Water Supply Assessment

SUWANNEE RIVER WATER MANAGEMENT DISTRICT

Water for Nature, Water for People

2010

Exhibit INT216
June 26, 2012

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Purpose

The purpose of the Suwannee River Water Management District's Water Supply Assessment is to determine whether water supplies will be adequate to satisfy water demands for all use categories for the 2010 to 2030 planning period while protecting natural systems. Subsection 373.036(2)(b)4., 2009 Florida Statutes (FS), requires the District to estimate existing and future water use, the potential for water conservation to reduce demand, and availability of all water sources. Nearly all water used in the District is supplied by groundwater from the Upper Floridan aquifer. The Water Supply Assessment identifies areas where the use of groundwater to satisfy water demands for the planning period will cause negative impacts to natural systems.

Water Use Demand Projections

The District developed a range of water use demand projections for the planning period for the major water use categories including public supply, domestic self supply, agriculture, industrial/commercial/institutional, thermo-electric power generation, and recreation. The low range projection, which is based on a rigorous analysis of established growth and water use trends for each water use category, indicates an increase of 11.82 million gallons per day by 2030. The high range projection, which was developed to reflect a potential peak water use scenario in excess of established growth trends, indicates an increase of 64.19 million gallons per day by 2030.

Water Resource Impact Assessment

The ability of groundwater to meet projected demands for the planning period was evaluated using data from previous and ongoing hydrologic investigations and the District's North Florida groundwater flow model. The North Florida Model is a predictive tool used to understand how current and projected groundwater withdrawals within the model area affect aquifer and lake levels and flow in springs and rivers. The model area includes all of the District as well as large areas in the St. John's River Water Management District, smaller areas in the Northwest and Southwest Florida Water Management Districts, and the State of Georgia. The results of this analysis indicate that the water resources of the northeastern portion of the District are in decline. This trend is especially evident in groundwater levels of the Upper Floridan aquifer, which declined significantly during the past 75 years. Figure ES-1 illustrates the southwestward migration of the groundwater basin divide resulting from the potentiometric decline that occurred from pre-development through 2005. The divide has migrated more than 35 miles to the southwest over the past 75 years. The result of this migration is a decrease in the size of the groundwater contributing area to the northeastern District by more than 20 percent or 1,900 square miles. This decrease is apparently a result of groundwater withdrawals originating in the District, the St. John's River Water Management District, and the State of Georgia.

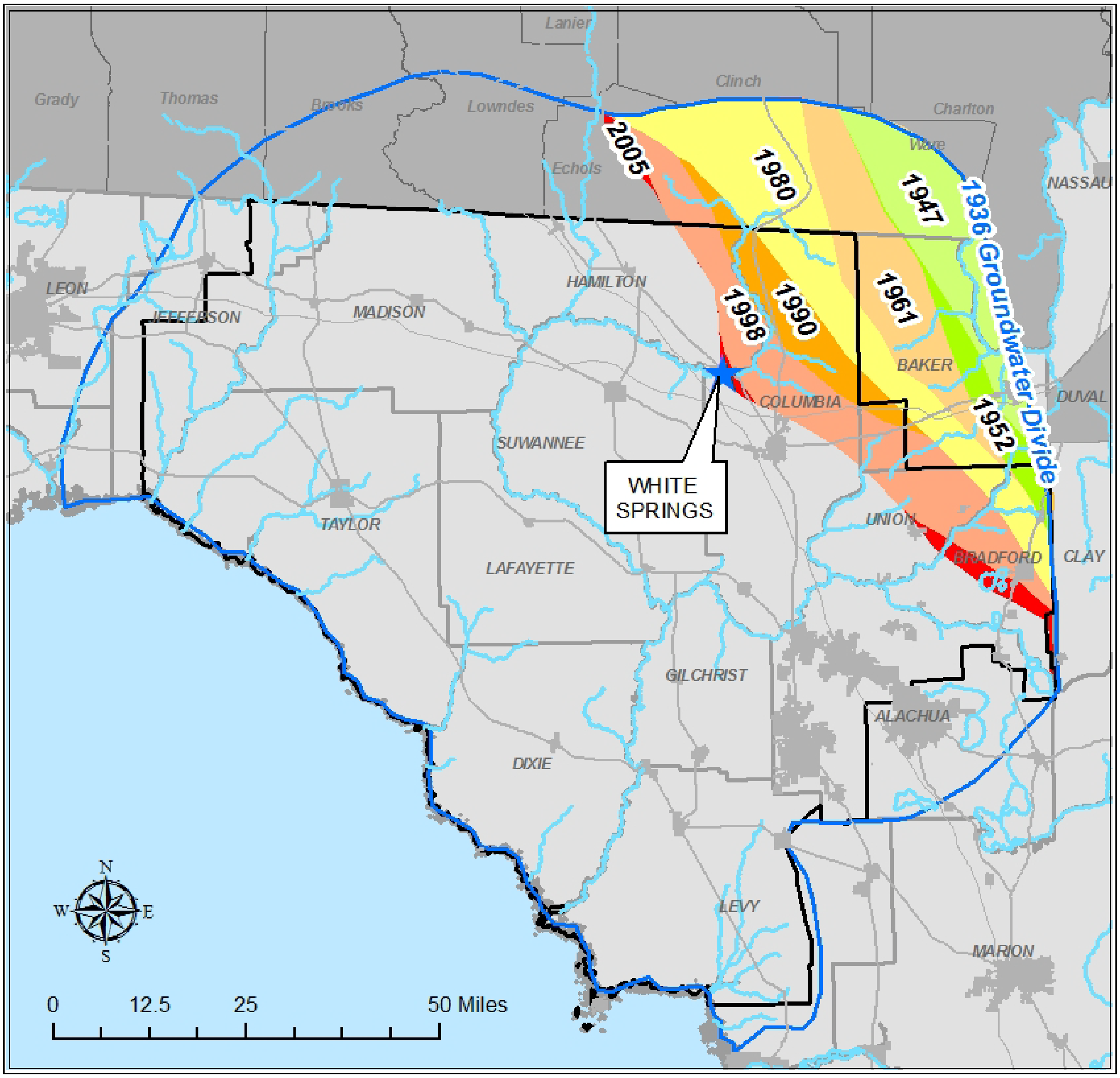

Figure ES-1. Migration of the Groundwater Basin Divide in the Northeastern Portion of the District.

Figure ES-2 illustrates the magnitude of the decline in average potentiometric levels from 1981 to the present that is responsible for a portion of the migration of the groundwater divide depicted in Figure ES-1. The figure shows potentiometric levels for a 28 mile long cross section through the Upper Floridan aquifer based on groundwater levels in three wells from the District's groundwater monitoring network. Average groundwater levels from each well for each five year period between 1981 and 2010 were analyzed for trends. The analysis indicates that the potentiometric surface of the Upper Floridan aquifer across section A-A' has experienced a cumulative drawdown of approximately six feet over the past 29 years. This decline is in

