-54). Commercial-Industrial is expected to remain the largest category of water use in the region through 2020.

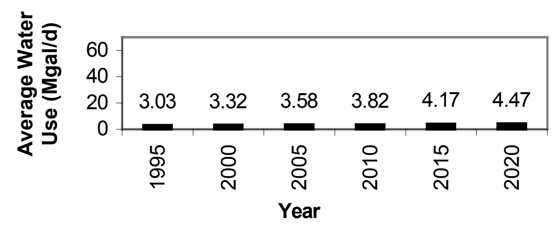
Figure 5-51
Region V: Total Average Water Use



Public Supply

Water use projections indicate that Public Supply water use will increase by approximately 48 percent from 3.03 Mgal/d in 1995 to 4.47 Mgal/d in 2020 (Figure 5-52). While regional population is expected to increase, the percentage of the population dependent upon Public Supply systems is anticipated to decrease slightly.

Figure 5-52
Region V: Public Supply



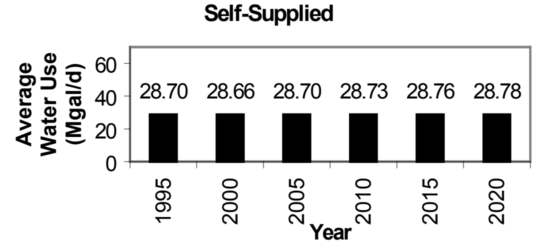
Domestic Self-Supply and Small Public Supply Systems

Although only accounting for a minimal amount of regional water use, water use in this category is projected to more than double from 0.37 Mgal/d in 1995 to 0.92 Mgal/d in 2020. In addition, the percentage of the regional population dependent upon Domestic Self-Supply and Small Public Supply Systems is expected to increase by approximately five percent.

Commercial-Industrial Self-Supplied

Water use projections suggest that the Commercial-Industrial Self-Supplied will continue to be the predominant water use category in the region. Regional projections indicate that Commercial-Industrial Self-Supplied water use will increase only slightly, approximately 0.78 Mgal/d between 1995 and 2020 (Figure 5-53).

Figure 5-53
Region V: Commercial-Industrial Self-Supplied



Recreational Irrigation

Recreational Irrigation includes water used for golf course irrigation and accounts for less than one percent of the region's total average water use. Water use in this category is projected to increase by approximately 50 percent from 0.18 Mgal/d in 1995 to 0.27 Mgal/d in 2020.

Agricultural Irrigation

Agricultural forecasts indicate that the amount of water used in Region V for Agricultural Irrigation will remain extremely small through 2020. Therefore, projections of water use for Agricultural Irrigation were not prepared for this region.

Power Generation

There is not any projected Power Generation use of water in Region V through 2020.

Reasonably-Anticipated Future Water Needs by County Through 2020

Figure 5-54 illustrates projected total average water use by county through 2020. Gulf County accounts for most of the water use in Region V, with total average usage of 30.51 Mgal/d in 1995 to 31.21 Mgal/d in 2020 (Table 5-32). Commercial-Industrial is the county's largest water use category, accounting for approximately 28.70 Mgal/d in 1995 and increasing to 28.78 Mgal/d in 2020. Total average water use in Franklin County is projected to increase from 1.77 Mgal/d in 1995 to 3.24 Mgal/d in 2020. Public Supply is by far the county's largest water use category, accounting for approximately 1.74 Mgal/d in 1995 and increasing to 2.88 Mgal/d in 2020 (Table 5-33).

Figure 5-54
Region V: Total Average Water Use by County

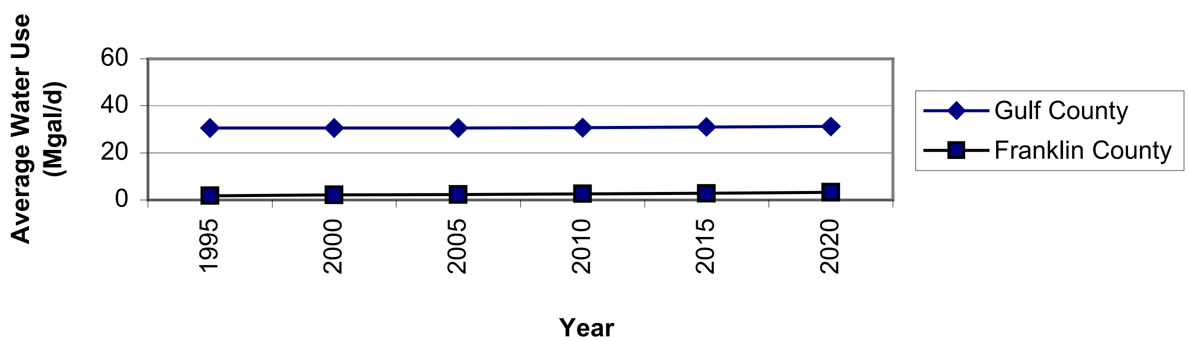


Table 5-31 Region V: Estimated (1995) & Projected (2000-2020) Average Water Demand by Category (Mgal/d)

	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	3.03	3.32	3.58	3.82	4.17	4.47
Domestic SS/Small Public SS	0.37	0.39	0.39	0.46	0.59	0.92
Commercial-Industrial SS	28.70	28.66	28.70	28.73	28.76	28.78
Recreational Irrigation	0.18	0.18	0.18	0.18	0.27	0.27
Agricultural Irrigation	0.00	0.00	0.00	0.00	0.00	0.00

Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	32.28	32.55	32.85	33.19	33.79	34.44

Table 5-32 Gulf County Water Demand Data (water amounts in Mgal/d)

	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	1.29	1.36	1.41	1.45	1.53	1.60
Domestic SS/Small Public SS	0.34	0.32	0.30	0.32	0.41	0.56
Commercial-Industrial SS	28.70	28.66	28.70	28.73	28.76	28.78
Recreational Irrigation	0.18	0.18	0.18	0.18	0.27	0.27
Agricultural Irrigation	0.00	0.00	0.00	0.00	0.00	0.00
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	30.51	30.52	30.59	30.68	30.97	31.21
Average Daily Flow (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Area of Special Concern	30.05	30.08	30.11	30.16	30.30	30.41
Non Area of Special Concern	0.40	0.40	0.44	0.48	0.62	0.75
Total	30.45	30.48	30.55	30.64	30.92	31.16
Large Public Supply System Water Use						
	1995	2000	2005	2010	2015	2020
Total population served	10,108	10,432	11,418	12,431	13,452	14,502
Percent of total population	76	79	80	80	78	75
Per capita (gal/d)	127	130	123	117	114	110
Average Daily Flow of Large Public Supply Systems (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Utility						
Lighthouse Utilities *(ASC)*	0.11	0.13	0.15	0.16	0.17	0.18
Port St. Joe *(ASC)*	1.04	1.08	1.09	1.10	1.11	1.11
Wewahitchka (*NonASC)*	0.13	0.15	0.17	0.19	0.26	0.31
Total	1.29	1.36	1.41	1.45	1.53	1.60

Table 5-33 Franklin County Water Demand Data (water amounts in Mgal/d)

	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	1.74	1.96	2.18	2.37	2.63	2.88
Domestic SS/Small Public SS	0.03	0.07	0.08	0.14	0.18	0.36
Commercial-Industrial SS	0.00	0.00	0.00	0.00	0.00	0.00
Recreational Irrigation	0.00	0.00	0.00	0.00	0.00	0.00
Agricultural Irrigation	0.00	0.00	0.00	0.00	0.00	0.00
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	1.77	2.03	2.26	2.51	2.81	3.24
Average Daily Flow (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Area of Special Concern	1.75	2.00	2.23	2.47	2.75	3.16
Non Area of Special Concern	0.02	0.02	0.03	0.04	0.05	0.07
Total	1.77	2.02	2.26	2.51	2.8	3.23
Large Public Supply System Water Use						
	1995	2000	2005	2010	2015	2020
Total population served	9,926	10,680	12,060	13,626	15,796	17,777
Percent of total population	97	95	95	93	93	88
Per capita (gal/d)	175	184	180	174	167	162
Average Daily Flow of Large Public Supply Systems (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Utility-- ASC						
Alligator Point	0.12	0.13	0.14	0.13	0.17	0.18

Apalachicola	0.70	0.80	0.87	0.95	1.04	1.13
Carrabelle	0.17	0.18	0.18	0.18	0.18	0.18
East Point	0.21	0.26	0.30	0.34	0.37	0.41
Lanark Village	0.20	0.22	0.25	0.27	0.30	0.33
St. George Island	0.34	0.38	0.44	0.51	0.58	0.64
Total	1.74	1.96	2.18	2.37	2.63	2.88

Source Evaluation

Within Region V, surface water is the principal source of supply. In 1995, surface water accounted for about 87 percent of the fresh water used within the region. Ground water supplied the remaining 13 percent. The traditional source for ground water is the Floridan Aquifer. Over the last 20 years, some ground water demand has been diverted into the Surficial Aquifer System. Given the high availability of water from the Port St. Joe Canal, surface water is anticipated to remain the principal source of supply for the region's freshwater demand through 2020.

Historically, Gulf County was dependent on ground water for public and industrial supplies of water. Ground water withdrawals began in earnest in the 1930s, with the construction of a combined Floridan and Surficial aquifer wellfield in the Port St. Joe area. This wellfield supplied water to the then St. Joe Paper Company Mill and associated process industries. In the early 1950s, ground water was being withdrawn from 16 wells, eight in the Floridan Aquifer and eight in the Surficial Aquifer, at a rate of about nine Mgal/d. Most of this water was obtained from the Floridan Aquifer.

As a result of this pumping, the potentiometric surface of the Floridan Aquifer was substantially depressed around the City of Port St. Joe. Recognizing that ground water was not available in sufficient quantities to meet the expanding needs of the plant, work on an alternate water supply was completed in 1953. To this end, an 18.5-mile long canal was constructed between Port St. Joe and the Chipola River. The present pump capacity is 51.48 Mgal/day, and Florida Coast Paper Company, the present mill owner, received 28 Mgal/d from the Chipola River in 1995.

No records are available prior to 1953 to define the Floridan Aquifer potentiometric surface depression that resulted from the mill's ground water withdrawals. Reportedly, with the cessation of Floridan Aquifer ground water usage, water levels quickly rebounded. Current demand from the Floridan Aquifer is much less than historical demands. Nonetheless, the current demand is sufficient to produce a modest cone of depression centered on the City of Port St. Joe.

Neighboring Franklin County has historically been dependent on water from the Floridan Aquifer System for potable uses. In 1995, 1.74 Mgal/d (98 percent of the county's demand) was utilized for Public Supply. This use of the Floridan Aquifer System is anticipated to continue and expand as population in the coastal area of Franklin County grows. Water use in the area has expanded rapidly in recent years and has heightened concerns about resource sustainability in this region.

Overview of Hydrologic System

The key aspects of the Region V hydrology are the surface water source canal connecting the largest water user in the region to the Apalachicola River, and the ground water resources of the Surficial and Floridan Aquifer systems. The Florida Coast Paper Company presently receives about 28 Mgal/d surface water. This is, by far, the largest water use in the region. By comparison, current public water demand in the region is a modest one-tenth of the industrial demand (about 3 Mgal/d). Public water supply is obtained exclusively from ground water. Two sources contribute this water, the Surficial and Floridan Aquifer systems.

Region V lies within the Apalachicola Embayment region of the Panhandle. Accordingly, water availability from the Floridan Aquifer is constrained by the factors typically associated with the embayment, i.e. low transmissivities and poor water quality at depth. Throughout the region, the Gulf of Mexico coastline is a discharge boundary for the Floridan Aquifer System. Heads range from about 40 ft above sea level in northern Gulf County to about 20 ft below sea level at Port St. Joe. Only in the northernmost part of Gulf County does the portion of the aquifer containing fresh water approximately equal the entire thickness of the aquifer. Approaching the coastline, the freshwater portion of the aquifer thins considerably, reflecting the loss of fresh water to the Gulf of Mexico discharge boundary. This places a significant constraint on the long-term viability of water production from the Floridan Aquifer in immediate proximity of the coast.

Surface Water Hydrology

Surface water is obtained from the Chipola River via a canal, which connects Port St. Joe to the Chipola River near its confluence with the Apalachicola River. The median flow value of the Apalachicola River at Sumatra, just below the confluence, is 20,900 cfs (14,135 Mgal/day). During average flow conditions, the permitted withdrawal of 70 cfs (48 Mgal/day) from the Chipola River is a small fraction of the total flow under these conditions. The anticipated average flow of 57.5 cfs (38.9 Mgal/day) is even less likely to impact the system.

Ground Water Hydrology

Three hydrostratigraphic systems define the regional ground water flow system; a thin to moderately thick Surficial Aquifer System, a moderately thick Intermediate System, and a thick Floridan Aquifer System. The Surficial Aquifer System and the Floridan Aquifer System are composed of moderately permeable sediments, capable of transmitting and storing large quantities of water. The Intermediate System is primarily composed of low-permeability sediments and forms a regionally extensive confining unit.

The Surficial Aquifer System typically consists of undifferentiated sand and clay. Ground water within the Surficial Aquifer System exists, for the most part, under unconfined conditions, with some areas being semi-confined under stringers of sandy clay. The thickness of the Surficial Aquifer ranges from zero ft to 150 ft across the region. In low-lying areas along the Apalachicola River, the Surficial Aquifer is absent.

In Gulf County, the saturated thickness and permeability of the surficial sands are sufficient to form a locally important source of ground water. Surficial Aquifer System water is desirable because it tends to be less mineralized than water from the underlying Floridan Aquifer. The Surficial Aquifer provides approximately half of the Public Supply demand of the City of Port St. Joe. Clearly, the Surficial Aquifer in coastal Gulf County is capable of meeting some of the local water use demand. In order to exploit this resource, well depths less than 150 ft are sufficient.

A multi-well aquifer test of the Surficial Aquifer System was conducted at a site located four miles northeast of Port St. Joe, circa 1980. Time-drawdown data were available from four observation wells. Each observation well was cased to a depth of 70 ft below land surface and had a total depth of 100 ft. Transmissivity values ranged between 3,900 ft^2/d and 4,300 ft^2/d. The storage coefficient ranged between 4.6 x 10^{4} and 2.3 x 10^{-3} (dimensionless). Data were analyzed by the Theis method (unpublished files of the NWFWMD).

Single-well performance tests at the City of Port St. Joe water treatment plant yielded the following transmissivity estimates: Port St. Joe Well #5; transmissivity = 3,500 ft^2/d; St. Joe Paper SW #1; transmissivity = 1,500 ft^2/d (unpublished files of the NWFWMD). The city's Surficial Aquifer wells currently yield about 200 gpm and are believed to be capable of higher production rates.

The Surficial Aquifer System in Franklin County, however, is thin, ranging in thickness from 12 ft to 40 ft. The only known use of the Surficial Aquifer is on the barrier islands where wells yielding up to 50 gpm are utilized for Landscape Irrigation. No significant exploration of the source on the mainland has occurred. Over much of the county, the Surficial Aquifer System intersects the ground surface in the form of wetlands. Compared to Gulf County, the Surficial Aquifer is a much less viable supplemental water source in Franklin County.

Underlying the Surficial Aquifer is the Intermediate System. This unit consists primarily of soft, sandy, clayey, fossiliferous limestone, overlain by a thin unit of sandy clay and clayey sand. The Intermediate System is approximately 400 ft thick in the Port St. Joe area. It thins toward both the north and the east. In eastern Franklin County, it is less than 50 ft thick. In northern Gulf County, it thins to about 200 ft. As the Intermediate System thins in eastern Franklin County, leakage across it increases and it behaves as a semi-confining unit. As a result, the coastal fringe of the region, particularly eastern Franklin County, is a discharge area for the Floridan Aquifer.

In Region V, the Intermediate System has some capacity to serve as a supplemental source of water. In eastern Bay County, the City of Mexico Beach constructed two Intermediate System wells, each producing about 300 gpm. These wells have specific capacities of nine and 11.5 gpm/ft, respectively. Conditions within the western half of Region V, with respect to the permeability and thickness of the Intermediate System, should be similar to Region III. To date, no test drilling, aquifer testing and water quality sampling has been done on the Intermediate System in Region V to determine its viability as a source. There is, however, approximately 200 ft of Intracoastal Formation at a site in southernmost Gulf County. As the Intermediate System thins in Franklin County, it becomes less viable as an alternate source of water.

Underlying the Intermediate System is the Floridan Aquifer System, the source of most of the ground water pumped in Region V. The Floridan Aquifer consists of a thick sequence of carbonate sediments of varying permeability. The aquifer thickness ranges from about 1,000 ft in the extreme northwestern part of Gulf County to more that 2,800 ft in southern Franklin County.

Throughout Region V, the hydraulic conductivity of the Floridan Aquifer is quite variable. Though poorly substantiated by field data, hydraulic conductivities are believed to be higher in extreme eastern Franklin County. This area is the southernmost extension of the Woodville Karst Plain, an area of active recharge, flow, and dissolution of the Floridan Aquifer System.

In the western half of the region, hydraulic conductivities are lower. At a site located 15 miles north of Port. St. Joe, a multi-well aquifer test was conducted on the Floridan Aquifer, circa 1980 (Barr and Pratt 1981). The test site had two observation wells and yielded the transmissivity estimates, 6,300 ft^2/d and 6,900 ft^2/d. Storage coefficient estimates were 4×10^{-5} and 7×10^{-5} (dimensionless). Floridan Aquifer specific capacity values in coastal Gulf County are typically in the single digits. Franklin County Floridan Aquifer specific capacities are higher, on the order of ten to 20 gpm/ft.

The Sub-Floridan System underlies and confines the Floridan Aquifer System. Due to a lack of data, little is known of the hydraulic character of this unit.

Floridan Aquifer System Water Levels

The Floridan Aquifer System's zone of contribution, within which Region V lies, extends north into Liberty and Calhoun counties. In the extreme northern portions of the two counties, the potentiometric surface of the Floridan Aquifer reaches a maximum elevation of approximately 40 ft above sea level. From this high, water levels decline toward the Gulf of Mexico discharge boundary. As a result of pumping in the Port St. Joe area, a modest cone of depression has formed. Water levels in the cone are depressed as much as 20 ft below sea level.