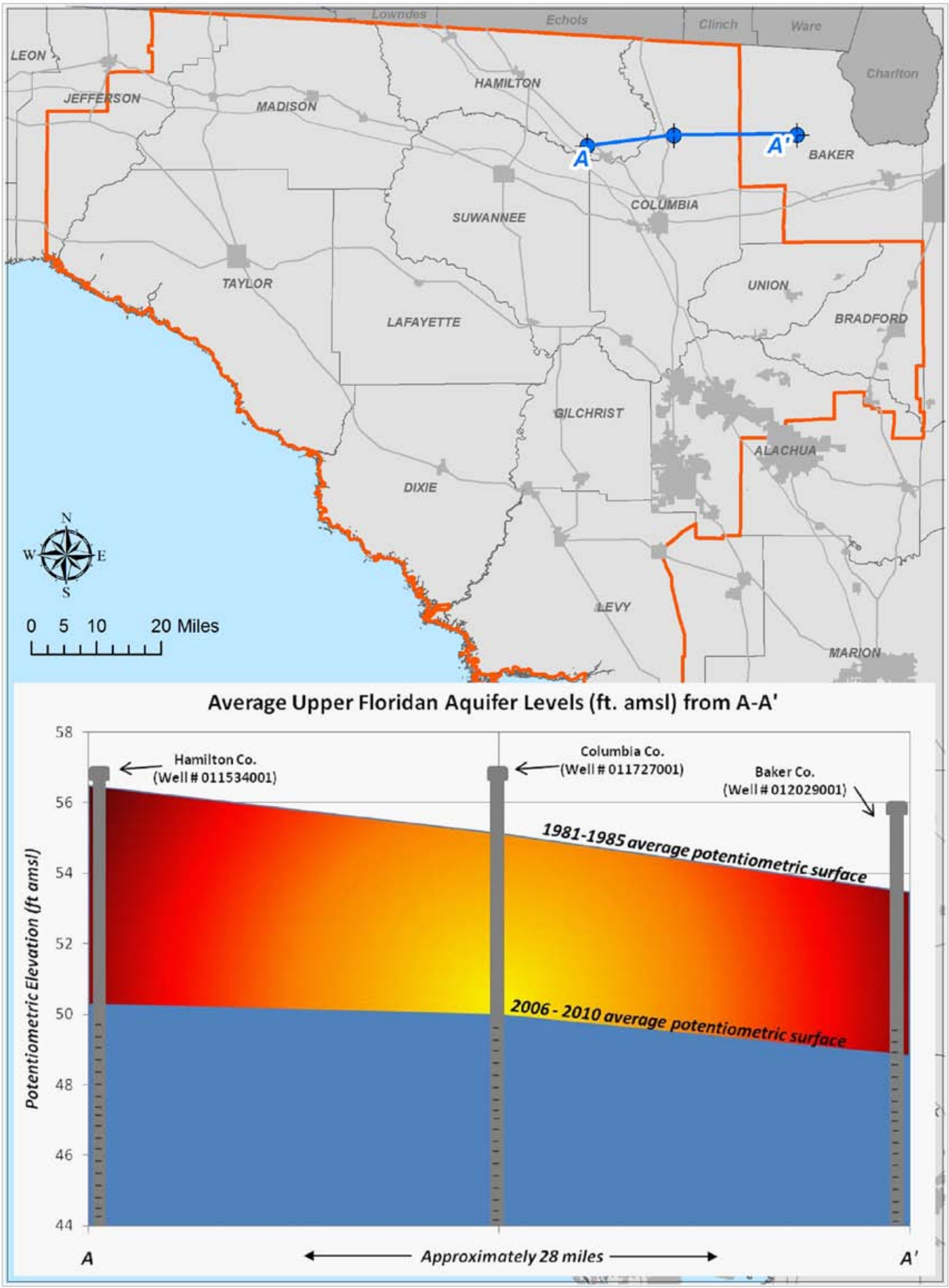

Figure ES-2. Potentiometric Surface Decline Across Section A-A' Associated with the Southwestward Migration of the Groundwater Basin Divide Shown in Figure ES-1.

addition to significant drawdown that occurred prior to 1981. Unfortunately, the magnitude of this drawdown cannot be accurately calculated because the necessary data was not collected.

The decline in groundwater levels in the northeastern District is suspected to have impacted a number of rivers and springs to the degree that they are not currently meeting their established minimum flows or interim flow constraints, or they are predicted to fall below them during the planning period. Restrictions on the development of additional groundwater in this area will be necessary to mitigate current impacts and avoid future predicted impacts. It is therefore recommended that the District designate the Upper Santa Fe River Basin, Lower Santa Fe River Basin, Upper Suwannee River Region, and Alapaha River Basin as Water Supply Planning Regions. Figure ES-3 shows the location and extent of the proposed Water Supply Planning Regions.

The Water Supply Planning Region designation requires the development of water supply plans that will identify strategies to use alternative water sources (when feasible) and conservation in addition to groundwater to meet projected demands. In addition, the water supply plans must contain a recovery strategy for water resources that currently do not meet their established minimum flow and levels or interim flow constraints, or a prevention strategy for water resources that are projected to fall below these constraints at some point during the planning period. The water supply plan for the Upper Santa Fe River Basin is currently under development. The water supply plans for the other three regions will be initiated according to a schedule to be developed by District staff and the Governing Board.

Within one year of designating the Water Supply Planning Regions, they must also be designated as Water Resource Caution Areas. A Water Resource Caution Area is where existing sources of water will not be adequate to satisfy future water demands and sustain water resources.

Alternative Water Source Availability Assessment

An assessment was conducted to quantify the amount of water that could feasibly be developed from alternative water sources and water conservation in the District to help meet water demands through 2030. Alternative water sources are defined as all sources of water other than fresh groundwater from the Upper Floridan aquifer. Alternative water sources will be of the greatest importance in areas where the development of additional groundwater from the Upper Floridan aquifer is limited or projected to be limited prior to 2030. Alternative sources of water that were evaluated include surface water from rivers, reclaimed water, brackish groundwater, and seawater. Water conservation was also included in the evaluation even though it is a demand management method and not technically considered a source of water.

In addition to an evaluation of the availability of each source, additional information is provided including discussions of how sources could be developed by various water users, the most appropriate source for each use category, how storage options such as aquifer storage and recovery, aquifer recharge, and off-stream reservoirs could be used, planning level infrastructure requirements and conceptual costs, and permitting considerations.

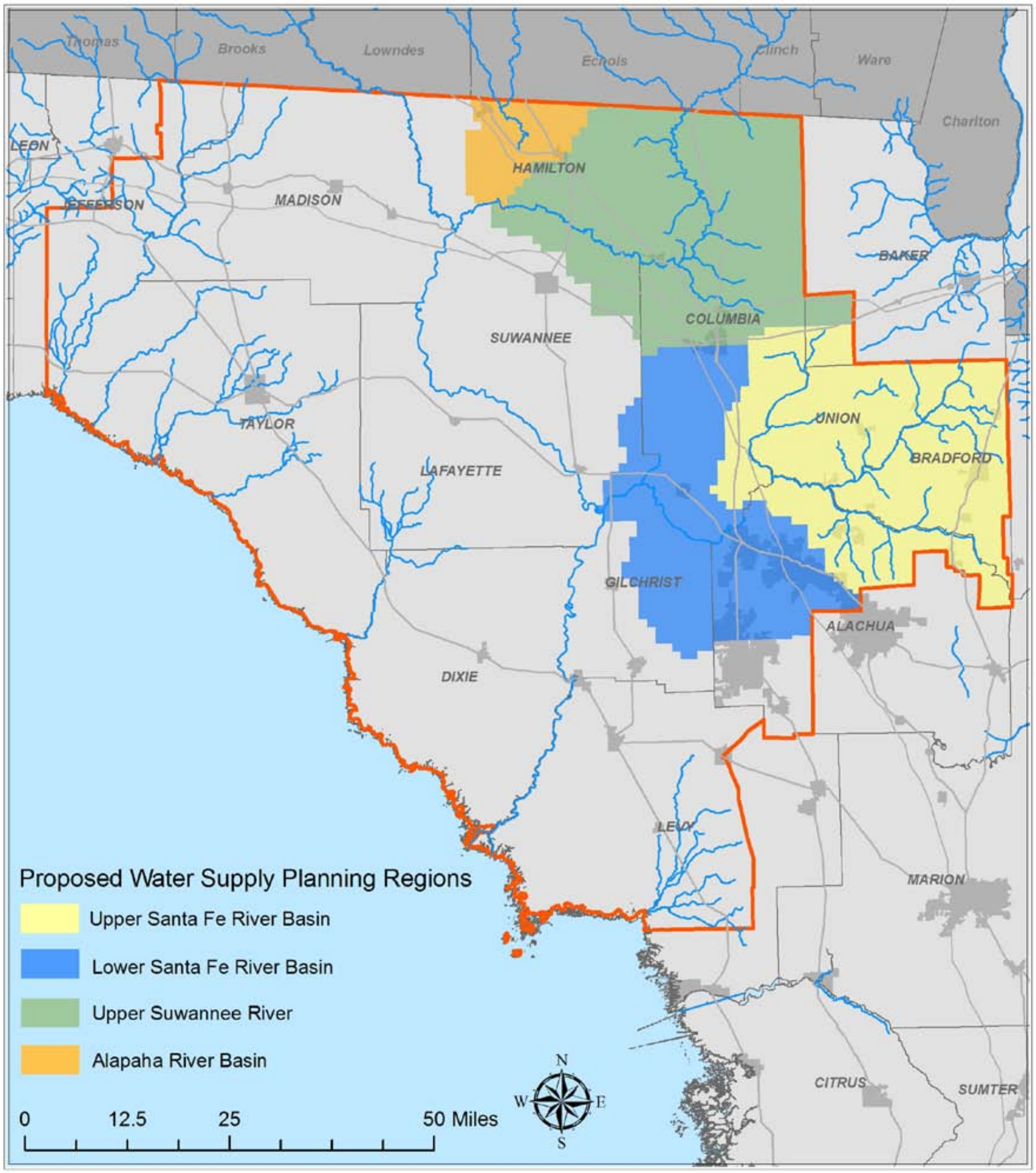

Figure ES-3. Proposed Water Supply Planning Regions

Recommendations

A series of recommendations is provided to identify how the District can enhance its statutory responsibilities to meet water supply demand while protecting natural systems. The most important recommendations are listed below.

- Designate the Upper Santa Fe River Basin, Lower Santa Fe River Basin, Upper Suwannee River Region, and Alapaha River Basin as Water Supply Planning Regions

due to significant regional declines in the Upper Floridan aquifer potentiometric surface and predicted exceedances of established minimum flows and interim flow constraints in these areas.

- Limit the duration of water use permits in the proposed Water Supply Planning Regions to no more than five years until recovery and prevention strategies are developed and implemented unless the applicant implements measures to provide reasonable assurance that their proposed use will result in a net benefit to the resource.
- Develop a plan to require new applicants for water use permits and those renewing permits in excess of 100,000 gallons per day in the proposed Water Supply Planning Regions to monitor and report their water use.
- Encourage all new applicants for water use permits in excess of 500,000 gallons per day in the proposed Water Supply Planning Regions to use alternative sources of water if the sources are technically, economically, and environmentally feasible.
- Develop recovery and prevention strategies for impacted water resources in conjunction with the St. John’s River Water Management District.
- Establish minimum flows and levels for all priority water resources as expeditiously as possible.
- Staff should recommend changes to the monitoring networks following a comprehensive audit of the District’s data collection networks to optimize the locations of data collection sites and frequency of collection to gain a better understanding of hydrologic trends and to gage whether minimum flows and levels and interim flow constraints are being met.
- Continue to use models to refine the understanding of the magnitude of existing and projected impacts to water resources in the proposed Water Supply Planning Regions. Use the models to apportion the degree of impact to water resources from groundwater withdrawals in the District, the St. John’s River Water Management District, and the State of Georgia.
- Coordinate with the St. John’s River Water Management District, the State of Georgia, the US Geological Survey and other agencies to develop a groundwater flow model that would encompass the entire north Florida/South Georgia Region that may contribute to water resource impacts in the District.
- Work with State of Georgia, the St. John’s River Water Management District, the US Geological Survey, and other agencies to develop a strategy for data collection, data analysis and groundwater modeling to better define current and future regional water resource impacts.
- Coordinate with the State of Georgia and the St. John’s River Water Management District to produce regional potentiometric maps to develop a more complete understanding of long-term aquifer trends.
- Work through the Suwannee River and Ichetucknee Partnerships to enhance agricultural water conservation incentive and outreach efforts, such as the mobile irrigation lab program, to help farmers increase the efficiency of their water use.
- Require the major industrial, mining, and agricultural users in the proposed Water Supply Planning Regions to develop and implement comprehensive water conservation plans to maximize reductions in water use.

Part 1. Introduction

The purpose of the Suwannee River Water Management District's (District) Water Supply Assessment is to determine whether water supplies will be adequate to satisfy water demands for all use categories for the 2010 to 2030 planning period while protecting natural systems. Subsection 373.036(2)(b)4., 2009 Florida Statutes (FS), requires the District (Figure 1-1) to estimate existing and future water use, the potential for water conservation to reduce demand, and availability of all water sources. The statute requires the District to compare existing and future water use to availability of water sources, while considering water conservation, to determine whether sources can provide sufficient water while maintaining the health of natural systems.

The Water Supply Assessment provides estimates of current water use and projections of future demands for all water use categories for the planning period. Water sources are evaluated to determine whether they can meet projected demands. Nearly all water used in the District is supplied by groundwater from the Upper Floridan aquifer. The Water Supply Assessment identifies areas where the use of groundwater to satisfy water demands for the planning period will cause negative impacts to natural systems.

The ability of groundwater to meet projected demands was evaluated using the District's North Florida groundwater flow model. The North Florida model is a predictive tool used to understand how current and projected groundwater withdrawals within the model area (Figure 1-2) affect aquifer and lake levels, and flow in springs and rivers. A key assumption of the modeling is that all future water demands will be met using Upper Floridan aquifer groundwater. The model area includes all of the District as well as large areas in the St. John's River Water Management District, smaller areas in the Northwest and Southwest Florida Water Management District's, and the State of Georgia. This was done to provide the model with the ability to assess the degree of impacts that could occur to natural systems in the District from current and future groundwater withdrawals in areas surrounding the District.

Each water resource within the model area was given a constraint (i.e., a level of flow that must be maintained to prevent harm to the water resource). One of two constraints was used for each water resource; either an established minimum flow or level (as documented in Chapter 40B-8, Florida Administrative Code) or an interim flow constraint. Interim flow constraints are either draft minimum flows or levels or estimates of minimum flows or levels based on existing data and knowledge from District staff, consultants, and staff of other water management districts. Areas where flow constraints are predicted to be exceeded during the planning period may be designated as areas in need of regional water supply planning, depending on the severity of impacts and how early in the planning period they are predicted to occur. Within one year of designating these areas as Regional Water Supply Planning areas, they will also be designated as Water Resource Caution Areas. A Water Resource Caution Area is where existing sources of water will not be adequate to satisfy future water demands and sustain water resources.