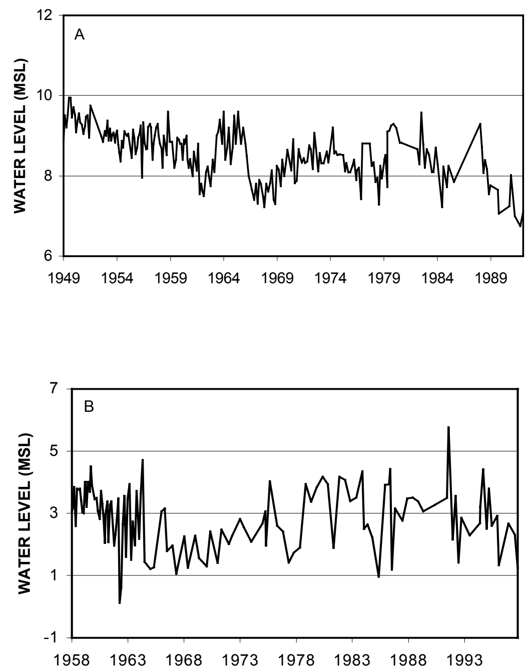
Hydrographs for two wells are presented to depict long-term trends in Floridan Aquifer water levels (Figure 5-55). Data are presented for the Pavilion well in Apalachicola and the Ice Plant well in Carrabelle. Each well has an approximately 40-year period of record. The Pavilion well shows a slight, but pronounced, decline in water level over the period of record. Likely, this decline is due to pumping for the City of Apalachicola. The Ice Plant well shows no trend of declining water level with time.

Floridan Aquifer System Water Quality

Over most of Region V, the quality of ground water in all three aquifer systems is suitable for most uses. Within the Floridan Aquifer, the "suitable for most uses" water is found in the upper portion of the aquifer. Traditionally, potable ground water has been obtained from the Floridan Aquifer System. Some potable water is presently being obtained from the Surficial Aquifer System (e.g., City of Port St. Joe). Typically, the Surficial Aquifer is used for non-potable uses (e.g. Recreational Irrigation).

Over the region, water quality in the Floridan Aquifer degrades both with increasing depth of penetration and with proximity to the Gulf of Mexico shoreline. In northern Gulf County, TDS concentrations from the upper part of the Floridan Aquifer are on the order of 250 mg/L (Maddox et al. 1992). In northern Franklin County, TDS concentrations exceed 350 mg/L (Maddox et al., 1992). Along the coastline, TDS concentrations from the upper part of the Floridan Aquifer range between 250 mg/L and 650 mg/L. Sprinkle (1989) estimates that the portion of the Floridan Aquifer containing fresh water in northernmost Gulf County is approximately 1,000 ft thick. His estimated thickness of the freshwater portion of the flow system along the coastline was less than 500 ft.

Figure 5-55 Hydrographs of the A) Pavilion and B) Ice Plant Floridan Aquifer Wells

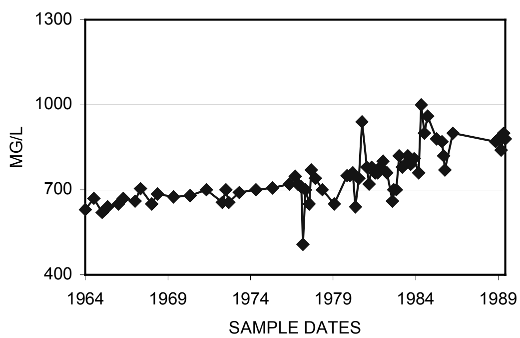


This degradation of water quality with increasing depth of penetration is evidenced by data from a site 15 miles north of Port St. Joe. At this site, a test well was drilled to total depth of 715 ft below sea level and sampled. Water from above a depth of 555 ft below sea level had a chloride concentration of less than 100 mg/L (Barr and Pratt 1981). Water from the bottom of the well (715 ft below sea level) had water with chlorides over 400 mg/L. It is reasonable to expect that this vertical degradation with increasing depth of penetration is typical of the entire region.

Long-term records of Floridan Aquifer chloride data (source USGS) are available for the Pavilion well in Apalachicola (cased 422 ft below land surface, total depth 522 ft) for the period 1964 through 1989 (Figure 5-

56). Between 1964 and 1989, water levels in the well declined about two ft, and the chloride concentration rose from 630 mg/L to 880 mg/L. This well is somewhat deeper than the existing Apalachicola production wells and is located closer to the coast. The increase in chloride concentrations appears to be related to City of Apalachicola pumping. The trend of declining water quality in the aquifer in the vicinity of Apalachicola raises concerns regarding the continued use of the shallower production wells over the long-term.

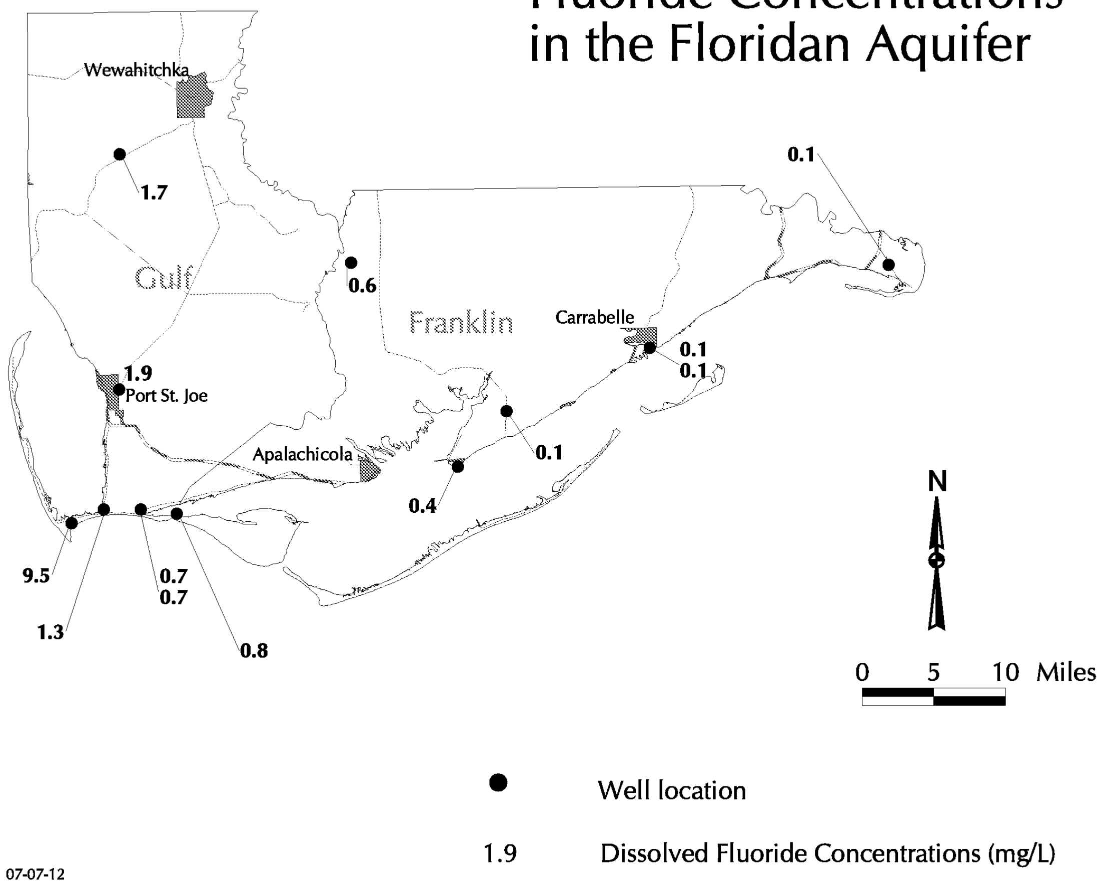
Figure 5-56 Chloride Concentration Data for the Pavilion Well in Apalachicola



The coastal area of Gulf County has a problem with naturally-occurring, elevated levels of fluoride and iron in water from the Floridan Aquifer System. Drinking water standards require a fluoride concentration of less than four mg/L. Ground water from the Floridan Aquifer in this area can have concentrations as high as 10 mg/L (Figure 5-57). Treatment for fluoride is generally expensive.

Drinking water standards for iron recommend a limit of 0.3 mg/L. Iron concentrations in the Floridan Aquifer System in the Port St. Joe area commonly range from one to seven mg/l. Treatment for iron, however, is relatively simple and inexpensive. Port St. Joe manages its Floridan Aquifer water quality problems by blending Floridan Aquifer water with Surficial Aquifer water. The city has two production wells in each system.

Figure 5-57
Fluoride Concentrations
in the Floridan Aquifer



Ground Water Budget

Although surface water represents approximately 87 percent of freshwater use in Region V, ground water is used almost exclusively for Public Supply. Within the region, the principal source of fresh ground water is the Floridan Aquifer System. To assess whether the Floridan Aquifer will meet regional Public Supply needs through 2020, a regional scale ground water budget was prepared. The water budget presented here is intended only to represent an order-of-magnitude approximation of the major Floridan Aquifer System sources and discharges for the region. The budget was delineated using output from a numerical flow model. Although a calibrated steady-state model does not account for seasonal or annual variation in flow, the model does provide a means to estimate the relative magnitude of the various inflows to and outflows from the aquifer.

The flow system components were estimated, in part, using output from two steady-state ground water flow models for the Floridan Aquifer System. The model domain of Davis (1996) covered the eastern part of Region V and was calibrated to conditions as they occurred in October and November of 1991. The model of Richards (1997) covered the western part of the region and was calibrated to conditions as they occurred in August 1996. The use of output from two separate models, calibrated to different time periods, was mandated by the fact that neither model covered the region in its entirety. Such an approach adds unavoidable uncertainty to the water budget generated from the two models.

Together, the domains of both the Davis (1996) and Richards (1997) models provided coverage for most of Region V. Regional coverage of the two models did not include a 20-mi^2 area in the southwest portion of the region. Ground water withdrawals in this area were evaluated to determine the magnitude of these demands relative to the overall estimated regional water budget.

Figure 5-58 Region V Floridan Aquifer Ground Water Budget.

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In order to estimate water budget components for the region, the computer program ZONEBUDGET (Harbaugh 1990) was used to analyze output obtained from the Davis and Richards ground water flow models. ZONEBUDGET allows the user to define a subregion within a MODFLOW model domain and to calculate the inflow and outflow to that subregion. A subregion was defined for the portion of each model domain that included Region V. A composite was made of the resulting subregions to create a single region for which the appropriate inflows and outflows were estimated.

The major regional ground water sources to the Floridan Aquifer System are 1) downward leakage from the Surficial Aquifer and 2) subsurface inflow from areas hydraulically upgradient (Calhoun, Liberty, and Wakulla counties). The Surficial Aquifer leakage to the Floridan Aquifer System were estimated to be 11.7 Mgal/d for the region. Subsurface inflow was estimated to be 7.3 Mgal/d. Thus, the Region V steady-state ground water inflow to the Floridan Aquifer is estimated to be 19 Mgal/d.

The major regional discharges from the Floridan Aquifer System are 1) leakage and stream discharge, 2) subsurface outflow to areas hydraulically downgradient (Bay County and Gulf of Mexico), and 3) ground water discharge via wells. Leakage and stream discharge was estimated to be 8.9 Mgal/d from the Floridan Aquifer System. Subsurface outflow to areas hydraulically downgradient of Region V was estimated to be 6.9 Mgal/d. The total ground water use for Region V were estimated to be 3.2 Mgal/d, based on ZONEBUDGET results and average daily discharge rates for wells located in regional areas not included in the ground water models. The Region V ground water outflow is equal to the estimated inflow (19 Mgal/d).

Approximately 0.73 Mgal/d of pumping was not simulated in the two models due to either the lack of regional coverage by the model domains or the proximity of wells to model boundaries. However, inclusion of this pumping is not expected to have significantly changed the regional flow system estimates.

The region-wide recharge rate to the Floridan Aquifer (11.7 Mgal/d) equates to an annual recharge rate of less than 0.5 inches per year over the region. The 1995 Region V Floridan Aquifer ground water use of approximately three Mgal/d represents one-seventh of the overall estimated Floridan Aquifer ground water budget. Projected 2020 demands for Floridan Aquifer water (estimated at five Mgal/d) represent about one-quarter of the overall estimated Floridan Aquifer water budget. It is apparent that, even though the Floridan Aquifer is expected to be able to adequately meet future needs, a slight increase (two Mgal/d) in demand will constitute a significant fraction of the total water budget.

Assessment Criteria Used

Surface Water

The criteria for assessing impacts to surface waters was whether or not the diversion into the Florida Coast Paper Company canal could be maintained, while sustaining water resources and related natural systems downstream of the diversion.

Ground Water

Two criteria were used to assess impacts on ground water resources; long-term depression of the potentiometric surface of the Floridan Aquifer system and attendant alteration of ground water quality.

Impacts to Water Resources and Related Natural Systems

Surface Water

As previously stated, the 28 Mgal/d that St. Joe Paper used in 1995 has historically represented only a small portion of the flow of the surface water system the canal taps. At the current and anticipated levels of use, no additional, future impact to the resource is anticipated.

Ground Water

Presently, ground water from the Floridan Aquifer constitutes a relatively small percentage of the fresh water used in Region V. In Gulf County, that use has resulted in the formation of a modest cone of depression in the Floridan Aquifer. The potentiometric surface depression is presently centered on the City of Port St. Joe and results from a withdrawal of about two Mgal/d. Heads within the cone of depression are drawn down as much as 20 ft below sea level. This feature has existed for at least the past decade. It will persist as long as ground water is produced at current rates within the current ground water production footprint.

Pumping has had much less effect on aquifer heads in the coastal area of Franklin County. Likely this derives from lower overall pumping rates, more widely distributed pumping and greater leakiness of the Intermediate System. The Intermediate System is only half as thick in coastal Franklin County as it is in coastal Gulf County. Leakage from the Surficial Aquifer System likely plays a part in attenuating drawdowns in this area. Unfortunately, this poses a potential threat to ground water quality in the form of possible saltwater intrusion from nearby, overlying saline surface waterbodies.

Coupled with concerns about the potentiometric surface decline are concerns about Floridan Aquifer water quality along the Gulf Coast. Historic water quality data from a Franklin County Floridan Aquifer well indicate increasing concentrations of chloride with time. Projected increases in utilization of Floridan Aquifer ground water in the current spatial distribution leads to concerns that ground water in the more shallow portions of the Floridan Aquifer System may begin to see a corresponding alteration of ground water quality.

Adequacy of Regional Sources

In Region V, the existing and reasonably-anticipated water sources (both surface and ground water) are considered adequate to meet the requirements of existing legal users and reasonably-anticipated future water supply needs of the region (projected 2020 demands), while sustaining the water resource and related natural systems.

Given water quality concerns about continued Floridan Aquifer ground water production along the coastline, however, some adjustments should be considered. In Gulf County, realignment of the relative proportion of surface water, Floridan Aquifer water, Surficial Aquifer water, and Intermediate System water used to meet regional needs is an option. The Surficial Aquifer System should be able to meet much of the public water supply demand in Gulf County without impact to water resources or related natural systems.

In eastern Franklin County, the principal option for minimizing unacceptable water quality impacts from pumping near the coast is to spread pumping out and move it well away from the shoreline. Well depths need to be as shallow as possible to minimize the potential for upconing. These precautions are required to assure that the Floridan Aquifer will be able to meet the 1.45

Mgal/d projected increase in average demand through 2020 without adverse impacts to water resources or related natural systems. This may require construction of additional inland Floridan Aquifer wells. While no Regional Water Supply Plan is recommended, water quality concerns are sufficiently high to warrant additional resource monitoring. This resource monitoring should be performed by both the utilities using the resource and the District.

The concerns expressed for Floridan Aquifer use in eastern Franklin County apply to the western part of the county. In addition, in this area, both the Surficial Aquifer System and the Intermediate System are of sufficient thickness to offer the possibility of alternate water supply. Both systems provide significant quantities of water further west in Gulf and Bay counties. The feasibility of using these units in western Franklin County would require a program of test drilling and water quality and aquifer testing. Any efforts to expand use of the Floridan Aquifer in western Franklin County should include an evaluation of these two units.

Level-of-Certainty

Using the methodology described in Section IV, water demand during drought conditions was estimated for Region V through the year 2020 (Table 5-34). The amount of water available from traditional sources within this region should be sufficient to meet all of the projected average and drought condition demands through the year 2020, while sustaining natural resources.

This determination is based upon an analysis of regional water sources. Locally, individual utilities' high demand periods could place unacceptable stress on their current sources. In these instances, there may be a need for increased reliance on available surface water, Surficial Aquifer System water, or inland supplies as well as related infrastructure improvements.

Reuse and Conservation

Within Region V, 0.92 Mgal/d of wastewater treatment capacity existed in 1997; however, only 0.56 Mgal/d of wastewater treatment plant (WWTP) effluent was disposed of in a manner that meets the Department of Environmental Protection definition of reuse (Table 5-35). According to information collected in 1997 (Marella et al. 1998), few water conservation programs have been implemented in the region. This assessment has identified concerns with continued sustainability of Floridan Aquifer ground water production along the coast and recommends that either a realignment of the relative proportion of ground and surface water sources used to meet regional needs or shifting production away from the coastline.

It was beyond the scope of this assessment to fully evaluate the status and effectiveness of reuse and conservation programs. However, available information indicates that reuse and conservation programs are not being implemented to their full potential in Region V. It may be possible and feasible to reduce demands on ground water resources in the southern portion of the region through implementation of additional reuse and conservation programs. Implementation of a water conserving rate structure has resulted in water use reductions of approximately 30 percent for a coastal area utility in southern Walton County. Recent studies also indicate that indoor water use can be reduced by approximately one-third through technological improvements such as increased plumbing efficiency and new water efficient appliances (Osann and Young 1998).

In addition to the substantial reductions of ground water pumping that can be accomplished through these efforts, cost savings may also be realized when new water sources are developed or procured to replace existing wells. As future water supply strategies are evaluated, the feasibility and potential effectiveness of additional reuse and conservation efforts should be examined.