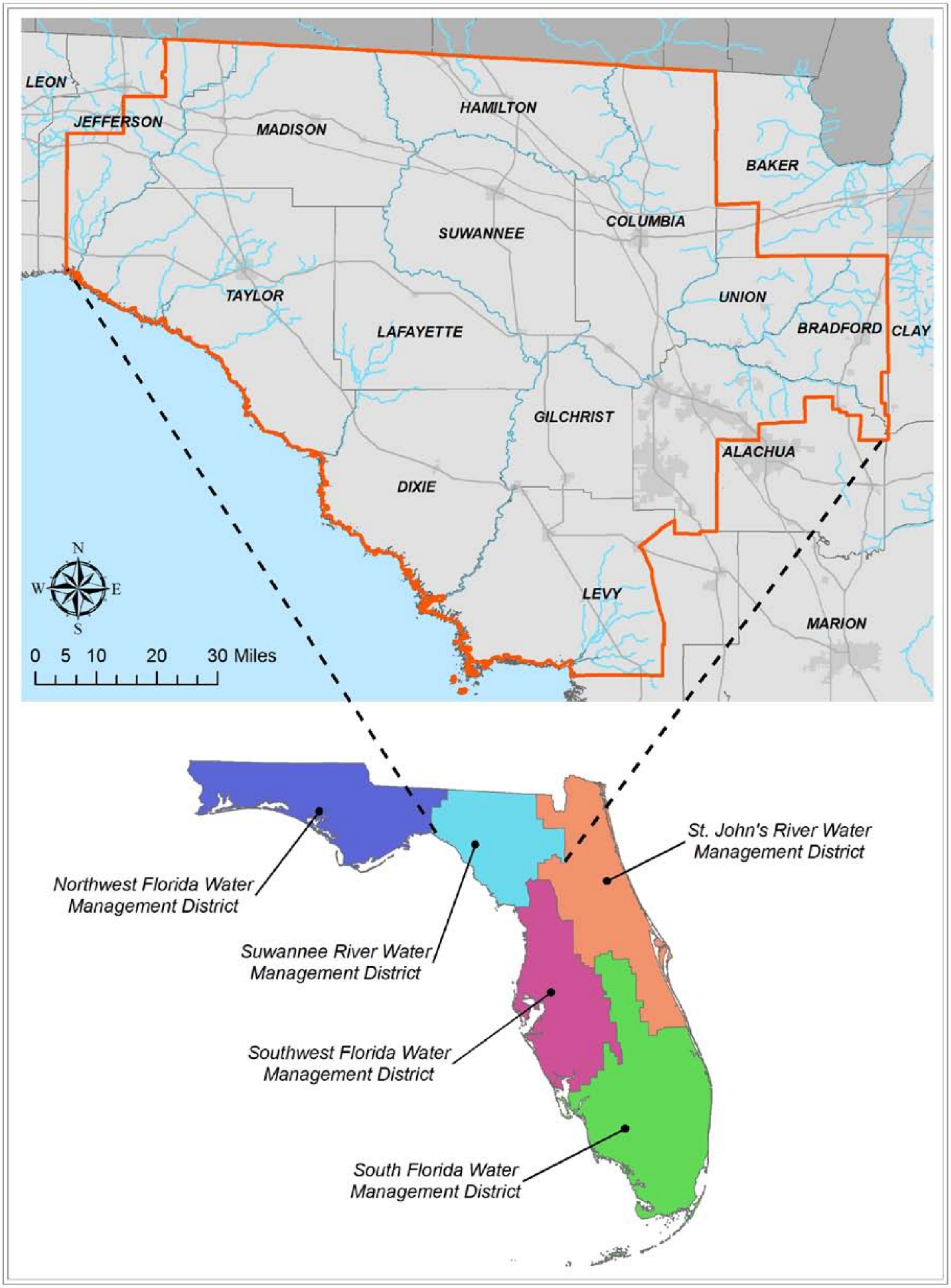

Figure 1-1. Map of the Suwannee River Water Management District.

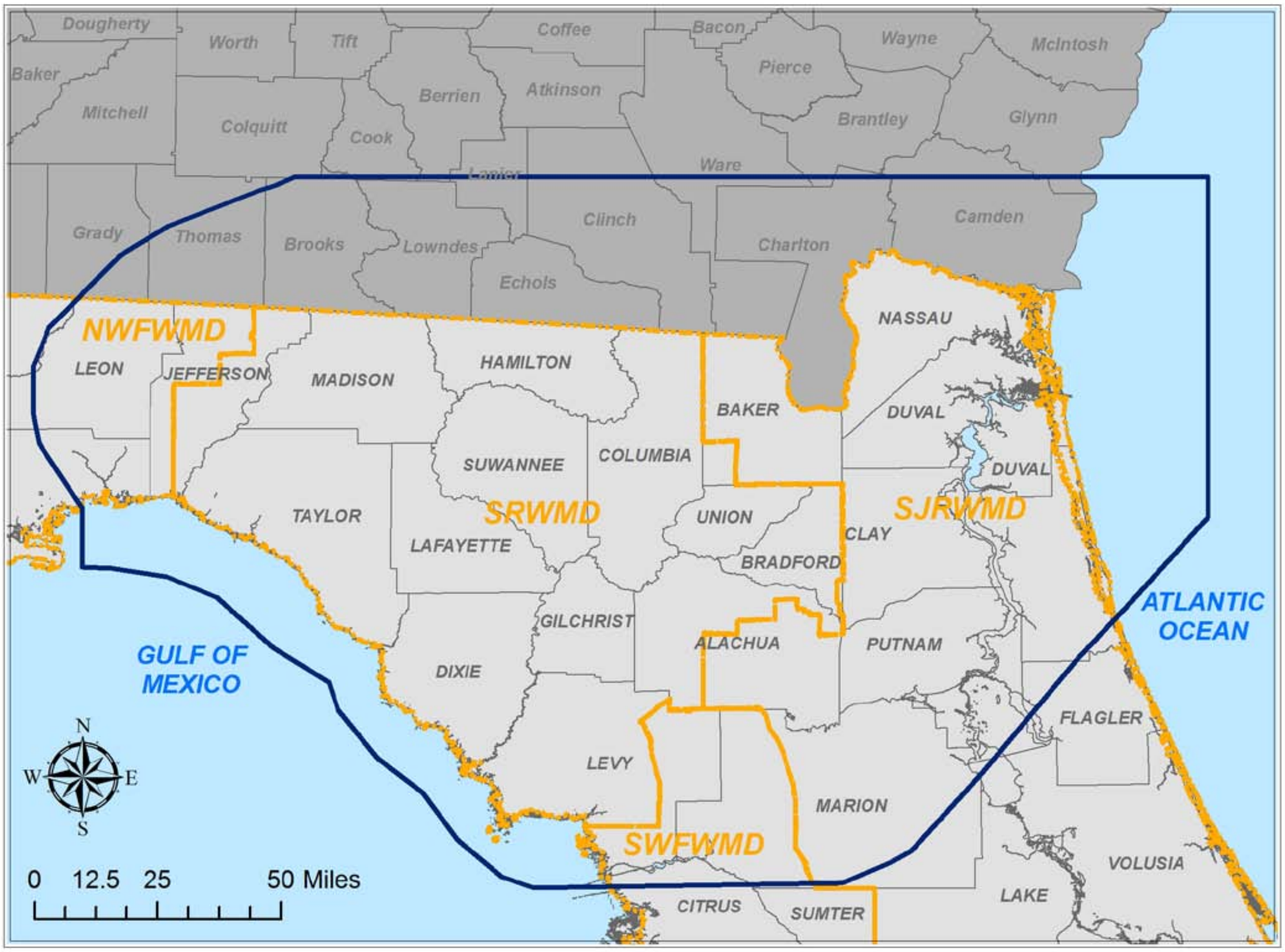

Figure 1-2. Geographic Extent of the North Florida Model.

Part 2. Outreach and Coordination

Development of the Water Supply Assessment has been an open public process, in coordination and cooperation with local governments and utilities, the agricultural community, business and industry representatives, environmental organizations and other affected and interested parties. The District's objective has been to involve all stakeholders in the planning process. The District has also coordinated closely with the St. John's River Water Management District in the preparation of the Water Supply Assessment. The St. John's River Water Management District is also preparing a Water Supply Assessment and Water Supply Plans for their District. Coordination was for the purposes listed below.

- Ensure a consistent understanding of existing and projected water demands, particularly for counties split by the District boundaries.
- Ensure a consistent understanding of how existing and future withdrawals in one District may contribute toward resource impacts in the adjacent District.
- Dissemination and comprehensive explanation of project-related information.

- Facilitate a smooth and accurate exchange of data and results between the two Districts.
- Ensure the use of best available data to perform evaluations.
- Ensure that project-related concerns were addressed.
- Ensure that the water supply planning efforts of the water management districts would be compatible.

Part 3. Organization and Content of the Water Supply Assessment

The District's Water Supply Assessment is organized as follows. Chapter 1, *Introduction*, states the purpose of the assessment and includes the statutory requirements. Chapter 2, *Water Use Demand Projections*, contains population and water demand estimates for all water use categories in the District for the 2010-2030 planning period. Water use categories include public supply, domestic self supply, agriculture, commercial/industrial/institutional, thermo-electric power generation, and recreation. Chapter 3, *Water Resource Modeling and Impact Assessment*, is a summary of the results of using the District's North Florida Model to assess impacts to established minimum flows and levels and interim flow constraints to determine the limits on the use of groundwater to meet future demands. Within this Chapter, Water Supply Planning Regions are delineated and the rationale for this designation is discussed. Chapter 4, *Alternative Water Source Availability Assessment*, is an assessment of the type and quantity of alternative water sources that could feasibly be developed during the planning period using technical, economic, and environmental criteria. Potential alternative water supplies include surface water, reclaimed water, and brackish groundwater. Water conservation is also discussed. While not an alternative water source, water conservation has great potential to reduce the projected demand for water during the planning period, which could eliminate or delay the need for costly alternative sources. Chapter 5, *Conclusions and Recommendations*, provides a summary of key issues and conclusions in addition to a series of recommendations pertinent to water supply planning issues in the District for the planning period and beyond.

Part 4. Physical Setting, Geology, and Hydrogeology of the District

Section 1. Physical Setting

The two major physiographic provinces in the District include the Northern Highlands and Gulf Coastal Lowlands (White, 1970; Ceryak et al., 1983; Figure 1-3). Characteristics of the Northern Highlands include gently rolling topography, generally from 100-200 feet above mean sea level. Soils typically range from sand to clayey sand. Clayey sediments in the subsurface serve as a base for the surficial aquifer system and retard infiltration of rainwater into the underlying Upper Floridan aquifer. The result is the presence of abundant surface water features (streams, lakes and ponds) throughout the Northern Highlands.

The Gulf Coastal Lowlands are characterized by elevations ranging from sea level to about 100 feet above mean sea level. The Gulf Coastal Lowlands feature low relief, karstic topography, and shallow sandy soils with muck in many wetland areas. Karst landforms are widespread in the lowlands, with abundant sinkholes, sinking streams and springs, and a high degree of interconnection between surface water and groundwater systems. Carbonate rock (limestone

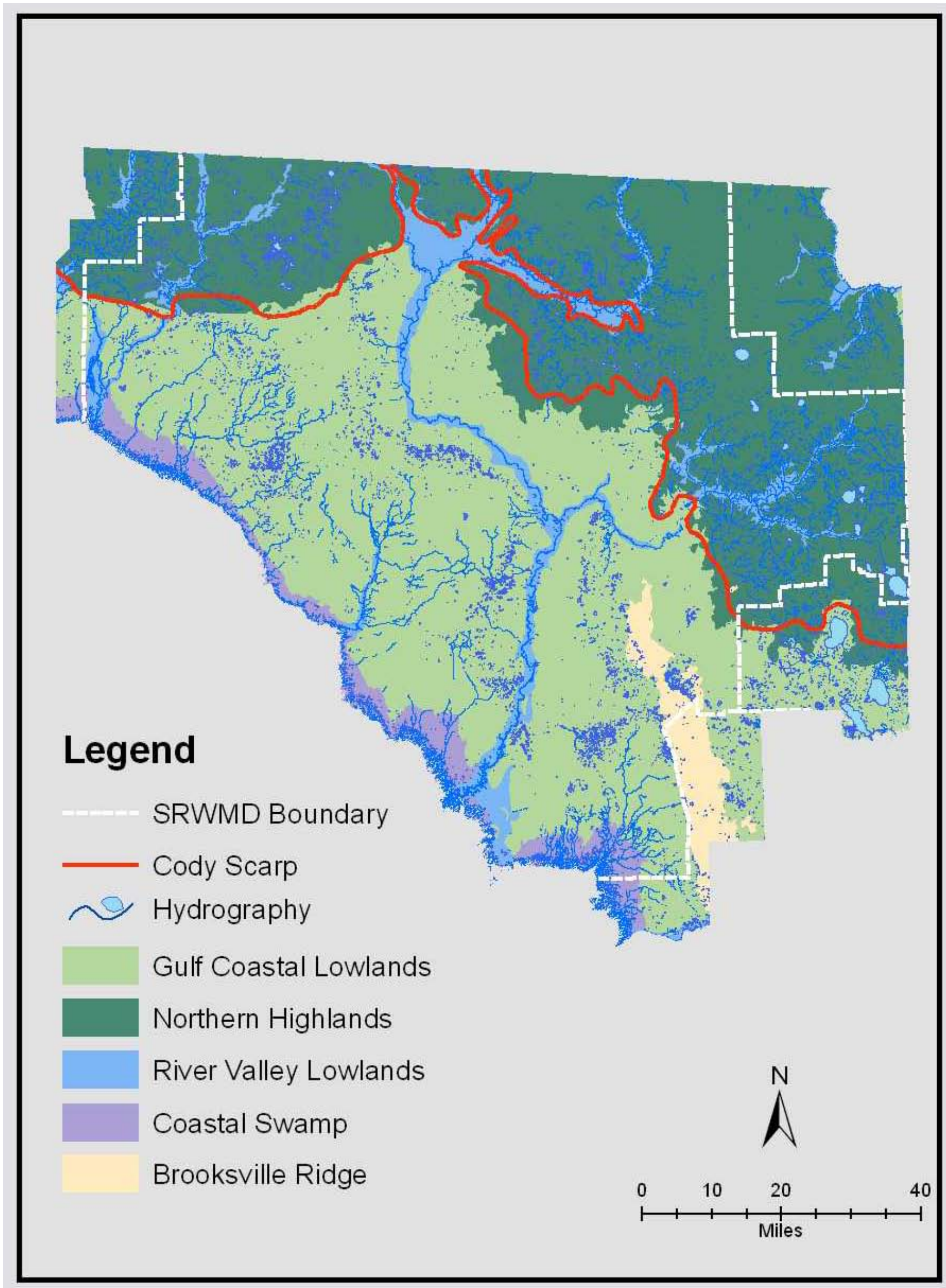

Figure 1-3. Physiographic Regions in the District.

or dolostone) is at or near land surface throughout the Gulf Coastal Lowlands. Whereas the surface water features in the Northern Highlands reflect the surficial aquifer system, those in the Gulf Coastal Lowlands may represent the potentiometric surface of the Upper Floridan aquifer.

A significant geologic region separating the two major physiographic provinces is the Cody Scarp (depicted as a red line in Figure 1-3). The Cody Scarp is the most persistent topographic break in Florida (Puri and Vernon, 1964), with as much as 80 feet of relief in some areas. The

region is characterized by active sinkhole formation, lakes, springs, sinking streams, and river rises (Ceryak et al., 1983). During average and lower flows, the Santa Fe and Alapaha Rivers are completely captured by sinkholes as they cross the Cody Scarp and re-emerge downgradient as river rises. Due to its size, the Suwannee River is the only stream that is not significantly captured by a sink feature as it crosses the Cody Scarp. Upgradient of the Cody Scarp, surficial drainage has developed, with numerous small creeks branching off the upper Suwannee River and its tributaries (Figure 1-3). Below the Cody Scarp, drainage is predominantly internal and streams that are tributary to the Suwannee River are rare. Figure 1-4 shows the basins of the major river in the District and their extent in the state of Georgia.