Table 5-34 Region V Estimated Water Demand During Drought Conditions (Mgal/d)

Water Use Category	2000	2005	2010	2015	2020
Public Supply	3.52	3.79	4.05	4.42	4.74
Domestic SS/Small Public Supply Systems	0.41	0.41	0.49	0.63	0.98
Commercial-Industrial Self-Supply	28.66	28.70	28.73	28.76	28.78
Recreational Irrigation	0.22	0.22	0.22	0.33	0.33
Agricultural Irrigation	0.00	0.00	0.00	0.00	0.00
Power Generation	0.00	0.00	0.00	0.00	0.00
Total	32.81	33.13	33.48	34.13	34.82
Increase Over Average Daily Demand	0.26	0.28	0.29	0.43	0.47

Table 5-35 Reuse of Domestic Wastewater in Region V in 1997

Domestic Wastewater Facility Name	Total Plant Capacity (Mgal/d)	Total Plant Flow (Mgal/d)	Reuse Capacity (Mgal/d)	Reuse Flow (Mgal/d)	Reuse Required
Franklin County					
City of Apalachicola	01.00	00.69	00.00	00.00	N
City of Carrabelle	00.30	00.18	00.30	00.18	Y
Eastpoint Water and Sewer District	00.17	00.21	00.17	00.21	N
Lanark Village	00.10	00.08	00.10	00.08	N
County Total	01.57	01.16	00.57	00.47	1
Gulf County					
Gulf Correctional Institute	00.35	00.09	00.35	00.09	N
County Total	00.35	00.09	00.35	00.09	0
Region V Total	01.92	01.25	00.92	00.56	1

Source: NWFWMD 1997 Annual Reuse Report *(ND=No Data)*

REGION VI: GADSDEN COUNTY

Region-at-a-Glance	1995	2020
Population:	44,734	52,719
Avg. Water Use (Mgal/d):	12.50	15.78
Primary Source:	Floridan Aquifer/ Telogia Creek/ Quincy Creek	
Regional Water Supply Plan Recommendation:	No plan needed	

Demand Assessment Overview

Water Supply Planning Region VI consists of only Gadsden County. The region is relatively rural, with over half of the population residing in unincorporated areas, and has slow regional population growth. Agriculture is the primary component of the region's economy and Agricultural Irrigation is the largest water use category in the region. Forestry is a major activity and dominant agricultural crops include vegetables, nurseries, cotton and sod. The largest employment sectors are government, agriculture and retail trade.

Although ground water provides approximately half of all the water used within the region, ground water availability is limited in most of the region due to low water yielding properties of the Floridan Aquifer. Ground water is the only source for Commercial-Industrial Self-Supply and Domestic Self-Supply and Small Public Supply Systems. The majority of surface water in the region is used for Agricultural Irrigation; but, the largest public supply system, the City of Quincy, also withdraws most of its water from Quincy Creek, a surface water source.

Because Agricultural Irrigation demand upon surface water in the Telogia Creek Basin has stressed this limited resource, the District has designated this area as a Water Resource Caution Area (WRCA) under Chapter 40A-2, F.A.C. The WRCA designation subjects all non-exempt withdrawals to more rigorous scrutiny to ensure that the proposed withdrawal does not result in unacceptable impacts to the resource. Permittees within a WRCA also have increased water use reporting requirements, must implement water conservation measures and must improve water use efficiencies. They are also required to perform an evaluation of the technical, environmental and economic feasibility of utilizing reclaimed water for all nonpotable water uses. In addition, the central portion of Gadsden County, including the Telogia Creek WRCA, has been identified by the District as an Area of Special Concern (ASC) for water supply planning (Figure 5-1). This designation was established as part of the WSA for areas where the potential for water supply problems exists and close examination of both regional demand projections and locally available water resources is warranted.

Existing Water Use (1995)

Region VI 1995 water use is shown by water use category in Table 5-36; Figure 5-59 depicts the location of permitted regional water withdrawals greater than 0.1 Mgal/d.

Table 5-36 Region VI: 1995 Water Use (Mgal/d)

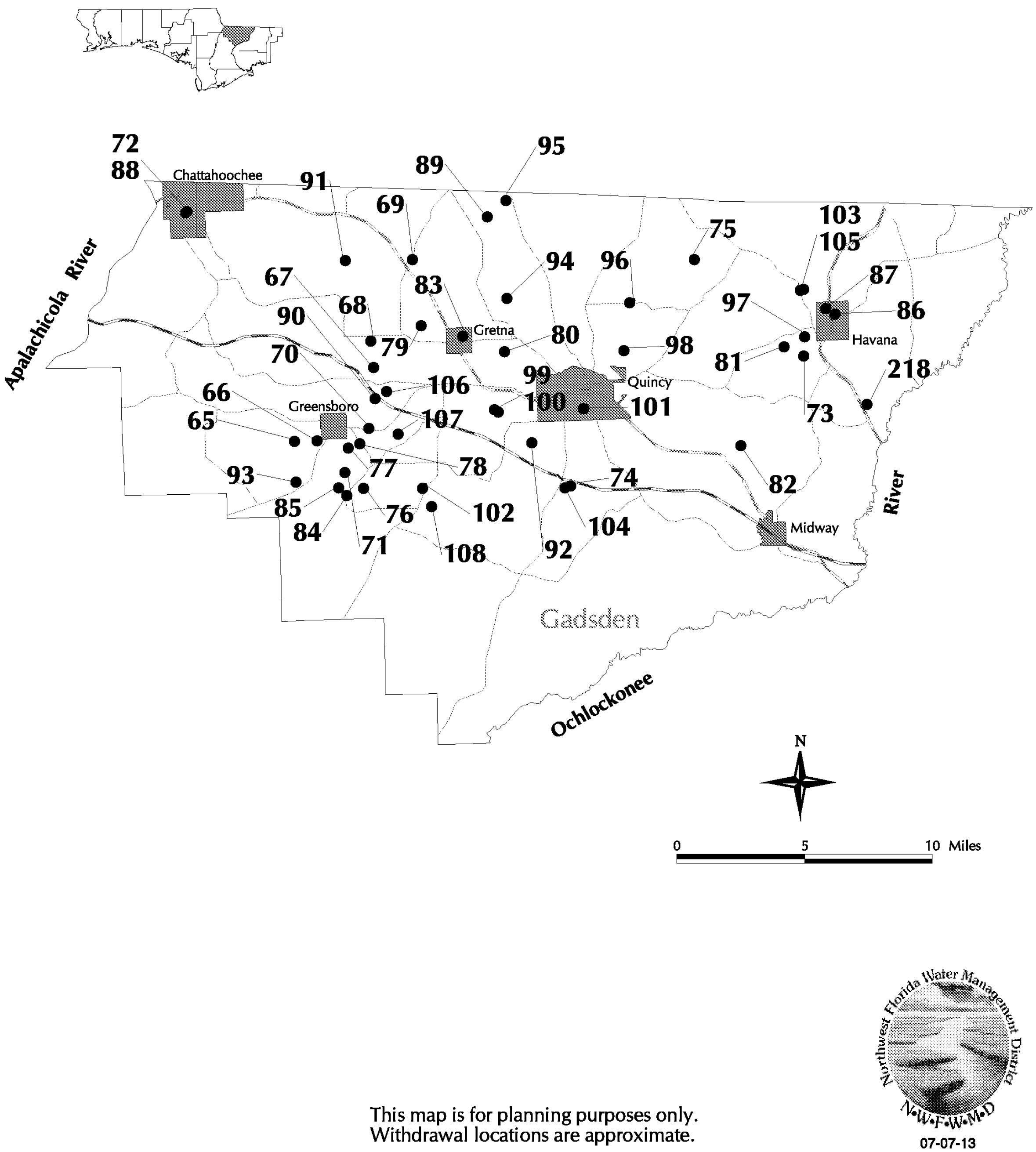
	Gadsden County
Public Supply	3.79
Domestic SS/Small Public Supply Systems	2.20
Commercial-Industrial SS	1.02
Recreational Irrigation	0.25
Agricultural Irrigation	5.24
Power Generation	0.00
Total	12.50

Public Supply

The Public Supply water use category accounted for approximately 30 percent (3.79 Mgal/d) of average regional water use in 1995. The City of Quincy, located within the ASC, is the largest public supplier in the region, with an average withdrawal of 1.44 Mgal/d in 1995 (Table 5-37).

Figure 5-59

Region VI



1995 Permitted Average Daily Rates (ADR) Greater Than 0.1 Mgal/d

(See following page for map key)

Figure 5-59 Map Key

Index #	Permit #	Name	Primary Use*	Permitted ADR (gal/d)	Aquifer/Surface Water	Source*
65	910019	Adrian C. Fletcher Farms	AI	130,171	Juniper Branch	SW
66	910025	Adrian C. Fletcher Farms	AI	130,171	Tallahassee Creek	SW
67	910020	W. M. Ard, Jr.	AI	120,501	Hannas Mill Pond	SW
68	910024	W. M. Ard, Jr.	AI	126,526	Hurricane Branch	SW
69	840027	Beefstake Tomato Growers	AI	500,303	Floridan	GW
70	910002	Big Wish Farms	AI	120,873	Telogia Creek	SW
71	910007	Big Wish Farms	AI	168,479	Telogia Creek	SW
72	830027	City of Chattahoochee	PS	774,000	Floridan	GW
73	850050	Clinton Nurseries of Florida	AI	934,000	Floridan/Unnamed Pond	GW/SW
74	830012	Coastal Tomato Growers	AI	290,000	Floridan	GW
75	940016	Engelhard Corporation	IN	165,000	Quincy Creek	SW
76	910018	Fernlea Nurseries	AI	177,818	Floridan	GW
77	910008	H. Maxwell Fletcher	AI	109,716	Floridan/Telogia Creek	GW/SW
78	910010	Fletcher Nursery	AI	855,411	Little Telogia Cr./ Trib. of Telogia Cr.	SW
79	910028	Florida Redlands	AI	786,978	Telogia Creek	SW
80	910073	Golf Club of Quincy	GI	175,802	English Branch	SW
81	890002	Iragene H. Gregory	AI	134,000	Trib. of Hurricane Creek	SW
82	910092	Gregory Farms	AI	104,000	Floridan/Trib. of Little River	GW/SW
83	841323	City of Gretna	PS	362,000	Floridan	GW
84	910016	Hackney Nursery Company	AI	282,286	Juniper Creek	SW
85	910017	Hackney Nursery Company	AI	171,082	Telogia Creek	SW
86	830013	Town of Havana	PS	629,000	Floridan	GW
87	910143	Havana Golf & Country Club	GI	160,000	Trib. of Salem Creek	SW
88	860220	Health & Rehabilitative Services	PS	4,300,000	Floridan/Mosquito Creek	GW/SW
89	910096	High Hope Farms	AI	149,000	Floridan	GW
90	910001	Howard H. Hopper	AI	455,665	Floridan/Telogia Creek	GW/SW
91	850196	Raymond C. Hurst	AI	246,575	South Mosquito Creek	SW
92	850330	Imperial Nurseries	AI	1,283,305	Floridan/Cox and Vote Creeks	GW/SW
93	910023	Juniper Produce	AI	114,179	Yon Creek	SW
94	910118	Manley Farms	AI	109,000	Trib. of Quincy Creek	SW
95	910123	Manley Farms	AI	260,000	Floridan	GW
96	910129	May Nursery	AI	156,000	Trib.s of Willacoochee Creek & Hubbert Branch	SW
97	870029	May Nursery	AI	386,000	Floridan	GW
98	950090	Terence P. McCoy	AI	122,000	Unnamed Farm Pond	SW
99	910066	N.T. Gargiulo	AI	388,000	Mill Dam Creek	SW
100	950066	N.T. Gargiulo	AI	176,000	Mill Dam Creek	SW
101	830021	City of Quincy	PS	1,669,000	Floridan/Quincy Creek	GW/SW
102	850183	Quincy Corporation	AI	123,288	Floridan	GW
103	910057	James L. & Geralean Simpson	AI	175,000	Salem Branch	SW
104	840059	Talquin Electric Cooperative	PS	563,000	Floridan	GW
105	910057	Terry and Marie Taylor	AI	140,585	Salem Branch	SW
106	910014	Thomas B. Smith Farms	AI	128,558	Telogia Creek and Trib. of Little River	SW
107	910015	Thomas B. Smith Farms	AI	204,949	Little Telogia Creek	SW
108	910013	Tomato Farms	AI	129,000	Goza Branch	SW
218	841778	Talquin Electric Cooperative	PS	2,100,000	Floridan	GW

* AI= Agricultural Irrigation, AR = Aquifer Recharge, GI = Golf Course Irrigation, HS = Heat Pump Supply, IN = Industrial, LA = Landscape Irrigation, NI = Nursery Irrigation, PP = Power Production, PS = Public Supply, AQ = Aquaculture, GW = Ground Water, SW = Surface Water

Domestic Self-Supply and Small Public Supply Systems

Water use by Domestic Self-Supply and Small Public Supply Systems accounted for approximately 18 percent of the region's water use (2.20 Mgal/d) in 1995.

Commercial-Industrial Self-Supplied

The Commercial-Industrial Self-Supplied category accounted for eight percent of total average regional water use with 1.02 Mgal/d being attributed to users in this category in 1995. The larger permitted Commercial-Industrial water users within the region include the Florida Department of Corrections, Florida Department of Transportation's I-10 Rest Area and Quincy Farms, a mushroom processing facility.

Recreational Irrigation

The Recreational Irrigation category accounts for the least amount of water used within the region, with only one percent of total regional water use (0.25 Mgal/d) being attributed to users in this category in 1995.

Agricultural Irrigation

Agricultural Irrigation is the largest water user within the region. This water use category accounts for an average of approximately 5.24 Mgal/d or 42 percent of total regional water use.

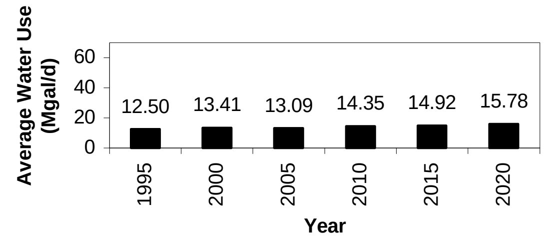
Power Generation

There is not any water used for Power Generation within Region VI.

Reasonably-Anticipated Future Needs for Each Water Use Category Through 2020

Average regional water use is projected to increase from approximately 12.50 Mgal/d in 1995 to 15.78 Mgal/d in the year 2020, an increase of approximately 26 percent (Figure 5-60 and 5-63). Agricultural Irrigation is expected to continue to be the largest water use category in Gadsden County through 2020.

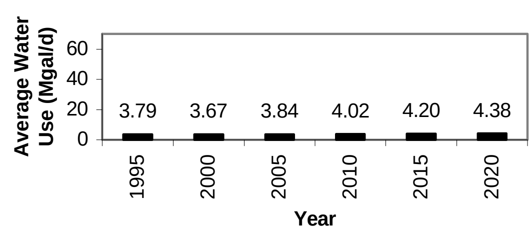
Figure 5-60
Region VI: Total Average Water Use



Public Supply

Water use projections suggest that Public Supply will continue to be a predominant water use category within Region VI through the year 2020. Regional Public Supply projections indicate that use will increase approximately 16 percent from an average of 3.79 Mgal/d in 1995 to 4.38 Mgal/d in the year 2020 (Figure 5-61). Although the population of Gadsden County using Public Supply is projected to increase through 2020, the percentage of the population using Public Supply is projected to decrease slightly from 66 percent in 1995 to 58 percent in 2020.

Figure 5-61
Region VI: Public Supply



Domestic Self-Supply and Small Public Supply Systems

This water use category is projected to increase approximately 48 percent between 1995 (2.20 Mgal/d) and the year 2020 (4.38 Mgal/d) (Figure 5-62). In addition, the regional population dependent upon Domestic Self-Supply and Small Public Supply Systems is projected to increase by eight percent.

Figure 5-62
Region VI: Domestic Self-supplied & Small Public Supply Systems

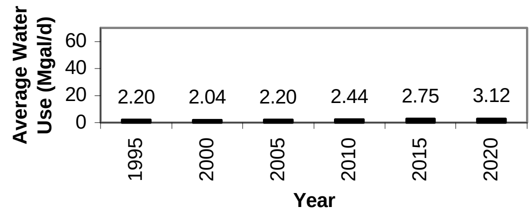
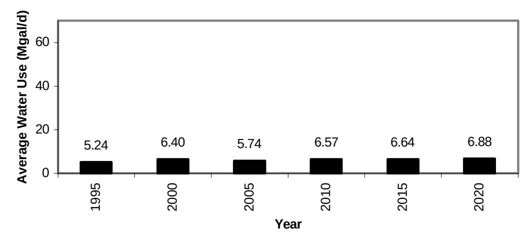


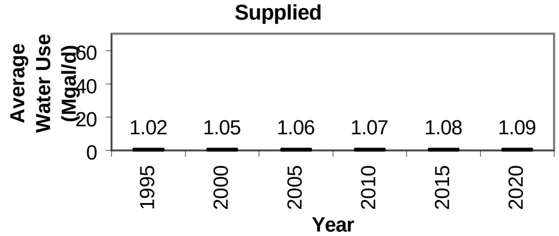
Figure 5-64
Region VI: Agricultural Irrigation



Commercial-Industrial Self-Supplied

The Commercial-Industrial Self-Supplied water use category is projected to increase approximately seven percent or 0.07 Mgal/d between 1995 and the year 2020 (Figure 5-63).

Figure 5-63
Region VI: Commercial-Industrial Self-Supplied



Recreational Irrigation

The Recreational Irrigation water use category accounts for the least amount of water used in the region. Water use in this category is expected to increase from 0.25 Mgal/d in 1995 to 0.31 Mgal/d in 2020.

Power Generation

There is not any projected Power Generation use of water in Region VI through 2020.

Agricultural Irrigation

Through 2020, Agricultural Irrigation is projected to continue to be the water use category with the largest withdrawals in Gadsden County. Agricultural Irrigation water use is expected to increase approximately 31 percent from 5.24 Mgal/d in 1995 to 6.88 Mgal/d in 2020 (Figure 5-64).

Telogia Creek Agricultural Demands

The earliest accounts of irrigated agriculture in the Telogia Creek basin (Womack 1976) were during the shade tobacco growing era, when as many as 3,000 acres were irrigated. The earliest method of irrigation in the 1920s was by pumping water through wooden troughs used to direct water down each row of plants. This method was later replaced by overhead sprinklers which applied water at very high application rates of about 1.5 to 3.0 inches per week depending on temperature, rainfall and soil moisture conditions. These application rates, which are estimated to have been as high as 50 cfs, resulted in excess, non-reclaimed runoff. Reports from surveyed farmers indicated the creek never ran completely dry, but some did use sandbags to temporarily block the stream or reverse flows in their pipes to blow out an area so that pump intakes could obtain water.

Today, the Agricultural Irrigation demands in the basin are largely for tomato production. Average annual demands in 1995 were 1.8 Mgal/d, while the peak monthly average value reported to occur in May was 5.13 Mgal/d. A one-in-ten drought factor, which can be multiplied by the monthly value, is estimated to be 1.4, resulting in a drought demand of about 7.18 Mgal/d. Projected future demands, if not constrained by the current resource limits, would be about 1.07 times the current demands. The future crop mix acreage projections indicate that a shift in acreage from tomatoes to nursery could, in the future, result in a lower 1-in-10 year drought factor at 1.1. It should be noted that these demand estimates are reasonably consistent with the current maximum monthly demand allotments as permitted by the District at 10.27 Mgal/d (Average Daily Rate, 4.18 Mgal/d).

Figure 5-65
Region VI: Average Water Use by County (Mgal/d)

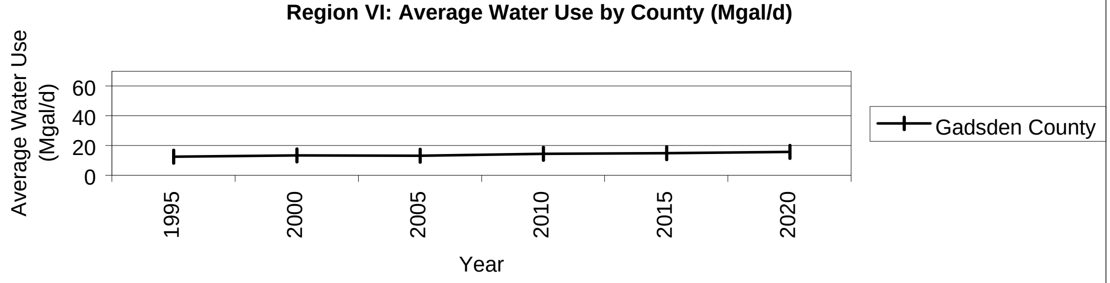


Table 5-37 Gadsden County Water Demand Data (water amounts in Mgal/d)

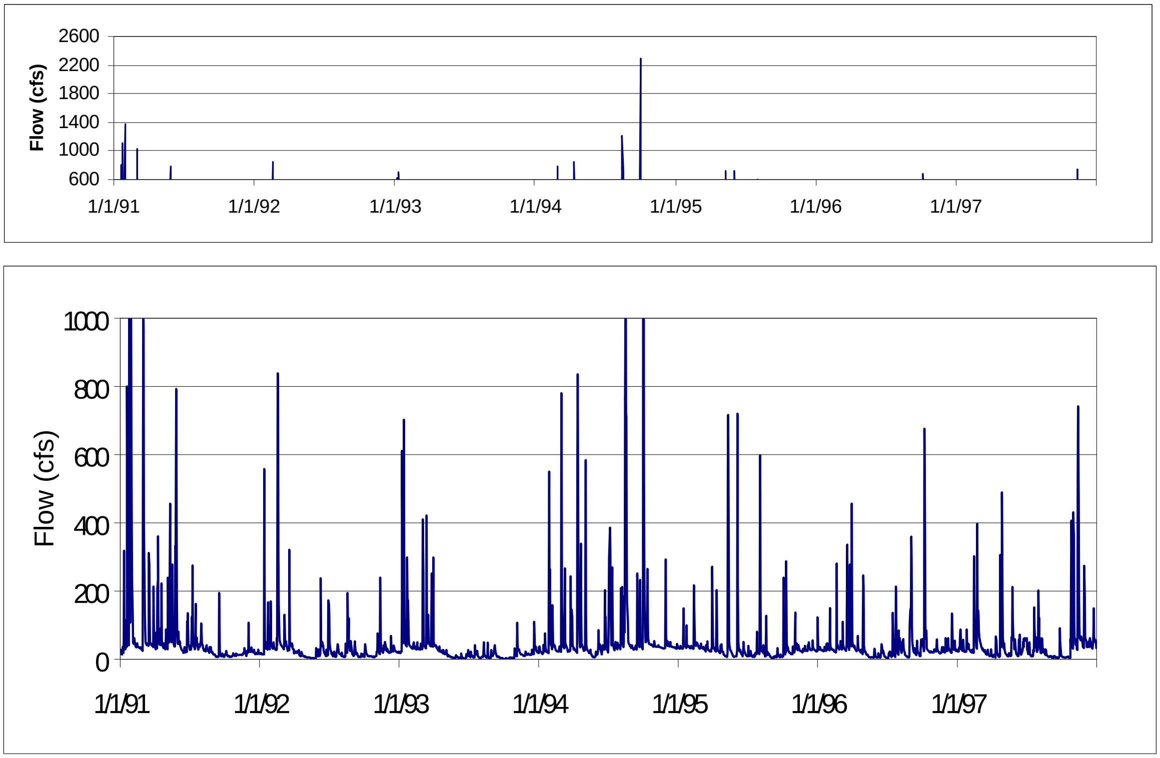
Average Daily Flow (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	3.79	3.67	3.84	4.02	4.20	4.38
Domestic SS/Small Public SS	2.20	2.04	2.20	2.44	2.75	3.12
Commercial-Industrial SS	1.02	1.05	1.06	1.07	1.08	1.09
Recreational Irrigation	0.25	0.25	0.25	0.25	0.25	0.31
Agricultural Irrigation	5.24	6.40	5.74	6.57	6.64	6.88
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	12.50	13.41	13.09	14.35	14.92	15.78
Average Daily Flow (Mgal/d)*						
	1995	2000	2005	2010	2015	2020
Area of Special Concern	2.31	2.48	2.67	2.86	3.06	3.25
Non Area of Special Concern	1.49	1.19	1.18	1.16	1.15	1.13
Total	3.80	3.67	3.85	4.02	4.21	4.38
Large Public Supply System Water Use						
	1995	2000	2005	2010	2015	2020
Total population served	29,619	29,227	29,933	30,340	30,604	30,810
Percent of total population	66%	65%	64%	63%	61%	58%
Per capita (gal/d)	128	126	128	133	137	142
Average Daily Flow of Large Public Supply Systems (Mgal/d)						
	1995	2000	2005	2010	2015	2020
Utility						
ASC						
Greensboro	0.08	0.08	0.08	0.08	0.09	0.09
Gretna	0.25	0.24	0.24	0.24	0.24	0.24
Quincy	1.44	1.40	1.43	1.47	1.51	1.55
Talquin-Gadsden Regional	0.54	0.76	0.91	1.06	1.22	1.37
NonASC						
Chattahoochee	0.91	0.66	0.66	0.66	0.66	0.66
Havana	0.58	0.53	0.52	0.50	0.48	0.47
Total	3.79	3.67	3.84	4.02	4.20	4.38

* *Agricultural Irrigation figures are not divided between ASC and NonASC.*

Source Evaluation

Within Region VI, ground water from the Floridan Aquifer System supplies approximately half of the water used (approximately six Mgal/d). It is the primary source of water for all uses, except Agricultural Irrigation. Surface water from the region's many streams, rivers and man-made impoundments, provides the other half of the water used. Agricultural Irrigation accounts for a large portion of the surface water use within the region. Surface water is also used for Recreational

Figure 5-66 Hydrograph of Telogia Creek at County Road 65D



Irrigation and, in the case of the City of Quincy, for drinking water supply. Quincy Creek is one of two Class I waterbodies within the Northwest Florida Water Management District.

Due to limited alternatives and the region's slow overall growth, it is reasonable to anticipate that current water use patterns will continue through the year 2020.

Overview of Hydrologic System

The key aspects of the Region VI hydrology are the two surface watersheds presently supplying Agricultural Irrigation and Public Supply (Telogia and Quincy creeks), and the Floridan Aquifer system. The Telogia Creek basin supplies much of the 5.2 Mgal/d of irrigation water used in the region. Because of concerns over the availability of ground and surface water within the basin, the upper Telogia watershed was designated as a Water Resource Caution Area (WRCA) under Chapter 40A-2, F.A.C. Quincy Creek is the source of the vast majority of potable water used by the City of Quincy and accounts for about one-third of the entire public water supply used in the county. The Floridan Aquifer System accounts for the remainder of the water used in the region (about six Mgal/d). Over most of the region, water availability from the Floridan Aquifer is very limited. This derives from extremely low transmissivities and naturally occurring poor quality water found at depth.

Surface Water Hydrology

Telogia Creek

For the purposes of assessing surface water flow conditions in the Telogia Creek basin, the District has maintained a gaging station (S106) on Telogia Creek at County Road 65D since 1990. Figure 5-66 is the hydrograph for this site, which includes approximately 36.4 mi^2 of intensely-farmed watershed area. This hydrologic data represents the available flow record for the most upstream, long-term gaging station in the watershed. The gaging station is downstream from where most of the agricultural surface water withdrawals occur. At this location the Q_{90} flow is about 7 cfs. Flows at this location range from zero to 2,290 cfs. Mean annual runoff is about 19 inches per year. Telogia Creek flows have also been measured by the USGS at Highway 20, approximately 14 miles downstream from the District gage for a period of 1950 to present. Summary statistics for this long-term monitoring station, which characterize the entire basin, are provided in Table 5-38.

Previous attempts (Bartel 1996) to use the flow records at this location to extend the flow records at the upstream gage have been unsatisfactory for the purposes of assessing long-term drought conditions at upstream locations. Factors attributed to the differences between the downstream reaches of the creek and upstream reaches include the greater downstream contribution to base flow from ground water, rainfall distribution patterns and the disproportion of pumping in the upper basin. Analysis on the limited period of record historical data from the up-stream gage indicate that streamflow may cease on a more frequent basis due to pumping demands. However, since the declaration of the area as a WRCA, no significant increase of surface water withdrawals has been authorized and any impact on the frequency of low flows due to pumping activity has been stabilized.

Table 5-38 Telogia Creek at Highway 20 Summary Flow Statistics

Summary Statistics	Amount
Annual Runoff (inches)	28.0
Annual Mean (cfs)	222
Ten-year seven-day minimum (cfs)	37
Q_{90} (cfs)	63
Instantaneous Low Flow (cfs)	28
Instantaneous Peak Flow (cfs)	20,600

Quincy Creek

The City of Quincy has used Quincy Creek as a dependable source of potable water since 1948. The creek system has a tributary watershed of about 16.8 mi^2, which contributes an average daily flow of about 20 Mgal/d. Also contributing to the potable water source is Colson Creek, including the Interlocking Lakes region. The Quincy Creek headwaters consist of a 6.4 mi^2 drainage basin, and Colson Creek contributes runoff from a drainage basin of 9.6 mi^2. Review of data from a USGS gaging station located approximately 400 ft downstream of the city's raw water intake indicate an observed minimum flow of 2.3 Mgal/d (3.6 cfs) during the period of August 1974 to September 1988. A low-flow analysis provided in Table 5-39 indicates that even during the 50-year return period drought, the flow should not drop below 2.3 Mgal/d, indicating an adequate supply of water for present needs. The stream is characterized by low base flows throughout the year. Extended droughts are infrequent in the region and base flows can be sustained for the duration of the droughts. Therefore, the creek appears adequate for the purpose of water supply.

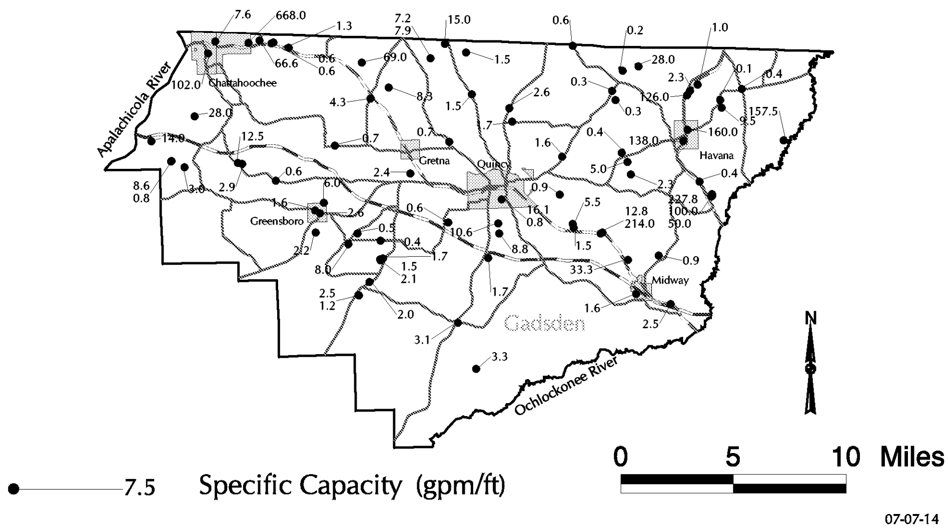
Table 5-39 Quincy Creek at SR267 Low Flow Analysis

Low Flow Period (days)	Discharge for Given Return Period (CFS)		
	10-yr	20-yr	50-yr
1	4.6	4.0	3.6
7	5.0	4.3	3.7
14	5.3	4.6	3.9
30	5.4	4.6	3.7
60	6.8	5.9	5.0
90	10.1	9.0	7.9

The data also indicates that the naturally occurring flow in Quincy Creek could be supplemented with water stored in the Interlocking Lakes reservoir to provide the city with a sustained surface water supply of about five Mgal/d. The 60-day low flow period would approach the limit of available water in the system. The city currently has the capability to use the Interlocking Lakes and is exploring options to acquire the lakes area for this purpose. Additional statistics for Quincy Creek from the period of record from August 1974 to September 1988 are provided in Table 5-40.

City water treatment plant operators have reported turbidity levels of around ten NTU in Quincy Creek, with surges to 250 NTU, following significant rain events. Alum treatments have often proven inadequate to reduce turbidity to drinking water standards. Lime applications after filtration are now often used to increase coagulation and flocculation at a significant cost increase.

Figure 5-67
Region VI: Specific Capacity Data for Floridan Aquifer System



One of the most pressing problems the City of Quincy faces is the adequacy of its water supply. Under present conditions, the source is adequate in quantity and quality most of the time. However, high turbidity levels in Quincy Creek following significant storm events force the city to shut down its surface water intake for several days. This results in the city supplementing its supply with ground water.

Table 5-40 Quincy Creek at SR267 Flow Statistics

Summary Statistic	Amount	Yr./Date
Average Annual Runoff (in)	22.67	
Annual Mean (cfs)	28.0	
Q_{90} (cfs)	5.5	
Highest Annual Mean (cfs)	47.2	1991
Lowest Annual Mean (cfs)	17.3	1982
Highest Daily Mean (cfs)	1630.0	3/3/91
Lowest Daily Mean (cfs)	3.0	5/27/86
Instantaneous Peak Flow (cfs)	2,910.0	3/3/91
Instantaneous Peak Stage(ft)	11.83	3/3/91
Instantaneous Low Flow (cfs)	2.3	5/7/85

Note: Reported values include water treatment plant withdrawals

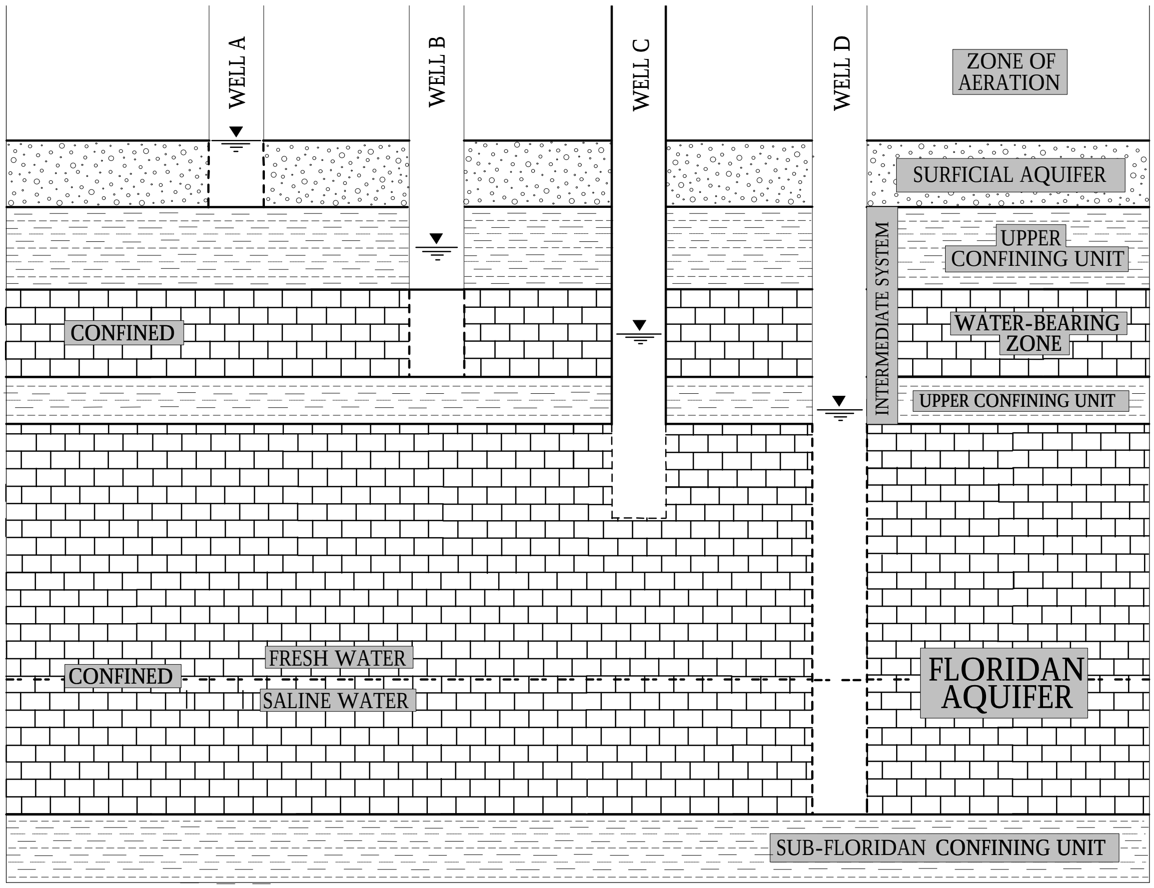
Surface Water Quality

Water quality in Quincy Creek presents a problem only following periods of high rainfall when high turbidity makes the creek unusable. During these periods, the City of Quincy utilizes Floridan Aquifer wells to provide potable water to their customers. These periods of high turbidity are typically short in duration, with surface water quality returning to acceptable levels within several days. One alternative available to the city to avoid this problem is to extend an additional intake to Colson Creek.

Ground Water Hydrology

The ground water hydrology of Region VI varies greatly. In the central portion of the county, low-permeability sediments found in the structural trough known as the Apalachicola Embayment dominate the hydrogeology. The embayment runs through central Gadsden County from northeast to southwest and is thickest in the center of the county. It underlies the entire upper Telogia Creek basin WRCA. The overall low permeability of sediments through much of the county limits both recharge to and availability from the Floridan Aquifer System. On the extreme eastern and

Figure 5-68: Hydraulic Head Variations Among Hydrostratigraphic Units in Region VI



western flanks of the county, the permeability of the Floridan Aquifer significantly increases, resulting in increased ground water availability. Within the region, three hydrostratigraphic systems are present; a moderately thick to absent Surficial Aquifer System, a thick to moderately thick Intermediate System and a thick Floridan Aquifer System. As a source of potable water, the Surficial Aquifer System is inconsequential. Its significance to the regional water supply derives from its role as a source of recharge water for underlying systems and its discharge to surface waters. Due to erosion, the Surficial Aquifer System is thin to absent in some of the deeper stream channels within the region.