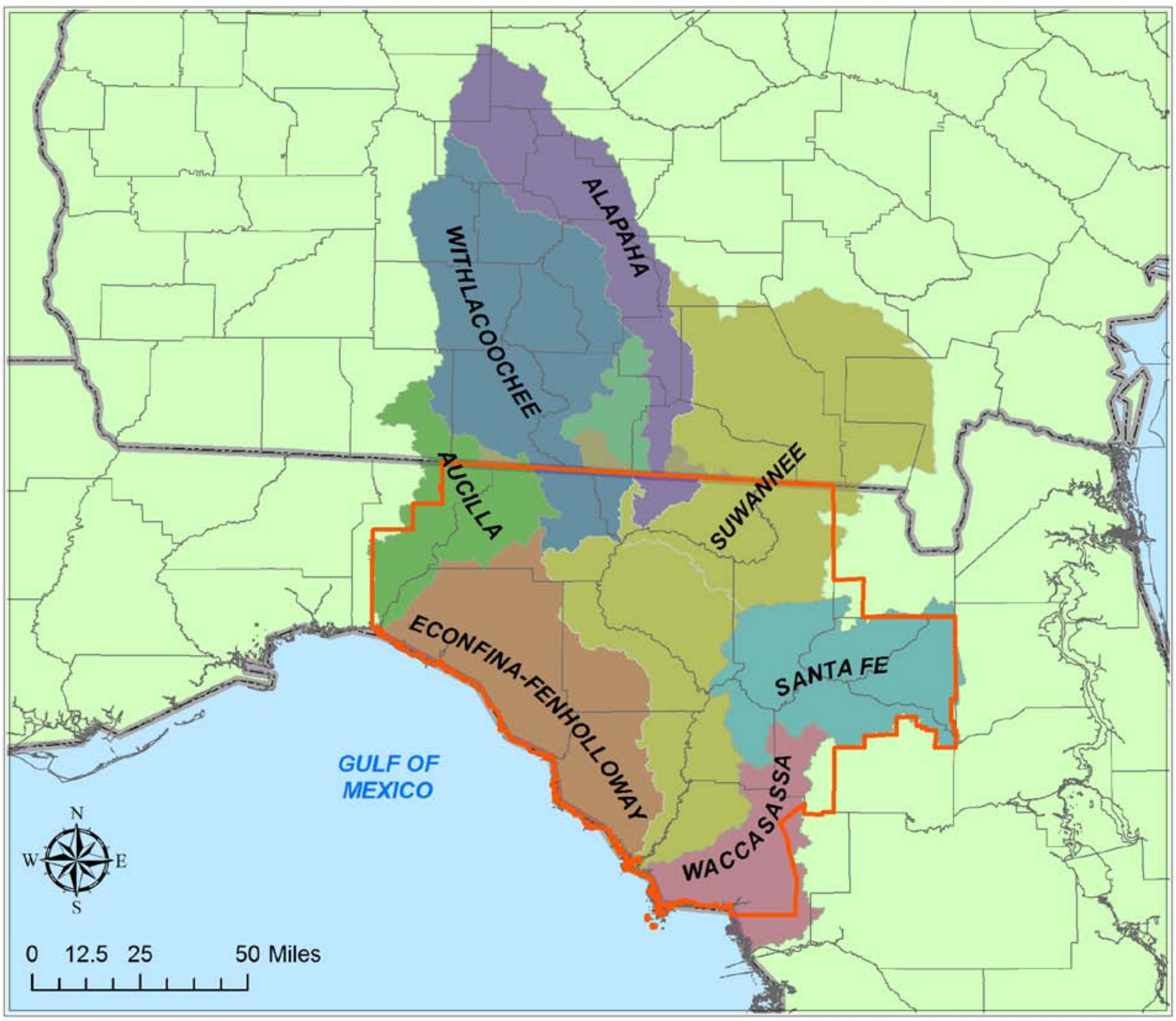

Figure 1-4. Basins of the Major Rivers in the District and their Extent in the State of Georgia.

Section 2. Geology and Hydrogeology

The uppermost geologic unit in the District consists of the Pliocene- and Quaternary-aged (Pleistocene/Holocene) surficial sand deposits. These deposits are undifferentiated and may

include shell and clay horizons. They were primarily formed by deposition associated with marine terraces and by erosion and chemical weathering of pre-existing strata. In many places throughout the District, these undifferentiated surficial sands represent the surficial aquifer system.

Underlying the surficial sands is the Miocene-age Hawthorn Group. The Hawthorn Group is largely undifferentiated and is present in the northern and northeastern portions of the District. In general, the Hawthorn Group is absent below the Cody Scarp. It consists of interbedded clay, sand, and carbonate strata (Scott, 1988). Clay beds and other low-permeability units within the Hawthorn Group (e.g., clayey sands and sandy or silty clays) impede recharge from the surface into the underlying limestone. The permeable units within the Hawthorn Group (e.g., sands and limestone) are able to transmit water on a limited basis for such uses as domestic self supply or livestock watering; however, they do not transmit water in great enough quantity to serve as regional sources of water. Collectively, the Hawthorn Group represents the intermediate aquifer system/intermediate confining unit in the northern and northeastern portions of the District.

While the Miocene and Plio-Pleistocene strata are predominantly composed of siliciclastic materials (sand, clay, silt) interbedded with carbonate-rich strata, the underlying strata are predominantly composed of limestone and/or dolostone. These consolidated geologic units include (in descending order) the Oligocene-age Suwannee Limestone, Eocene-age Ocala Limestone, and middle Eocene-age Avon Park Formation, and early Eocene-age Oldsmar Formation. These strata comprise the Upper Floridan aquifer and, where present, the mid-Floridan confining unit in the District. The Ocala Limestone, the uppermost section of the Upper Floridan aquifer in the majority of the District, is also the primary source of groundwater for all water-use categories in the District. The Suwannee Limestone overlies the Ocala Limestone in places (particularly in portions of Madison, Hamilton, Suwannee, and Taylor Counties, and along major streams), and ranks second in groundwater production.

The Floridan aquifer system in the Suwannee River Water Management District is only a small portion of the entire Floridan aquifer system that extends throughout the Floridan peninsula and into the coastal reaches of Mississippi, Alabama, Georgia, and South Carolina. Figure 1-5 shows the extent of the Floridan aquifer system in the southeastern United States (adapted from USGS, 2010).

Table 1-1 depicts the lithostratigraphic (geologic formation) as well as the hydrostratigraphic (aquifer system) nomenclature used to characterize the shallow geologic and hydrogeologic units in the District. Typically, the presence or absence of the Hawthorn Group determines whether the Upper Floridan aquifer is confined/semi-confined or unconfined, respectively (Figure 1-6). In addition, the relative recharge rate is generally inversely proportional to the degree of confinement (i.e., the less confinement, the higher the recharge).

Figure 1-5. Extent of the Floridan Aquifer System in the Southeastern United States.

Table 1-1. Generalized Lithostratigraphic Column and Aquifer Systems in the District.

Lithostratigraphic (Rock) Nomenclature			Aquifer System
System	Series	Formation	
Quaternary	Holocene/Pleistocene	undifferentiated sands	surficial aquifer system
Tertiary	Pliocene	undifferentiated sands	surficial aquifer system
Tertiary	Miocene	Hawthorn Group St. Mark's Formation	Intermediate aquifer system/intermediate confining unit
Tertiary	Oligocene	Suwannee Limestone	Upper Floridan aquifer
Tertiary	Eocene	Ocala Limestone Avon Park Formation Oldsmar Formation	Upper Floridan aquifer
Tertiary	Paleocene	Cedar Keys Formation	Mid-Floridan Confining Unit

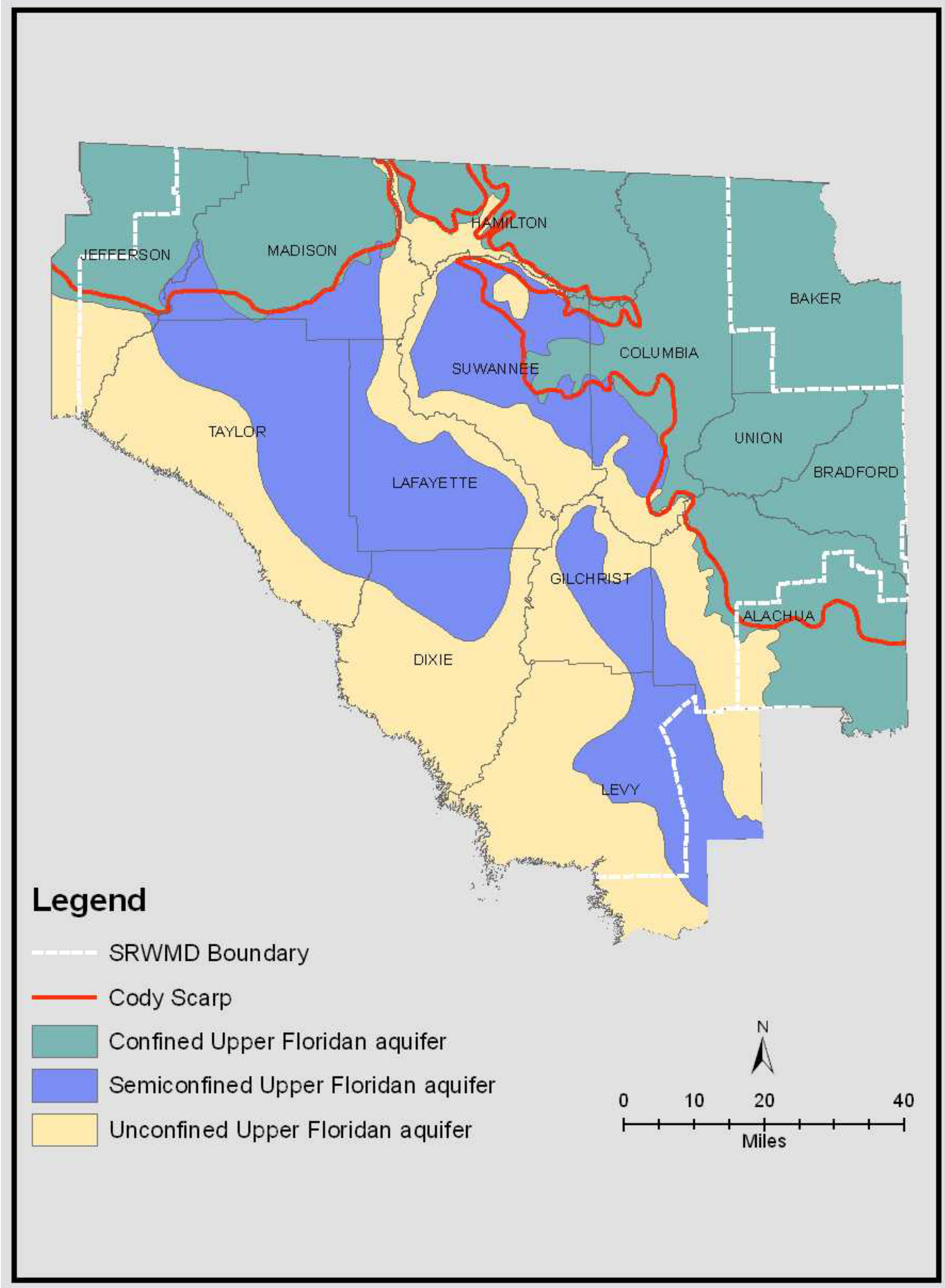

Figure 1-6. Confinement Conditions of the Upper Floridan Aquifer in the District.

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Part 1. Introduction

To understand the potential impacts of future water demands on the water resources of the District, detailed water use projections were developed and incorporated into the Water Supply Assessment for the 2010-2030 planning period. The water use projections are a key component of the groundwater impact model and the delineation of Water Supply Planning Regions/Water Resource Caution Areas and in determining the necessity of developing alternative water sources and improving water conservation efforts. Demand projections were developed for the following use categories; public supply, domestic self supply, agriculture, industrial/commercial/institutional, thermo-electric power generation, and recreation. Descriptions of these categories are listed below.

- Public Water Supply - includes all municipal, public, and private systems that supply potable water for a variety of uses.
- Domestic Self Supply - includes self-supplied domestic uses generally associated with single family residences.
- Agriculture - includes water used for livestock watering, overhead irrigation, flood irrigation, low-volume irrigation, and nursery operations.
- Industrial/Commercial/Institutional - includes self-supplied entities and does not include a number of entities served by public supply utilities within the District. This use category includes small and large businesses, aquaculture operations, mining/mineral processing operations, timber processing operations, heavy and light industrial facilities, water bottling plants, manufacturers, churches, schools, prisons, and government offices.
- Thermo-Electric Power Generation - includes water that is used consumptively in the electric power generating process. Typically, a large portion of this water is discharged into the atmosphere as steam, while a small portion is discharged to ground or surface waters. Within the District, all water needs for this use category during the planning period are assumed to come from groundwater for the purposes of predictive groundwater modeling. This category does not include water used from rivers or other surface water bodies for pass-through, non-consumptive cooling purposes.
- Recreational - includes water for aesthetic uses, golf course irrigation, landscape irrigation, irrigation of turf at sports complexes, aquatic recreation facilities, and the augmentation of ponds and fountains.

Two sets of demand projections were developed for the Water Supply Assessment. The first is a “low-range” projection that is based on a rigorous analysis of established growth trends within the study area. These projections were developed using a geographic information system (GIS)-based methodology that modeled increases in population and water use within the District and the North Florida Model area (Figure 1-2 and Chapter 3). Data from multiple sources was processed, aggregated, and standardized to create the final database of water demands for each withdrawal point. Different assumptions and methods were used for each water category to obtain realistic projections based on current trends and water use practices. Water demands for each use category were projected for each five-year increment between 2010 and 2030 for an area encompassing the District and parts of the State of Georgia, the St. John’s River Water Management District, the Northwest Florida Water Management District, and the Southwest Florida Water Management District (Figure 1-2).

The second set of projections are "high-range" demands that were developed from the knowledge of District staff as to potential new residential developments, agricultural operations, industrial parks, and power generating facilities. The high-range projections were developed in response to concerns that the low-range projections might not adequately address a potential peak growth scenario. Information used to determine the high-range demand projections included data obtained from water use permit or site certification pre-application meetings, Developments of Regional Impacts plans, and other data supplied by developers, municipalities, and agricultural entities. The high-range scenario represents demands which are in excess of the established growth trends for each water use category captured in the low-range projections.

It is important to note that the demand projections reflect demands for groundwater. While groundwater is the principal source of supply for consumptive uses in the District, surface water is also used, albeit to a much lesser extent, for cooling of thermo-electric power plants and for agricultural irrigation. The following sections describe the projection methodologies and present the water demands by use category for the planning period.

Part 2. Low-Range Demand Projections

Section 1. Low-Range Public Supply Demand Projections

1.0 Public Supply Base Data Development

A number of data sets were used to develop the population and water use estimates. The following sections present the methodology and assumptions that were used in the development of the water use projections database.

2.0 Public Water Supply Service Area Boundaries

For each public water supply entity which produces 0.1 million gallons per day or more, service area boundaries were developed within a GIS database. The service area boundaries were developed from a variety of sources listed below.

- County GIS data libraries
- Interviews with municipal utility staff and utility consultants
- City limits GIS data
- Water main line data
- Urban service area GIS boundary data
- Florida Department of Revenue parcels
- Aerial imagery

Figure 2-1 is a map of the public supply service areas delineated in support of the water use demand projections.