Beneath the Surficial Aquifer System lies the Intermediate System. In most of Gadsden County, the Intermediate System is thick and has low permeability. The thickness of the Intermediate System exceeds 300 ft in the central portion of the county. In northwestern, eastern and southern Gadsden County, the system thins to around 150 ft. The Intermediate System functions primarily as a confining unit. However, carbonates within the Intermediate System form minor water-bearing zones, which are occasionally utilized for domestic water supply. These units also supply some recharge to the underlying Floridan Aquifer System.

The Floridan Aquifer System consists of a thick sequence (600 to 1,200 ft) of carbonates. Due to the overall low permeability of the Intermediate System, recharge to the Floridan Aquifer System is limited and very little secondary dissolution of the carbonates has taken place. As a result, Floridan Aquifer transmissivities are very low (generally less than 1,000 ft^2/d) throughout the embayment. These are some of the lowest values in northwest Florida. The limited amount of leakage into the Floridan Aquifer System has prevented flushing of naturally-occurring, poor quality water from within the deeper portions of the aquifer.

In northwestern and eastern Gadsden County, on the outer edges of the embayment, the Intermediate System thins and the Floridan Aquifer System is closer to the surface and much more permeable. These portions of the county are adjacent to and greatly resemble the active ground water flow areas of western Leon and eastern Jackson County. Transmissivities on the flanks of the embayment are, by Region VI standards, very high. In the Chattahoochee area, they are on the order of 100,000 ft^2/day. On the eastern flank of the embayment, proximal to the Ochlockonee River, they are around 40,000 ft^2/day.

Typically, only the upper 60 percent of the aquifer thickness is utilized for water supply, due to increasingly mineralized water in deeper portions of the aquifer. The upper third of the aquifer exhibits well yields generally less than 100 gal/min. Somewhat greater yields of up to 300 gal/min. are possible in the middle portion of the aquifer. High pumping rates or long periods of pumping in the upper or middle portion of the Floridan Aquifer System can cause upconing of highly mineralized water from below. Due to higher transmissivities, greater well yields occur in the northwestern and in the eastern portion of Gadsden County.

The Sub-Floridan System underlies and confines the Floridan Aquifer flow system. Due to a lack of data, little is known of the hydraulic character of this unit.

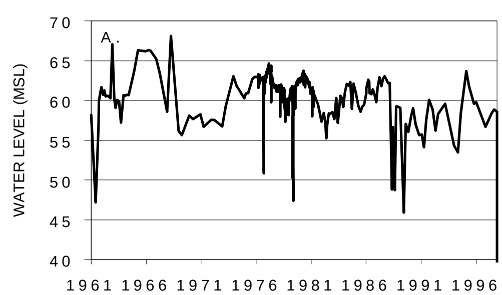
Floridan Aquifer System Water Levels

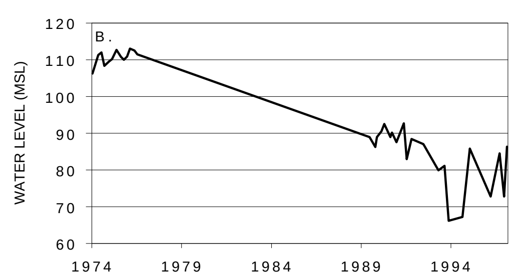
The Floridan Aquifer System's zone of contribution, within which Region VI lies, extends north into southwest Georgia (Davis 1996). The Georgia portion of the zone of contribution includes parts of Decatur and Grady counties. In northernmost Gadsden County, the Floridan Aquifer potentiometric surface stands at an elevation of approximately 65 ft above sea level. From this elevation, the potentiometric surface declines gradually to approximately 40 ft above sea level in the southeastern part of the county.

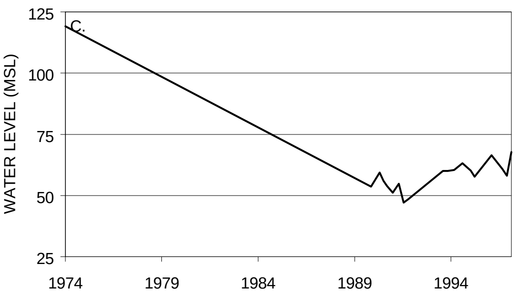
Throughout Gadsden County water levels within the upper third of the Floridan Aquifer can be as much as 110 ft above sea level, or about 40 ft higher than the water levels in the middle and lower portions of the aquifer (Wagner 1982). This is due to the presence of marl and other low permeability sediments within the upper third of the Floridan Aquifer. These low permeability sediments retard the downward movement of water within the Floridan Aquifer and are the cause of the higher heads found in the upper portion of the aquifer. This upper portion of the Floridan Aquifer is the interval tapped by most domestic supply wells in the county. The middle, higher yielding portion of the aquifer is primarily utilized by agriculture and public water supply utilities. Figure 5-68 shows the relative water levels for the various hydrostratigraphic units in the region.

Hydrographs for three wells are presented to depict long-term trends in Floridan Aquifer water levels (Figure 5-69). Data are presented for a well located in Quincy (Quincy #2), a well located in Greensboro and a well located near Sawdust in central Gadsden County (Marcus Edwards well).

Figure 5-69: Hydrographs of the A) Quincy, the B) Greensboro and the C) Marcus Edwards Floridan Aquifer Wells







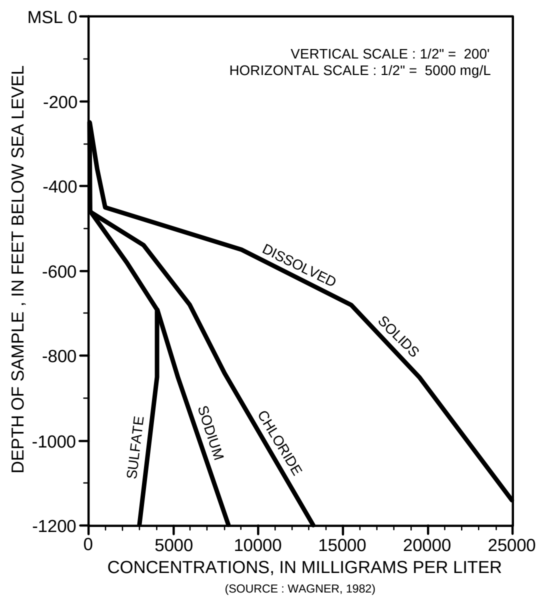
The Quincy well is completed in the middle, more productive portion of the aquifer. Between 1961 and 1997, water levels in the Quincy well varied between 46 and 68 ft above sea level. Water levels in this well have been little affected by pumping. Rather, water levels have risen and fallen in response to seasonal variations in rainfall. Both the Greensboro well and the Marcus Edwards well are completed in the upper portion of the aquifer and show historical water levels well above the estimated 65 ft water level elevation found in the underlying portions of the aquifer. Between 1974 and 1997, water levels in the Greensboro well varied between 112 and 66 ft above sea level. The well shows a downward water-level trend attributable to pumping. The trend resulted in approximately 30 ft of head loss over the 23-year period of record. Of the three wells illustrated, the Marcus Edwards well showed the most precipitous drop in water level. The water level has declined from 118 ft above sea level in 1974 to approximately 63 ft above sea level in 1997. This well has been influenced by increases in ground water withdrawals for public water supply and Agricultural Irrigation in the general vicinity of the well.

Within Region VI, although Floridan Aquifer ground water use is small, it is apparent that impacts to water levels have occurred as a result of current ground water withdrawals. Over much of the central portion of Gadsden County well withdrawal rates as low as 100 gal/min can cause significant lowering of water levels.

Floridan Aquifer System Water Quality

Highly mineralized, naturally occurring water in the lower portion of the Floridan Aquifer System represents a potential problem to developing ground water sources in the county. Water

Figure 5-70 Variations of Floridan Aquifer Water Quality with Increasing Depth of Penetration



concentrated pumping of the aquifer can result in the upconing of the poorer quality water. This deterioration of water quality with increasing depth is illustrated in data obtained from the City of Quincy Well #2, which was point sampled and analyzed for various constituents (Wagner, 1982).

Chloride concentrations went from being within drinking water standards (< 250 mg/L) 400 ft below sea level to almost 4,000 mg/L 550 ft below sea level. The chloride concentration approached 13,000 mg/L at the bottom of the well, 1,200 ft below sea level. Upconing of water of this quality can quickly degrade the quality of water in the upper portions of the aquifer and the aforementioned lack of flushing can contribute to a long recovery time for zones impacted in this manner.

Ground Water Budget

In order to assess the role that Floridan Aquifer ground water may play in Region VI water supply through 2020, a region-scale ground water budget was prepared (Figure 5-71). As presented here, the ground water budget is intended to present an order-of-magnitude approximation of the major Floridan Aquifer System sources and discharges for the region. It was prepared from a calibrated flow model. Although a calibrated steady-state model does not account for seasonal or annual variation in flow, the model does provide a means to estimate the relative magnitude of the various inflows to and outflows from the aquifer.

The flow system components for Region VI were estimated using output from a steady-state, three-dimensional ground water flow model (Davis 1996). The model was calibrated to conditions as they occurred in October and November of 1991. Region VI lies entirely within the larger model domain of Davis.

In order to estimate water budget components for this region, the computer program ZONEBUDGET (Harbaugh 1990) was used by the District to analyze model output obtained from the U.S. Geological Survey (Hal Davis, personal communication 1997). ZONEBUDGET allows the user to define a subregion within a MODFLOW model domain and to calculate the inflow and outflow to that subregion. In this way, a subregion corresponding to Region VI was defined and appropriate inflows and outflows calculated.

Major regional ground water sources are 1) subsurface inflow from areas hydraulically upgradient; 2) leakage into the upper Floridan Aquifer from the overlying Intermediate System within the region; and 3) surface infiltration and direct recharge to the upper Floridan Aquifer within the region. During the 1991 calibration period, subsurface inflow contributed an estimated 44.5 Mgal/d to the region. Leakage from the Intermediate System was an estimated 7.1 Mgal/d. Surface infiltration and direct recharge contributed an estimated 2.1 Mgal/d to the region. Thus, the 1991 Region VI steady-state ground water inflow into the Floridan Aquifer is estimated to be 54 Mgal/d.

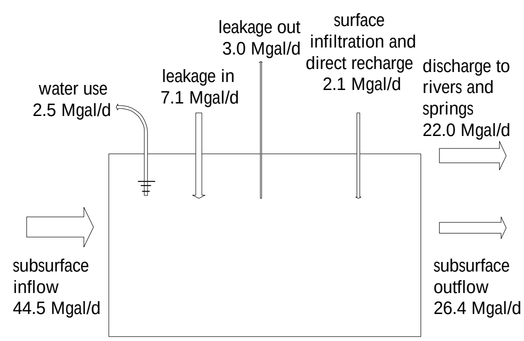
Major regional ground water discharges are 1) discharge to rivers and springs; 2) subsurface outflow to areas hydraulically downgradient; 3) ground water withdrawal via wells; and 4) upward leakage into the Intermediate System. During the 1991 calibration period, discharge to rivers and springs within Region VI totaled an estimated 22 Mgal/d to the water budget. Subsurface outflow was an estimated 26.4 Mgal/d. The Region VI model-simulated pumpage for all uses was 2.5 Mgal/d. Upward leakage into the Intermediate System was an estimated three Mgal/d. Given the steady-state nature of the model, the 1991 Region VI ground water outflow is equal to the estimated inflow (54 Mgal/d).

As evidenced by Figure 5-71, ground water availability within the region is limited. This limitation arises primarily from the low permeability of both the Intermediate and Floridan Aquifer systems. The low permeability of the Intermediate System restricts recharge to the underlying Floridan Aquifer. The region-wide recharge rate to the Floridan Aquifer (9.2 Mgal/d) equates to an annual recharge rate of less than 0.5 inches per year over the region.

This is an extremely small rate of recharge. In addition, the low transmissivity of the Floridan Aquifer produces, for modest withdrawal rates, large drawdowns. As a consequence, the Floridan Aquifer over much of the region is susceptible to both excessive drawdown and attendant upconing of poor quality water from depth.

The total ground water withdrawal represented in the model (2.5 Mgal/d) reflects only a fraction of the 1995 water use summarized by the USGS (Marella, in progress). However the reported 1995 ground water use of six Mgal/d is 11 percent of the overall estimated ground water budget. The estimated 2020 ground water demand (7.9 Mgal/d) represents approximately 15 percent of the overall estimated Region VI ground water budget. Thus, regional water ground water resources should be adequate to meet future needs without adverse impact.

Figure 5-71 Region VI Water Budget for 1991 Calibration Period



Assessment Criteria Used

Surface Water

Telogia Creek

For the purposes of water supply assessment the criteria used is based upon a guiding principle that the historic flow regime should be maintained to the extent that the natural systems as seen today are sustainable. As part of this criteria, flows which included the mean flow or higher flows are expected to manifest themselves because they are relatively much greater than water demands. Because the Telogia Creek basin is a highly altered system due to impoundment structures, among other factors, it is also recognized that the natural systems or related water resources of this system have also been highly altered. Thus, the primary criteria used is the evaluation of the low flow portion of the hydrologic regime and associated water level conditions which would be experienced in the stream channel as a result of withdrawals.

Quincy Creek

The primary assessment criterion for surface water availability is the sustainability of the surface water flow regime. For the purpose of water supply, the reduced availability of water during droughts or the increased probability of such is considered. Overall reductions in both surface and ground water relatively to historic discharges are also a consideration.

Ground Water

Two criteria were used to assess impacts of ground water resources; long-term depression of the Floridan Aquifer potentiometric surface and attendant alteration of ground water quality.

Impacts to Water Resources and Related Natural Systems

Surface Water

Telogia Creek

At low flows, which are not exceeded about ten percent of the time (Q_{90}), the wetted width of the Telogia Creek channel shrinks by an estimated one to seven feet due to projected pumping rates. All of these changes in wetted area occur within-bank and effect only the alluvial part of the channel. Above the estimated Q_{90} flows and further downstream from the District's gage changes in wetted area due to pumping become much less perceptible. It should be recognized that, historically, the flow regime in the upper reaches of the creek includes a zero flow condition. However, as previously discussed, this condition has occurred for at least 60 years, extending back to the tobacco farming era in the area. There are also many farm ponds and in-stream impoundments constructed throughout the Telogia Creek watershed which have significantly altered the historic flow regime. In several instances, new wetlands and lake areas have been created by these impoundments. Also, the irregular and infrequent drawdowns and refilling of the ponds for maintenance, which historically has also been a part of the usual practice by agriculturists, is another significant alteration of the hydrologic flow regime. These natural wetland systems, therefore, have historically been adapted to drought periods and dry streamflow conditions, as well as the backwater and regulation effect of the ponds.

Quincy Creek

During periods of extreme drought with a 50-to-100-year frequency, relatively low flows would be expected. This is a resource constraint that could on an infrequent basis, limit the projected surface water demand of the City of Quincy. However, the city has operational capabilities to obtain additional water from storage in the upstream Interlocking Lakes on Colson Creek and from wells. The wells are currently and routinely used as a supplemental source to reduce water treatment costs associated with increased turbidity in the surface water during wet weather periods.

According to U.S. Geological Survey stream discharge rating data and channel width data, the estimated decrease in water levels that could result at the city's intake (even during extreme drought conditions) would be less than one-tenth of a foot. Thus, for existing hydrologic conditions, no impacts in terms of diminishing the supply of water to existing users or downstream systems should be anticipated. Although the city's demand is very small, it should be noted that this demand from the creek is self-limiting in that flow to the treatment plant could be interrupted by an extreme (yet to be experienced) drought condition. Under this condition, the city would be forced to temporally shut down its intake and rely on supplemental sources, thereby restoring a natural, albeit dry, flow condition. Just downstream of the water treatment plant intake, Quincy Creek is fed by Holman Branch discharge from a wastewater treatment plant and municipal storm drains. These sources cause an increase in flow in the creek, which eventually feeds the Little River.

Ground Water

At present, there is some limited data to indicate that significant water level declines have occurred at some locations as a result of ground water withdrawals. The spatial extent over which significant drawdowns have occurred and whether the potentiometric surface is depressed at the regional scale is not known. It is known that conditions are present, which would, under sufficiently high and widely distributed pumpage, produce region-wide drawdowns in the Floridan Aquifer. Accordingly, further increases in pumpage from the Floridan Aquifer should be carefully evaluated, be widely spaced and not exceed the capacity of this system to produce water.

It is presently believed that current levels of pumping have not resulted in significant degradation of ground water quality. It is known that naturally-occurring poor quality is found in the Floridan Aquifer throughout the region at relatively shallow depths. It is also known that the Floridan Aquifer System responds to modest pumpage with excessive drawdowns. As such, this system is subject to water quality degradation due to excessive pumping. Measures recommended above to minimize head declines over the region will also minimize occurrences of upconing.

Adequacy of Regional Sources

For a variety of reasons, ground and surface water resources in Region VI are limited. This is particularly true in the central Region VI, in the vicinity of the WRCA. The projected increase in water demand through 2020 is 3.28 Mgal/d. Assuming that the present split between ground and surface water sources is maintained, each source will be required to yield an additional 1.6 Mgal/d. The ground water resources of the region, while extremely limited, should be able to provide 1.6 Mgal/d in additional production sustaining water resources or related natural systems. In order to produce additional ground water amounts, care will have to be used regarding well spacing, production amounts and depth of penetration.

The surface water resources are also extremely limited, but should be able to provide for future public supplies in additional production. Because of the historical influences of drought, past agricultural activities and physical alterations of the stream channels in the Telogia Creek basin, no harm to regional water resources due to the effects of agricultural withdrawals have been identified. However, future harm is reasonably anticipated if permitted water withdrawal amounts exceed resource limits during non-drought periods. This requires that the current permit thresholds on water withdrawals not be exceeded and hydrologic monitoring activities be continued. It is also anticipated that harm will be avoided in the future by projected shifts to nursery crops. Nurseries have lower peak application rates and are more conducive to lower demands during low streamflow conditions. Other efforts underway to further applications of reuse water for agricultural purposes should also help reduce withdrawal stress in this basin.

Water Quality Constraints on Water Availability

Surface Water

Surface water quality in Quincy Creek causes the source to be unusable only after periods of high rainfall. Large amounts of runoff resulting from high rainfall events causes turbidity in the creek to rise to levels that render it unsatisfactory for potable use at the present treatment levels. Water quality usually returns to usable levels within several days. During periods of high turbidity, the city utilizes ground water wells to provide water for their needs. Improved watershed management practices in the Quincy Creek basin as a means of reducing turbidity levels could be pursued. Other practices that could help are the previously suggested Colson Creek intake and additional impoundments.

Ground Water

Water quality constraints on ground water availability are limited to those associated with upconing of highly mineralized water from the lower portion of the Floridan Aquifer System resulting from heavy pumpage of ground water and from extraordinary depth of penetration of wells.

Level-of-Certainty

Using the methodology described in Section IV, water demand during drought conditions was estimated for Region VI through the year 2020 (Table 5-41). The amount of water available from traditional sources within this region should be sufficient to meet all of the projected average and drought condition demands through the year 2020, while sustaining natural resources.

Reuse and Conservation

Within Gadsden County, almost 0.35 Mgal/d of wastewater treatment capacity existed in 1997; however, there was insufficient data to determine the amount of wastewater treatment plant (WWTP) effluent disposed of in a manner that meets the FDEP definition of reuse (Table 5-42). The City of Gretna is located within the Upper Telogia Creek Drainage Basin Water Resource Caution Area (WRCA) of Gadsden County. This area is characterized by limited surface and ground water resources and competing demands for those resources. Within the WRCA, public water supply utilities are required to develop, adopt and implement water conservation plans and measures to encourage and promote water conservation and efficiency in the use of the area's water supplies. Further, utilities that treat domestic wastewater are required to determine the economic, environmental and technical feasibility of providing reclaimed water for reuse. The city's permit is conditioned to require both a water conservation plan and reuse feasibility determination.

It was beyond the scope of this assessment to fully evaluate the status and effectiveness of reuse and conservation programs. However, information collected in 1997 (USGS 1998) indicates that some water conservation programs have been implemented in the region. The City of Quincy, the region's largest public supplier, has identified and implemented a number of water conservation measures. Water resource constraints in central Gadsden County warrant the consideration of additional conservation and reuse programs to reduce consumptive uses. The feasibility of providing reuse water to golf courses and agricultural uses that are being investigated and aggressive water conservation programs should be implemented by utilities and other water users in this area.

Table 5-41 Region VI: Estimated Water Demand During Drought Conditions (Mgal/d)

Water Use Category	2000	2005	2010	2015	2020
Public Supply	4.96	5.20	5.45	5.69	5.94
Domestic SS/Small Public Supply Systems	2.75	2.97	3.32	3.71	4.24
Commercial-Industrial Self Supply	1.05	1.06	1.07	1.08	1.09
Recreational Irrigation	0.30	0.30	0.30	0.30	0.37
Agricultural Irrigation	15.25	15.12	16.86	17.65	18.92
Power Generation	0.00	0.00	0.00	0.00	0.00
Total	24.32	24.65	26.99	28.43	30.56
Increase Over Average Daily Demand	10.91	11.56	12.64	13.51	14.78

Table 5-42 Reuse of Domestic Wastewater in Region VI in 1997

Domestic Wastewater Facility Name	Total Plant Capacity (Mgal/d)	Total Plant Flow (Mgal/d)	Reuse Capacity (Mgal/d)	Reuse Flow (Mgal/d)	Reuse Required
Gadsden County					
City of Chattahoochee	00.50	00.30	00.00	00.00	N
Florida State Hospital	01.30	00.09	00.00	00.00	N
Town of Gretna	00.35	00.27	00.35	ND	N
Town of Havana	00.30	00.25	00.00	00.00	N
City of Quincy	01.50	00.73	00.00	00.00	Y
County Total	03.95	01.64	00.35	ND	1
Region VI Total	03.95	01.64	00.35	ND	1

Source: NWFWMD 1997 Annual Reuse Report (ND = No Data)

REGION VII: JEFFERSON COUNTY, LEON COUNTY AND WAKULLA COUNTY

Region-at-a-Glance		
	1995	2020
Population:	248,047	388,305
Avg. Water Use (Mgal/d):	46.73	73.70
Primary Source:	Floridan Aquifer	
Regional Water Supply Plan Recommendation:	No plan needed	

Overview

Water Supply Planning Region VII is comprised of Jefferson, Leon and Wakulla counties. The largest water uses in this region are Public Supply in Leon County and Power Generation in Wakulla County. With the exception of the Tallahassee metropolitan area, most of Region VII is relatively rural, a result of large public landholdings such as the St. Marks National Wildlife Refuge and the Apalachicola National Forest and large private ownerships such as the plantations in northern Leon and Jefferson counties and timber company landholdings throughout the southern portion of the region.

The City of Tallahassee, one of the largest metropolitan areas within the NWFWMD, is the state capital and home to two state universities and a community college and, as such, is the center of economic activity and population distribution in the region. The dominant employers within the planning region are government, retail trade and service sectors, and many residents of the region commute to Tallahassee to work. Due to the relatively stable economy and lack of significant tourism in the region, there is minimal seasonal fluctuation in population and the corresponding Public Supply water use. With the exception of the Purdom Power Plant in St. Marks, virtually all water used in the region is withdrawn from the upper Floridan Aquifer, a relatively prolific source of good quality water in this area. Overall, the water resources of this region sustain the St. Marks and Wakulla rivers and Apalachee Bay, and the natural systems dependence upon these water resources cannot be overstated.

Existing Water Use (1995)

Region VII 1995 water use is shown by county and water use category in Table 5-43. In addition, Figure 5-72 depicts permitted water withdrawals greater than 0.1 Mgal/d within Region VII.

Public Supply

Public Supply is the largest water use category within Region VII, accounting for approximately 63 percent (29.41 Mgal/d) of average regional water use in 1995. The City of Tallahassee within Leon County is the largest public supplier within the region, with an average withdrawal of 25.32 Mgal/d in 1995.

Domestic Self-Supply and Small Public Supply Systems

Water use within the rural areas of the planning region by Domestic Self-Supply and Small Public Supply Systems accounted for approximately 15 percent of the region's water use (6.82 Mgal/d) in 1995. The majority of water use in this category takes place in Leon County (4.61 Mgal/d).

Commercial-Industrial Self-Supplied

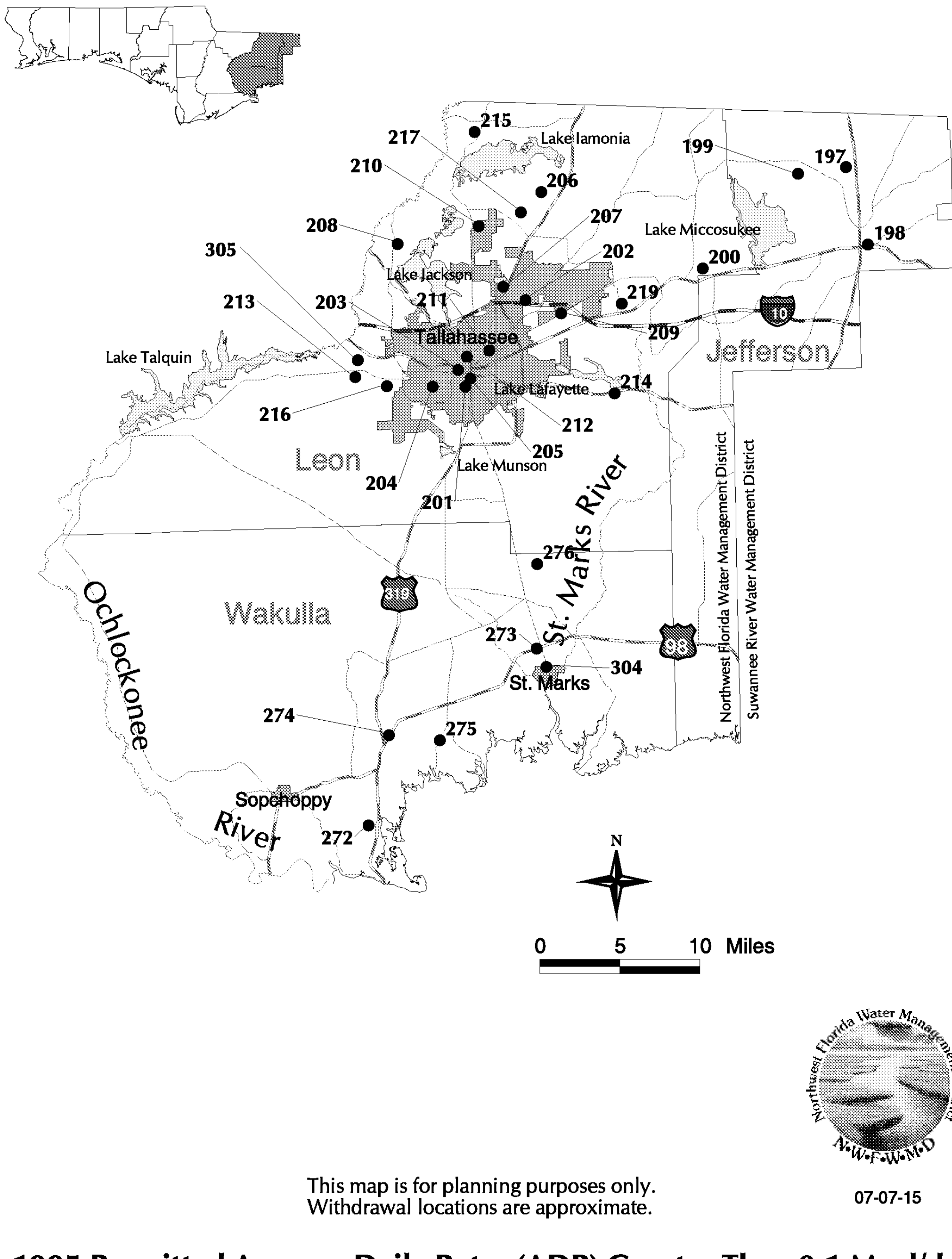
The Commercial-Industrial Self-Supplied category accounts for the least amount of water used within the region, with only two percent of total regional water use (1.09 Mgal/d) being attributed to users in this category in 1995. Permitted Commercial-Industrial water users within the region include the U.S. Justice Department's Federal Correctional Facility in Leon County, the Florida Department of Correction's Jefferson County Correctional Facility, Florida Department of Transportation I-10 Rest Area and Primex Technologies' St. Marks Plant.

Recreational Irrigation

Recreational Irrigation water use accounts for a small percentage of the region's total water use. In 1995 only an average of 1.24 Mgal/d (three percent of average regional water use) was used for Recreational Irrigation. The major users of water for Recreational Irrigation within the region are golf courses located in Leon County

Figure 5-72

Region VII



1995 Permitted Average Daily Rates (ADR) Greater Than 0.1 Mgal/d

(See following page for map key)

Figure 5-72 Map Key

Index #	Permit #	Name	Primary Use*	Permitted ADR (gal/d)	Aquifer/ Surface Water	Source*
197	910055	Kissaway Plantation	AI	207,003	Floridan	GW
198	830060	City of Monticello	PS	787,000	Floridan	GW
199	900005	Orvis Services	WR	135,221	Floridan	GW
200	840088	Paul Mercer Fearington	AI	526,082	Floridan	GW
201	940025	Florida A & M University	HS	15,900,000	Floridan	GW
202	930026	Florida State University	GI	108,000	Floridan	GW
203	840040	Florida State University	HS	32,100,000	Floridan	GW
204	930011	Florida State University - NHMFL	HS	469,000**	Floridan	GW
205	840122	Department of General Services	HS	2,160,000	Floridan	GW
206	920003	Horseshoe Plantation	WR	106,800	Floridan	GW
207	830077	Department of Natural Resources	LA	205,151	Floridan	GW
208	850017	John H. Phipps, Inc.	WR	319,561	Floridan	GW
209	920104	Powerhouse,Inc./ Welaunee Plantation	AI	122,000	Floridan/ Unnamed Ponds	GW/SW
210	930020	Summerbrooke Golf Course	GI	202,000	Floridan/Somerset Lake	GW/SW
211	830065	City of Tallahassee	PS	408,000	Floridan	GW
212	830061	City of Tallahassee	PS	27,800,000	Floridan	GW
213	830010	Talquin Electric Cooperative	PS	360,000	Floridan	GW
214	840043	Talquin Electric Cooperative	PS	194,040	Floridan	GW
215	842687	Talquin Electric Cooperative	PS	122,780	Floridan	GW
216	842690	Talquin Electric Cooperative	PS	104,460	Floridan	GW
217	840042	Talquin Electric Cooperative	PS	1,180,000	Floridan	GW
219	880107	Talquin Electric Cooperative	PS	177,000	Floridan	GW
272	850113	Panacea Area Water System	PS	190,000	Floridan	GW
273	950038	Primex Technologies	PS	910,000	Floridan	GW
274	850209	City of Sopchoppy	PS	358,800	Floridan	GW
275	840060	Talquin Electric Cooperative	PS	330,000	Floridan	GW
276	950046	Winco Utilities	PS	452,000	Floridan	GW
304	960104	City of Tallahassee-Purdom Plant	PP	85,288,000**	Floridan/St. Marks River	GW/SW
305	0	City of Tallahassee-Hopkins Plant	PP	2,640,000	Floridan	GW

* AI= Agricultural Irrigation, AR = Aquifer Recharge, GI = Golf Course Irrigation, HS = Heat Pump Supply, IN = Industrial, LA = Landscape Irrigation, NI = Nursery Irrigation, PP = Power Production, PS = Public Supply, WR = Water-based Recreation, AQ = Aquaculture, GW = Ground Water, SW = Surface Water

** Virtually all water is returned to source.

Agricultural Irrigation

Agricultural water use accounted for approximately 11 percent of the region's total water use in 1995. The majority of water used for agricultural purposes (an average of 5.24 Mgal/d) was used in Jefferson County (4.24 Mgal/d). The region's primary agricultural crops include corn, vegetables and nurseries.

Power Generation

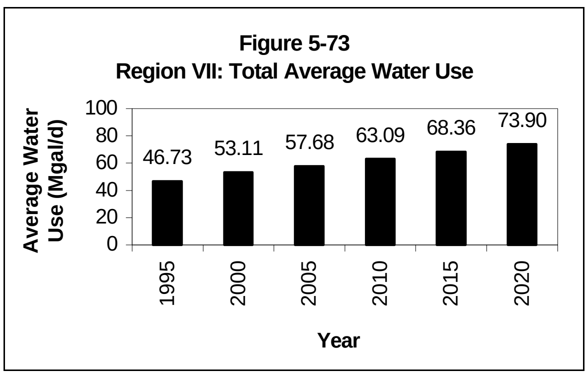
In 1995, water used for Power Generation accounted for approximately six percent of the region's average water use. The Hopkins Power Plant in Leon County used an average of 2.64 Mgal/d of water. The Sam O. Purdom Power Plant located in Wakulla County, which supplies electricity for the City of Tallahassee, withdrew an average of 69.13 Mgal/d of water. The Purdom Power Plant currently, on average, uses surface water for direct, once-through cooling and then returns it to the St. Marks River (approximately 107.83 Mgal/d). Ground water is used in steam boilers and is the only water currently used that is not returned to the resource (approximately 0.29 Mgal/d) and, for water supply planning purposes, the only water that is considered consumed.

Table 5-43 Region VII: 1995 Water Use (Mgal/d)

	Jefferson County	Leon County	Wakulla County	Total
Public Supply	0.70	27.66	1.05	29.41
Domestic SS/Small Public Supply Systems	1.28	4.61	0.93	6.82
Commercial-Industrial SS	0.23	0.23	0.63	1.09
Recreational Irrigation	0.19	0.95	0.10	1.24
Agricultural Irrigation	4.24	1.01	0.00	5.25
Power Generation	0.00	2.64	0.29	2.93
Total	6.64	37.10	3.00	46.73

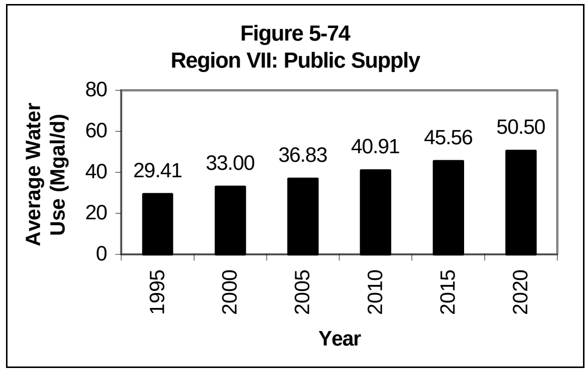
Reasonably-Anticipated Future Needs for Each Water Use Category Through 2020

Average regional water use is projected to increase from 46.73 Mgal/d in 1995 to 73.90 Mgal/d in the year 2020 (Figure 5-73 and Table 5-80). Public Supply will continue to be the largest water use category (50.50 Mgal/d in 2020) with the greatest projected percentage increase, approximately 71 percent, between 1995 and 2020.



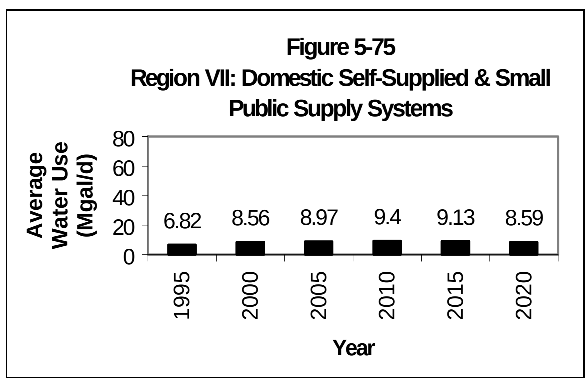
Public Supply

Water use projections suggest that Public Supply will continue to be a predominant water use category within Region VII through the year 2020. Regional Public Supply projections indicate that use will increase approximately 71 percent from an average of 29.41 Mgal/d in 1995 to 50.50 Mgal/d in the year 2020 (Figure 5-74). Population, as well as the percentage of households using Public Supply, is projected to increase in all three counties over the next 22 years. Leon County is projected to continue to account for the vast majority of Public Supply water use in Region VII (Table 5-46).



Domestic Self-Supply and Small Public Supply Systems

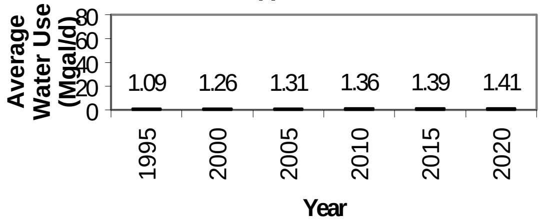
This water use category is projected to increase approximately 21 percent from 6.82 Mgal/d in 1995 to 8.59 Mgal/d in 2020 (Figure 5-75).



Commercial-Industrial Self-Supplied

The Commercial-Industrial Self-Supplied water use category accounts for the least amount of water used in the region. Water use in this category is projected to increase approximately 29 percent or 0.32 Mgal/d between 1995 and the year 2020 (Figure 5-76).

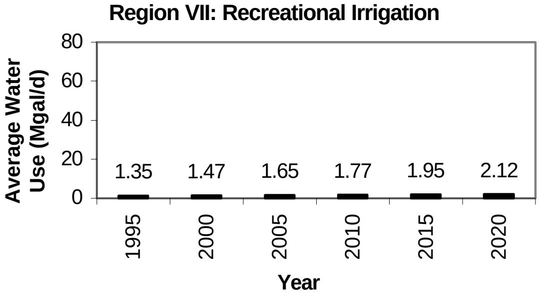
Figure 5-76
Region VII: Commercial-Industrial Self-Supplied



Recreational Irrigation

Recreational Irrigation includes water used for golf course irrigation and accounts for only a small percentage of the region's total water use. Water use in this category is projected to increase by approximately 58 percent from 1.24 Mgal/d in 1995 to approximately 1.96 Mgal/d in the year 2020 (Figure 5-77). This increase may be attributed to the expansion of land used for golf courses or an increase in the number of golf courses in the region.

Figure 5-77
Region VII: Recreational Irrigation



Agricultural Irrigation

Water used for Agricultural Irrigation in Planning Region VII is anticipated to increase by approximately 23 percent from 5.24 Mgal/d in 1995 to 6.48 Mgal/d in 2020 (Figure 5-78).

Power Generation

Water withdrawn for Power Generation use in Region VII was approximately 71.77 Mgal/d in 1995 and is anticipated to decrease to approximately 63.48 Mgal/d of water in 2020. However, because this report considers impacts to the resource, the figures reported here are for water that is actually consumed by Power Generation. For planning purposes, water is considered consumed when it is withdrawn and either not returned to the resource or not returned in the same location where it was withdrawn. Many power plants utilize surface water for once-through cooling, returning virtually all of the water to the point of withdrawal. Although water withdrawn for Power Generation is expected to decrease in Region VII, water consumption by Power Generation is anticipated to increase by approximately 62 percent from 2.93 Mgal/d in 1995 to 4.76 Mgal/d in 2020 (Figure 5-79). These changes are projected because the Purdom Power Plant plans to remove two units from operation while adding a new unit (Unit 8). With the addition of Unit 8, ground water withdrawals will cease in the year 2000 and surface water withdrawals will decrease by 50 percent. Although the amount of water not returned to the St. Marks River will increase (approximately 98 percent opposed to 100 percent), District staff does not anticipate any significant impacts to surface water resources, natural systems, or any nearby legal users.

Figure 5-78
Region VII: Agricultural Irrigation

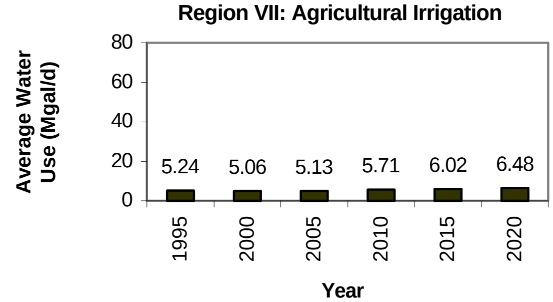
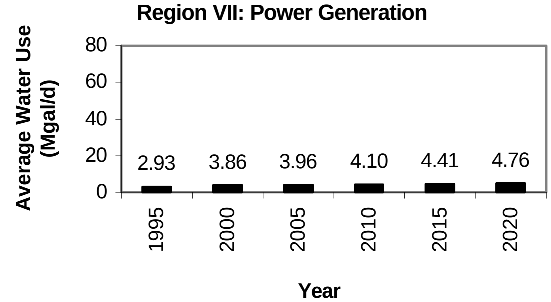


Figure 5-79
Region VII: Power Generation



Reasonably-Anticipated Future Needs by County Through 2020

Figure 5-80 illustrates projected total average water use by county through 2020. Water use in Jefferson County is projected to increase by approximately 26 percent from 5.41 Mgal/d in 1995 to 6.81 Mgal/d in 2020 (Table 5-45). Agricultural Irrigation is the county's largest water use category accounting for approximately 4.24 Mgal/d in 1995 and increasing to 5.52 Mgal/d in 2020. Leon County accounts for most of the water use within Region VII with total average usage of approximately 37.10 Mgal/d in 1995 and 58.79 Mgal/d in 2020 (Table 5-46). Public Supply is Leon County's largest water use category accounting for 27.66 Mgal/d in 1995 and 47.16 Mgal/d in 2020. Although accounting for only a small percentage of total regional water use, Wakulla County water use is projected to more than double between 1995 (3.05 Mgal/d) and 2020 (6.96 Mgal/d) (Table 5-47). The county's largest water use is Public Supply, accounting for 1.05 Mgal/d in 1995 and increasing to 2.34 Mgal/d in 2020. However, projections indicate that Domestic Self-Supply and Small Public Supply Systems will more than double between 1995 (0.93 Mgal/d) and 2020 (2.33 Mgal/d).

Source Evaluation

Within Region VII and for virtually all uses, ground water is the traditional source of supply. Further, the vast majority of ground water is obtained from the Floridan Aquifer System. Given the high availability of ground water from the Floridan Aquifer and its high quality, it is reasonable to anticipate that this use pattern will continue through the year 2020. Accordingly, the water source evaluation presented here emphasizes the characterization of ground water availability.

Overview of Hydrologic System

The hydrology of Region VII is strongly influenced by the karst character of the area and is characterized by a high degree of hydraulic connection between ground and surface waters. Over most of the region, the landscape has been substantially altered by karst landform development. As a consequence, there is substantial ground water recharge to the Floridan Aquifer in this area.

Due to secondary dissolution of the upper part of the carbonate sequence, the Floridan Aquifer exhibits a high capacity for transmitting water. Regional transmissivities are some of the highest in the panhandle. Ground water entering the Floridan Aquifer within the region, either by downward leakage or by subsurface inflow from hydraulically upgradient areas, moves readily to discharge points in the south. Regional discharge points include Wakulla Springs (average discharge of 400 cfs (260 Mgal/d)), Spring Creek (recent measured discharge of 307 cfs (200 Mgal/d)), St. Marks River (Q_{50} discharge near Newport, Florida of 630 cfs (410 Mgal/d)) and the Gulf of Mexico. Discharged ground water is the major component of streamflow in the Wakulla and St. Marks rivers.

Within Region VII, three hydrostratigraphic systems are present: a thin to absent Surficial Aquifer System, a moderately-thick to absent Intermediate System and a thick Floridan Aquifer System. As a source of potable water, the Surficial Aquifer System is inconsequential. Its significance to the regional water supply derives from its role as a source of recharge water for underlying systems. Due to erosion, the Surficial Aquifer System is absent in southeast Leon County and eastern Wakulla County (on the Coastal Lowlands below the Cody Scarp). Beneath the Surficial Aquifer System lies the Intermediate System. In much of Leon County the Intermediate System is fairly thick, though breached by sinkholes. In southeast Leon County and eastern Wakulla County, the system has been eroded away, leaving the Floridan Aquifer at land surface. In southwest Leon County and western Wakulla County, the Intermediate System is fairly thick and generally intact. Where present, the Intermediate System functions primarily as a confining unit. However, in the upland portion of the region (central and northern Leon County), basal carbonates units form minor water-bearing zones that are occasionally utilized for domestic water supply. Lying beneath the Intermediate System (where it is present) or immediately beneath land surface (where the Intermediate System is absent) is the Floridan Aquifer System. This system consists of a thick sequence (as much as 2,000 ft thick) of carbonates. Although quite thick, only the upper several hundred feet are utilized for water supply due to high ground water availability in this interval. Although poorly documented,

Figure 5-80
Region VII: Total Average Water Use by County

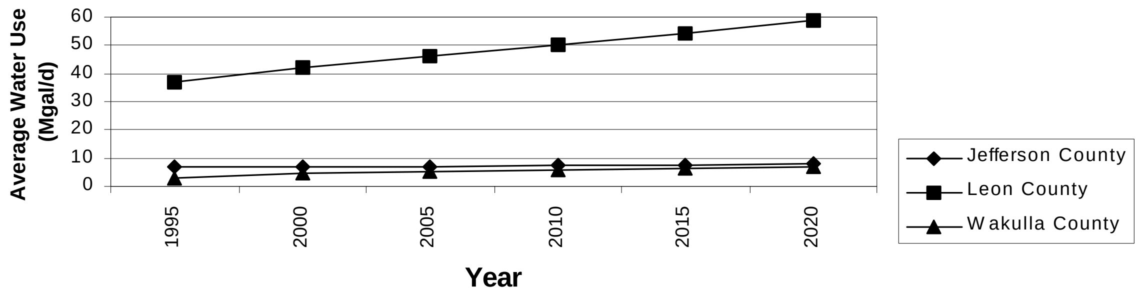


Table 5-44 Region VII: Estimated (1995) & Projected (2000-2020) Average Water Demand by Category (Mgal/d)

	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	29.41	33.00	36.83	40.91	45.56	50.50
Domestic SS/Small Public SS	6.82	8.56	8.97	9.40	9.13	8.59
Commercial-Industrial SS	1.09	1.26	1.31	1.36	1.39	1.41
Recreational Irrigation	1.24	1.37	1.48	1.61	1.85	1.96
Agricultural Irrigation	5.24	5.06	5.13	5.71	6.02	6.48
Power Generation	2.93	3.86	3.96	4.10	4.41	4.76
Total	46.73	53.11	57.68	63.09	68.36	73.70

Table 5-45 Jefferson County Water Demand Data (water amounts in Mgal/d)

	1995	2000	2005	2010	2015	2020
Average Daily Flow (Mgal/d)						
Water Use Category						
Public Supply	0.70	0.76	0.82	0.88	0.95	1.01
Domestic SS/Small Public SS	1.28	1.28	1.25	1.21	1.15	1.07
Commercial-Industrial SS	0.23	0.23	0.23	0.23	0.23	0.23
Recreational Irrigation	0.19	0.19	0.19	0.19	0.25	0.25
Agricultural Irrigation	4.24	4.37	4.39	4.89	5.14	5.52
Power Generation	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.64	6.83	6.88	7.40	7.72	8.08
Large Public Supply System Water Use	1995	2000	2005	2010	2015	2020
Total population served	4,788	5,132	5,773	6,494	7,304	8,216
Percent of total population	36	37	40	42	45	48
Per capita (gal/d)	147	149	143	136	129	122
Average Daily Flow of Large Public Supply Systems (Mgal/d)	1995	2000	2005	2010	2015	2020
Utility						
Monticello	0.70	0.76	0.82	0.88	0.95	1.01
Total	0.70	0.76	0.82	0.88	0.95	1.01

Table 5-46 Leon County Water Demand Data (water amounts in (Mgal/d)

Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	27.66	30.91	34.43	38.19	42.53	47.16
Domestic SS/Small Public SS	4.61	6.01	6.19	6.40	5.91	5.18
Commercial-Industrial SS	0.23	0.23	0.23	0.23	0.23	0.23
Recreational Irrigation	0.95	1.08	1.14	1.27	1.39	1.46
Agricultural Irrigation	1.01	0.70	0.75	0.82	0.88	0.96
Power Generation	2.64	2.90	3.00	3.10	3.45	3.80
Total	37.1	41.83	45.74	50.01	54.39	58.79
Large Public Supply System Water Use	1995	2000	2005	2010	2015	2020
Total population served	186,440	202,032	225,270	248,008	273,832	299,654
Percent of total population	86	84	85	86	88	90
Per capita (gal/d)	148	153	153	154	155	157
Average Daily Flow of Large Public Supply Systems (Mgal/d)	1995	2000	2005	2010	2015	2020
Utility						
City of Tallahassee	25.32	27.38	29.94	32.73	35.78	39.12
Bradfordville Regional	0.79	1.09	1.39	1.70	2.00	2.31
Meadows at Woodrun	0.32	0.39	0.48	0.57	0.66	0.75
Pine ridge Estates	0.06	0.70	1.08	1.47	2.18	2.89
Lake Jackson Area W/S	1.17	1.35	1.54	1.72	1.91	2.09
Total	27.66	30.91	34.43	38.19	42.53	47.16

Table 5-47 Wakulla County Water Demand Data (water amounts in Mgal/d)

Average Daily Flow (Mgal/d)	1995	2000	2005	2010	2015	2020
Water Use Category						
Public Supply	1.05	1.32	1.58	1.84	2.09	2.34
Domestic SS/Small Public SS	0.93	1.28	1.53	1.79	2.07	2.33
Commercial-Industrial SS	0.63	0.80	0.85	0.90	0.93	0.95
Recreational Irrigation	0.10	0.10	0.15	0.15	0.20	0.25
Agricultural Irrigation	0.00	0.00	0.00	0.00	0.00	0.00
Power Generation	0.29	0.96	0.96	0.96	0.96	0.96
Total	3.00	4.46	5.07	5.64	6.25	6.83
Large Public Supply System Water Use	1995	2000	2005	2010	2015	2020
Total population served	9,013	10,189	11,998	14,080	16,523	19,435
Percent of total population	53	51	51	51	50	50
Per capita (gal/d)	116	130	132	130	130	120
Average Daily Flow of Large Public Supply Systems (Mgal/d)	1995	2000	2005	2010	2015	2020
Utility						
Gulf Coast W/S	0.28	0.45	0.56	0.66	0.77	0.88
Panacea Area W/S	0.23	0.24	0.25	0.26	0.27	0.27
St. Marks	0.10	0.14	0.17	0.20	0.24	0.27
Sopchoppy	0.44	0.50	0.60	0.71	0.81	0.92
Total	1.05	1.33	1.58	1.83	2.09	2.34

aquifer productivity is believed to decline below the Ocala Limestone section. In addition, ground water becomes increasingly more mineralized in deeper portions of the aquifer.

The Sub-Floridan System underlies and confines the Floridan Aquifer flow system. Due to a lack of data, little is known of the hydraulic character of this unit.

Floridan Aquifer System Water Levels

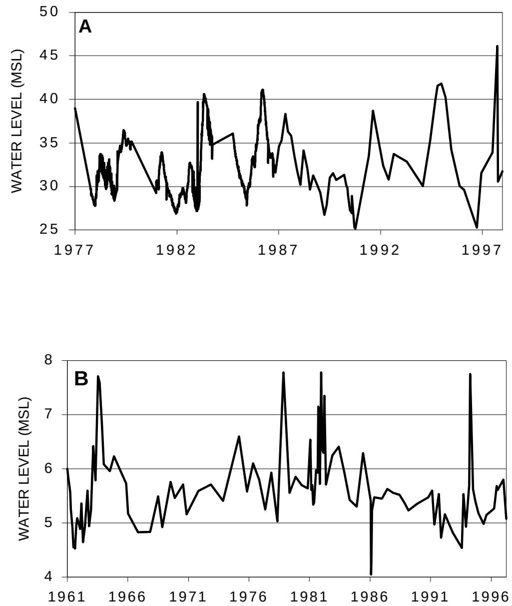
The Floridan Aquifer System's zone of contribution, within which Region VII lies, extends north into southwest Georgia (Davis 1996). The Georgia portion of the zone of contribution includes parts of Decatur, Grady, Thomas, Mitchell, and Colquitt counties. In northernmost Leon County, the Floridan Aquifer potentiometric surface stands at an elevation of approximately 60 ft above sea level. From this elevation, the potentiometric surface declines gradually to the south. Near the Gulf of Mexico, the potentiometric surface declines to within a few feet of sea level, reflecting the fact that the Gulf is a discharge boundary for the Floridan Aquifer flow system.

Hydrographs for two wells are presented to depict long-term trends in Floridan Aquifer water levels (Figure 5-81). Data are presented for a well located near Tallahassee, Florida (Olson Road well) and for a well located near Newport, Florida. Between 1977 and 1997, water levels in the Olson Road well varied between 25.2 and 41.8 ft above sea level. This well shows no downward water-level trend attributable to pumping. Rather, water levels have risen and fallen through time in response to seasonal variations in rainfall.

During its period of record (1961 and 1997), the Newport well showed a much smaller fluctuation in water levels, ranging between 4.1 and 7.8 ft above sea level. Fluctuations in this well are moderated by its proximity to the Gulf of Mexico discharge boundary.

Within Region VII, Floridan Aquifer ground water use is so small, relative to ground water availability, that no adverse impacts to water levels have occurred as a result of ground water usage.

Figure 5-81 Hydrographs of the A) Olson Road and the B) Newport Floridan Aquifer Wells



Floridan Aquifer System Water Quality

In virtually all of Region VII, the quality of ground water is suitable for all uses. One regionally-significant exception is the coastal fringe. Along the coastline, the carbonates of the Floridan Aquifer outcrop. Ground water from the Floridan Aquifer freely discharges to land surface along this boundary. The Floridan Aquifer potentiometric surface in coastal Wakulla County is only a few feet above sea level, reflecting the loss of energy associated with discharging ground water. Panacea Mineral Springs (sodium/chloride ratio of 0.55, TDS ranging between 860 and 1,700 mg/L) discharges dilute seawater originating within the zone of diffusion, thus placing the interface near the shoreline. As a result, ground water availability in the immediate proximity of the Gulf of Mexico is limited by this water quality concern.

The City of Tallahassee and Florida State University are the largest users of ground water in Region VII. Together they operate 56 supply wells and pump about 41 Mgal/d. Wells operated by these two entities tap the highly permeable upper zone of the Floridan Aquifer. For both systems respective well construction details are similar. City of Tallahassee wells are cased to a median depth of 49 ft below sea level and have a median total depth of 221 ft below sea level. FSU supply wells are cased to a median depth of 53 ft below sea level, with a median total depth of 214 ft below sea level.

In 1994, FSU constructed a supply well that was deeper than its typical supply well. This well (#43) was cased to 265 ft below sea level and had a total depth of 375 ft below sea level. Results obtained from the well are noteworthy for two reasons. First, the hydraulic response of the well was less than anticipated. The well had a specific capacity of 54, about a factor of 20 less than wells open to the uppermost Floridan Aquifer. Second, grab sample data (NWFWMD consumptive use permit files) from just below casing bottom (chloride 648 mg/L, sulfate 1,330 mg/L, TDS 3,290 mg/L) and from near the total depth (chloride 625 mg/L, sulfate 1,260 mg/L and TDS 3,110 mg/L) were substantially poorer than expected. These values are about two orders of magnitude higher than comparable data from the upper part of the Floridan Aquifer section.

Although limited in scope, these data indicate that a natural-occurring deterioration of Floridan Aquifer water quality with increasing depth of penetration. This phenomenon does not appear to be related to water use in the overlying highly transmissive zones of the Floridan Aquifer, nor is it presently viewed as a limitation on ground water availability within Region VII. However, it is relevant to water supply and availability issues to determine whether these data are an isolated occurrence or are spatially persistent within the region.

Ground Water Budget

Ground water is the traditional and reasonably-anticipated future source of the vast majority of water used in Region VII. To assess whether ground water resources are adequate to meet projected needs through 2020, a region-scale ground water budget was prepared. Given the assumption that the Floridan Aquifer continues to be the principal regional ground water source over the next 20 years, a water budget-based assessment approach was deemed appropriate. The water budget presents an order-of-magnitude approximation of the major Floridan Aquifer System sources and discharges for the region and was prepared from a calibrated flow model. Although a calibrated steady-state model does not account for seasonal or annual variation in flow, the model does provide a means to estimate the relative magnitude of the various inflows to and outflows from the aquifer.

The flow system components for Region VII were estimated using output from a steady-state, three-dimensional ground water flow model (Davis 1996). The Davis model was calibrated to conditions as they occurred in October and November of 1991. Region VII lies entirely within the larger model domain of Davis.

In order to estimate water budget components for just the region, the computer program ZONEBUDGET (Harbaugh 1990) was used by the District to analyze model output obtained from the U.S. Geological Survey (Hal Davis, personal communication 1997). ZONEBUDGET allows the user to define a subregion within a MODFLOW model domain and to calculate the inflow and outflow to that subregion. In this way, a subregion corresponding to Region VII was defined and appropriate inflows and outflows calculated.

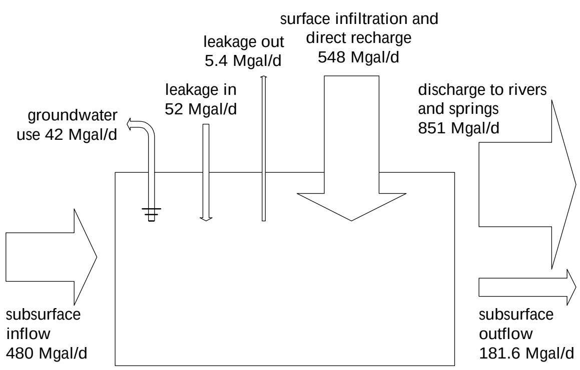
Major regional ground water sources are 1) surface infiltration and direct recharge to the upper Floridan Aquifer within the region; 2) subsurface inflow from areas hydraulically upgradient (southeast Georgia and Gadsden County); and 3) leakage into the upper Floridan Aquifer from the overlying Intermediate System within the region. During the 1991 calibration period, surface infiltration and direct recharge contributed an estimated 548 Mgal/d to the region. Subsurface inflow contributed an estimated 480 Mgal/d. Leakage from the Intermediate System was an estimated 52 Mgal/d. Thus, the 1991 Region VII steady-state ground water inflow into the Floridan Aquifer is estimated to be 1,080 Mgal/d.

Major regional ground water discharges are 1) discharge to rivers and springs; 2) subsurface outflow to areas hydraulically downgradient; 3) ground water withdrawal via wells; and 4) upward leakage into the Intermediate System. During the 1991 calibration period, discharge to rivers and springs within Region VII contributed an estimated 851 Mgal/d to the water budget. Subsurface outflow contributed an estimated 181.6 Mgal/d.

The Region VII model-simulated pumpage for all uses was 42 Mgal/d. Upward leakage into the Intermediate System was an estimated 5.4 Mgal/d. Given the steady-state nature of the model, the 1991 Region VII ground water outflow is equal to the estimated inflow (1,080 Mgal/d).

The region-wide recharge rate to the Floridan Aquifer (600 Mgal/d) equates to an annual recharge rate of approximately 5.3 inches per year over the region. Based on the steady-state model calibration to 1991 conditions (Figure 5-82), the projected 2020 demands for ground water are about one-thirteenth of the naturally-occurring discharge from the Floridan Aquifer flow system. This is only slightly more than the fraction of regional discharge represented by current ground water use. The Region VII surface water/ground water flow system is viewed as being capable of providing this quantity of water without significant adverse impacts.

Figure 5-82 Region VII Floridan Aquifer Ground Water Budget for 1991 Calibration Period



As a check on the accuracy of the river and spring discharge component of the ground water budget, flow statistics for three of the principal regional drains were examined. The examined drains include Wakulla Springs, Spring Creek and the St. Marks River. All three drains lie entirely within Region VII. The average discharge of Wakulla Springs is 260 Mgal/d. The discharge of Spring Creek was recently measured at 200 Mgal/d. The Q_{50} of the St. Marks River near Newport, Florida is 410 Mgal/d.

Assuming the Q_{50} statistic is a reasonable estimation of base flow, an estimate of the ground water discharge to these three drains about 870 Mgal/d. As an estimation of the total Region VII discharge to rivers and springs, 870 Mgal/d excludes any discharge to the Ochlockonee River. However, these data are sufficient to indicate that the estimated Region VII ground water discharge component to rivers and streams of 851 Mgal/d is of the correct order-of-magnitude.

Assessment Criteria Used

Given the very high hydraulic conductivities of the Floridan Aquifer System, pumpage has a minimal impact on the aquifer's potentiometric surface within Region VII. At the projected 2020 demands, no significant regional potentiometric surface depression is anticipated. Rather, given the intimate connection between ground and surface waters, ground water use should be expected to reduce streamflow to the major surface water drains in an amount equal to pumpage. These potentially affected features include Wakulla Springs and River, the St. Marks River and Spring Creek. Therefore, the primary assessment criterion is whether or not streamflow is significantly reduced by upgradient ground water withdrawals. Given the relative magnitudes of projected 2020 pumpage and the naturally-occurring ground water discharge to surface water features, adverse impacts are not expected.

Impacts to Water Resources and Related Natural Systems

As discussed earlier, impacts from excessive ground water withdrawals would likely manifest themselves as quantifiable reductions in spring and river flows in the southern portion of the region. The larger springs that could be impacted are the springs along the St. Marks River, Wakulla Springs and Spring Creek. Wakulla Springs and the St. Marks River springs lie a number of miles inland from the coast. Spring Creek is a submarine vent discharging directly into Apalachee Bay. In addition to direct flows from the large springs, there are a number of smaller springs in the region and a considerable amount of direct aquifer discharge into the St. Marks River and along the coast.

The St. Marks River, Wakulla River, and Apalachee Bay have each been designated as Outstanding Florida Waters (OFW), and their combined watershed is the fifth highest priority on the NWFWMD Surface Water Improvement and

Management (SWIM) Priority List. A SWIM plan was completed for this system in 1997. A large portion (450,000 acres) of Apalachee Bay has been designated as the Big Bend Aquatic Preserve. The primary purpose of the Aquatic Preserve is to conserve biological resources within the preserve and in adjacent waters.

The natural systems associated with the St. Marks and Wakulla rivers and Apalachee Bay are highly adapted to and dependent upon freshwater flows from the spring systems. The natural systems are presently in excellent condition, with only isolated problem areas. These problem areas are related to water quality problems resulting from urban areas. The rivers and bay provide habitat for a number of endangered and threatened species such as the bald eagle, Atlantic Ridley turtle and West Indian manatee.

To date, comprehensive ecological studies of these rivers and estuarine system have not been conducted, but a number of research projects have been conducted on various system components. To date, no harm to the water resources or related natural systems has been detected as a result of water withdrawals. Based upon the information evaluated by the District, no harm to the water resources or related natural systems is expected as a result of projected water withdrawals through the year 2020.

Adequacy of Regional Sources

In Region VII, the existing and reasonably-anticipated water sources are considered adequate to meet the requirements of existing legal users and reasonably anticipated future water supply needs of the region (projected 2020 demands) while sustaining the water resource and related natural systems.

Water Quality Constraints on Water Availability

Water quality constraints on ground water availability are limited to those associated with induction of saline water resulting from ground water production in the immediate vicinity of the Gulf of Mexico and from extraordinary depth of penetration elsewhere. Given the extremely high ground water availability in the uppermost Floridan Aquifer, there is little or no concern about the naturally-occurring deterioration of water quality with increasing depth. Local ground water contamination by organic chemicals is an issue in some locations within the City of Tallahassee. However, given the constituents involved, their concentrations, and the associated treatment options, this issue does not presently constrain ground water availability.

Level-of-Certainty

Using the methodology described in Section 3, water demand during drought conditions was estimated for Region VII through the year 2020 (Table 5-48). The amount of water available from traditional sources within this region should be sufficient to meet all of the projected average and drought condition demands through the year 2020 while sustaining natural resources.

Reuse and Conservation

Within Region VII, most of the wastewater treatment plants (WWTPs) dispose of effluent in a manner that meets the FDEP definition of reuse. Table 5-49 indicates that approximately 17 Mgal/d of the 30 Mgal/d of wastewater effluent generated in 1997 was disposed of as reuse water. Most of the reuse in this region was generated by the City of Tallahassee's WWTP, which disposes of effluent through a sprayfield application. This sprayfield is used for agricultural purposes. Water not returned to the atmosphere as evapotranspiration percolates into the Surficial Aquifer System as recharge. Although this disposal method meets the DEP definition of reuse, it does little to reduce consumption of water from the Floridan Aquifer. The provision of reuse water to users such as golf courses and new developments that would otherwise use Floridan Aquifer water should be strongly encouraged in the future.

Information collected in 1997 (Marella et al. 1998) indicates that some water conservation programs have been implemented in the region. While conservation should continue to be encouraged in the region by utilities, implementation of more aggressive conservation programs by the District is not warranted at this time.

Table 5-48 Region VII Estimated Water Demand During Drought Conditions (Mgal/d)

Water Use Category	2000	2005	2010	2015	2020
Public Supply	34.98	39.04	43.36	48.29	53.53
Domestic SS/Small Public Supply Systems	9.07	9.51	9.96	9.68	9.11
Commercial-Industrial Self Supply	1.26	1.31	1.36	1.39	1.41
Recreational Irrigation	1.66	1.81	1.96	2.26	2.41
Agricultural Irrigation	13.67	14.27	15.78	16.80	18.26
Power Generation	3.86	3.96	4.10	4.41	4.76
Total	64.50	68.89	76.53	82.83	89.48
Increase Over Average Daily Demand	11.39	12.21	13.44	14.47	15.78

Table 5-49 Reuse of Domestic Wastewater in Region VII in 1997

Domestic Wastewater Facility Name	Total Plant		Reuse		
	Capacity (Mgal/d)	Flow (Mgal/d)	Capacity (Mgal/d)	Flow (Mgal/d)	Reuse Required
Jefferson County					
City of Monticello	01.00	00.46	01.00	00.46	N
County Total	01.00	00.46	01.00	00.46	0
Leon County					
Falls Chase	00.18	N/D	00.00	00.00	N/A
Killearn Lakes Sbdvn (TEC)	00.35	00.22	00.35	00.22	N
Lake Bradford Road (TEC)	04.50	03.21	04.50	00.00	N
Lake Jackson	00.56	00.22	00.56	00.22	N
Thomas P. Smith (COT)	27.50	13.35	27.50	16.64	N
County Total	33.09	17.00	28.41	17.08	0
Wakulla County					
Wakulla County	00.20	00.14	00.20	00.14	N
Winco Utilities	00.50	00.03	00.50	ND	N
County Total	00.70	00.17	00.70	00.14	0
Region VII Total	34.79	17.63	30.11	17.68	0

Source: NWFWMD 1997 Annual Reuse Report (ND = No Data)

DISTRICT WATER SUPPLY ASSESSMENT

Northwest Florida Water Management District

Water Resources Assessment 98-2

June 1998

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This report was prepared pursuant to Section 373.036(2)(b)4., Florida Statutes. It also fulfills the portion of Section 373.0391(2)(e), F.S., which requires "an assessment of regional water resource needs and sources for the next 20 years".

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LIST OF ACRONYMS

ADR	average daily rate
AFB	Air Force Base
AFSIRS	Agricultural Field Scale Irrigation Requirements Simulation Model
ASC	Areas of Special Concern
BEBR	Bureau of Economic & Business Research (University of Florida)
cfs	cubic feet per second
cfs/mi^2	cubic feet per second per square mile
CRV	coefficient of relative variation
ECUA	Escambia County Utilities Authority
F.S.	Florida Statutes
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
FDOT	Florida Department of Transportation
ft	feet
ft/d	feet per day
ft^2/d	feet squared per day
gal/d	gallons per day
gpm	gallons per minute
gpm/ft	gallons per minute per foot
HRS	Florida Department of Health & Rehabilitative Services
IFAS	Institute of Food and Agricultural Sciences (University of Florida)
in/yr	inches per year
MAPE	mean absolute percentage error
mg/L	milligrams per liter
Mgal/d	million gallons per day
mi^2	square miles
MOR	monthly operating report
MSE	mean standard error
NWFWMD	Northwest Florida Water Management District
Q_{90}	streamflow exceeded 90 percent of the time
RO	reverse osmosis
RUA	Walton/Okaloosa/Santa Rosa Regional Utility Authority
RWSDP	Regional Water Supply Development Plan
SEE	standard error of estimate

LIST OF ACRONYMS (CONTINUED)

TDS	total dissolved solids
USCB	United States Census Bureau
USGS	United States Geological Survey
VISA	Very Intensive Study Area
WFRPC	West Florida Regional Planning Council
WMD	Water Management District
WRCA	Water Resource Caution Area
WSA	Water Supply Assessment
WWTP	Wastewater Treatment Plant

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I. Executive Summary

In response to growing concerns about water resource planning and management issues throughout the State of Florida, Governor Lawton Chiles issued Executive Order 96-297 in September 1996. Among other requirements, the Executive Order directed the state's five water management districts to each develop a "districtwide water supply assessment" by July 1, 1998. During the 1997 session, the Florida Legislature also made significant changes to the statutes that govern water resource planning and management. These changes included language virtually identical to the Executive Order in regard to preparation of districtwide water supply assessments (WSA).

Preparation of the WSA is the initial step of a new water supply planning process that will be an ongoing responsibility of the District. The WSA is intended to determine future water needs and whether existing or "Reasonably-Anticipated" water sources and conservation efforts are adequate to supply water for all existing and projected reasonable-beneficial uses and to sustain the water resources and related natural systems [Section 373.0361(1), F.S.]. If the future water needs of a water supply planning region are such that they are currently causing or are likely to cause water resource problems over the 20-year planning horizon, the second step of the process begins. In this step, the water management district must prepare a "regional water supply plan" which analyzes various alternatives for meeting the anticipated needs.

The WSAs are a part of the District Water Management Plan required by Section 373.036(2), F.S., and as such, are subject to updates every five years. These regular updates will provide an opportunity to reassess current and future water needs as well as the condition of existing water supply sources. If water demands are increasing faster than anticipated in the previous WSA, adjustments can be made to ensure that water continues to be available from sustainable sources. In accordance with statutory requirements, the WSA will be incorporated into the *Northwest Florida Water Management District (NWFWMD) District Water Management Plan* when it is revised in 1999.

The WSA was prepared in close coordination with the four other water management districts in the state and the Florida Department of Environmental Protection (FDEP). These agencies have worked closely to ensure that all five WSAs have a consistent format and that there is agreement in regard to the methods used to assess water supply needs and sources.

This WSA provides the first comprehensive assessment of water supply needs and sources for the Northwest Florida Water Management District. Preparation of this document began with the identification of seven "Water Supply Planning Regions" comprised of either single counties or multiple counties that have similar water supply issues and water resource conditions (Figure 2-1). These regions were used as the basis for assessment of needs and evaluation of sources. Also identified are "Areas of Special Concern" for which water supply needs and sources were more closely examined.

Water needs through the year 2020 were quantified to a high level of detail at the utility or user level for the withdrawals that, in combination, account for over 95 percent of the water use in the District. Water withdrawal locations and sources are identified for each user with a permitted withdrawal rate of over 100,000 gallons per day. Availability of water from existing and anticipated water supply sources was quantified by water supply planning region to the degree possible using best available resource information. Environmental water demands are not explicitly quantified, but are addressed to the extent possible with existing information.

Water use in northwest Florida is projected to increase by 35 percent during the 1995–2020 planning timeframe. An additional 115 million gallons per day will be required to meet the future needs of the region. Most of the increase is attributable to a 41 percent increase in population that is projected to occur in this period.

On a regional basis, existing water supply sources are quite sufficient for meeting the projected future water demands of northwest Florida.

However, in Water Supply Planning Region II (Santa Rosa, Okaloosa, and Walton counties), anticipated future water supply sources have not been identified to safely meet the projected future needs. **Thus, development of a "Regional Water Supply Plan" pursuant to Section 373.0361, F.S., is recommended for Water Supply Planning Region II**.

The WSA also identifies some water supply issues in Bay, Franklin, and Gadsden counties that warrant either local action or close observation by the water management district.

In Bay County (Water Supply Planning Region III), wells used by the City of Panama City Beach are exhibiting signs of saltwater intrusion. An adequate amount of water is available from the Deer Point Lake Reservoir to meet the city's needs, but infrastructure improvements are necessary to transmit reservoir water to the Panama City Beach area. The improvements necessary fall under the statutory definition of "water supply development," and as such, are primarily the responsibility of the affected local governments and water supply utilities [Sections 373.0831 and 373.019(21), F.S.]. The NWFWMD and FDEP should closely monitor Floridan Aquifer water quality conditions in the area of the wells and undertake regulatory actions as appropriate to mitigate aquifer impacts.

In Franklin County (Water Supply Planning Region V), wells in the coastal area are susceptible to saltwater intrusion under excessive pumping scenarios. While there is evidence of saltwater intrusion beginning to occur in the City of Apalachicola's wells, this has yet to be documented for other water supply systems in the county. Floridan Aquifer conditions throughout the coastal area of Franklin County should be closely monitored. Saltwater intrusion issues in Franklin County can likely be addressed by simply moving the withdrawal points inland. This activity would fall under the statutory definition of "water supply development," and as such, would primarily be the responsibility of the affected local governments and water supply utilities.

In Gadsden County (Water Supply Planning Region VI), two water supply issues warrant close monitoring by the NWFWMD. First, agricultural demands and streamflows in the Telogia Creek Basin Water Resource Caution Area (WRCA) should continue to be closely monitored. Because agricultural demands currently and historically have been constrained by a lack of available water, these demands will continue to be limited. Present day permitting thresholds, along with good monitoring data, will allow available water to continue to be used in a reasonable-beneficial fashion. While wetlands and similar water resources will continue to be sustained as they are today, these systems have been highly altered due to extensive structural modification of the creek with impoundments and related past agricultural practices. These alterations took place prior to the establishment of the NWFWMD.

Second, the geology of central Gadsden County is such that excessive withdrawals can cause intrusion of poor quality water from the lower portions of the Floridan Aquifer. This can be avoided by carefully locating any new wells with large withdrawals and ensuring that adequate spacing is provided between smaller wells in areas with aquifer constraints.