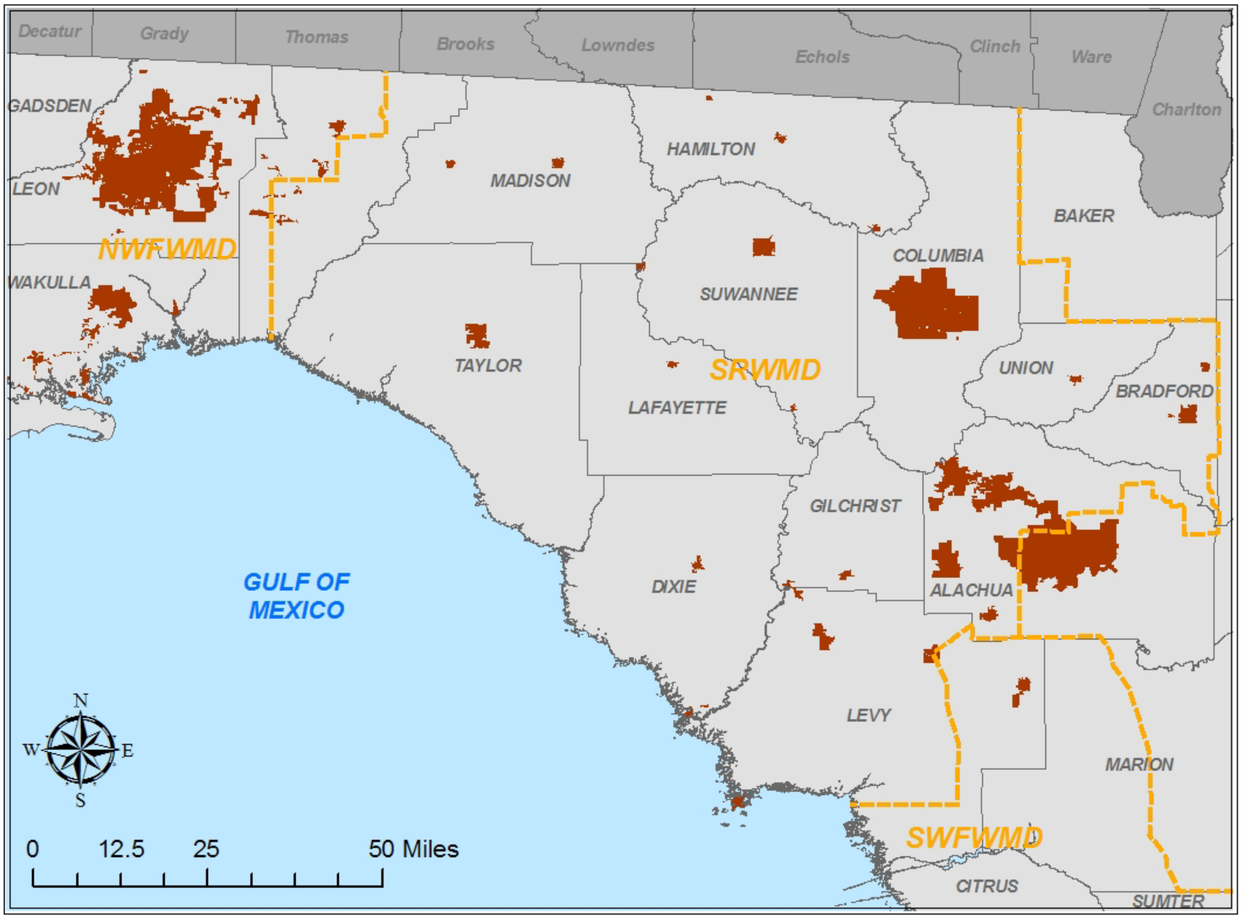


Figure 2-1. Public Supply Service Areas.

3.0 Public Water Supply Service Area Population Projections and Per Capita Water Use

A preliminary step in projecting public water supply water use is generating population projections for each public water supply service area. Baseline population estimates for public water supply service areas were created using population data from the year 2000 US Census. Population growth rates and estimates for the period from 2010 to 2030 were calculated by applying historic and projected growth data from the University of Florida's Bureau of Economic and Business Research 2008 population statistics report to the 2000 US Census baseline dataset. These population and growth rate calculations reflect the diminished population growth trends (through the year 2008) associated with the first half of the economic downturn. A weighted growth rate was applied to each census tract (within the North Florida Model area) within the counties of the District and Northwest Florida Water Management District to project future populations. Census tract population growth projections produced by the Southwest Florida and St. John's River Water Management Districts in support of their 2008 and 2010 planning efforts were used in the portions of those districts encompassed by the North Florida Model area. For the counties in Georgia within the North Florida Model area, populations were projected county-wide instead of at the census tract level. The population projections for the Suwannee River,

Northwest, St. John's, and Southwest Florida Water Management Districts, and for portions of southern Georgia were then aggregated into a comprehensive geo-database. Table 2-1 is the projected public supply service area population in five-year increments for the planning period and the per capita water use averaged for the five-year period from

Table 2-1. Public Supply Service Area Population Projections.

Public Water Supply Service Area Name	Water Mgmt. District	Per Capita Use (gpd)[1]	2010	2015	2020	2025	2030	Planning Period Increase
Advent Village	SRWMD	210.95	700	700	700	700	700	0
City of Alachua	SRWMD	188.18	7,486	8,131	8,652	9,153	9,623	2,137
City of Archer	SRWMD	84.8	1,680	1,799	1,895	1,988	2,075	395
Brandon-Brent/Verndale	SRWMD	110.69	223	232	240	248	255	32
Town of Branford	SRWMD	95.09	1,297	1,413	1,519	1,622	1,717	420
Town of Bronson	SRWMD	178.37	1,275	1,421	1,552	1,682	1,801	526
Town of Cedar Key	SRWMD	169.03	942	1,024	1,098	1,173	1,240	298
Town of Chiefland	SRWMD	157.81	2,666	2,803	2,925	3,047	3,159	493
Clayton Smith S/D	SRWMD	206.78	936	936	936	936	936	0
City of Cross City	SRWMD	226.96	3,048	3,314	3,558	3,780	4,002	954
Fanning Springs	SRWMD	169.51	832	915	990	1,064	1,134	302
Gainesville Reg. [2]	SJRWMD[3]	142.53	207,489	221,605	232,790	238,966	244,801	37,312
City of Greenville	SRWMD	110.87	1,159	1,159	1,159	1,159	1,159	0
City of High Springs	SRWMD	131.08	3,566	3,809	4,006	4,195	4,372	806
City of Jasper	SRWMD	168.17	4,000	4,000	4,000	4,000	4,000	0
Town of Jennings	SRWMD	132.85	966	966	966	966	966	0
City of Lake Butler	SRWMD	134.55	1,925	1,925	1,925	1,925	1,925	0
City of Lake City	SRWMD	165.44	21,428	22,568	23,611	24,631	25,560	4,132
Town of Lawtey	SRWMD	249.84	823	871	919	963	1,003	180
City of Live Oak	SRWMD	154.44	7,592	7,947	8,270	8,582	8,873	1,281
City of Madison	SRWMD	212.67	5,402	5,576	5,751	5,900	6,049	647
City of Mayo	SRWMD	169.44	1,264	1,264	1,264	1,264	1,264	0
Melton Bishop S/D	SRWMD	119.31	1,632	1,677	1,719	1,760	1,798	166
City of Newberry	SRWMD	178.22	3,480	3,787	4,031	4,304	4,549	1,069
City of Perry	SRWMD	206.57	8,007	8,069	8,124	8,179	8,229	222
Seally Pine Ridge	SRWMD	141.99	198	212	225	238	250	52
City of Starke	SRWMD	135.57	6,608	6,781	6,955	7,114	7,261	653
Town of Suwannee	SRWMD	106.38	940	940	940	940	940	0
Town of Trenton	SRWMD	124.59	1,850	1,850	1,850	1,850	1,850	0
White Springs	SRWMD	92.74	1,400	1,400	1,400	1,400	1,400	0
Total (Per Capita is Average)		**155.85**	**300,814**	**319,094**	**333,970**	**343,729**	**352,891**	**52,077**

[1]Per Capita Use is the average amount of water, in gallons per day, used by each person in a service area; calculated by dividing the average daily use by the population, also known as gross per capita use.
[2]Only a portion of the Gainesville Regional Utilities population is in the Suwannee River Water Management District. Although several NWFWMD utility service areas also extend into the District, no associated withdrawals are located in the District.
[3]Indicates that Public Supply Service Area extends into SRWMD, but the majority of the withdrawal facilities are located outside of the District.

2003 to 2008 for each service area. The table shows that most of the public supply service areas are projected to exhibit continued growth over the planning period, but a few are not projected to expand service to future water customers or are already built to capacity. By 2030, the population within the public supply service areas located wholly or partially within the Suwannee River Water Management District is projected to be more than

350,000. It is important to note that a significant portion of this is attributed to the Gainesville Regional Utilities service area, which is mostly within the St. John's River Water Management District, but overlaps into the Suwannee River Water Management District.

Table 2-2 is the Bureau of Business and Economic Research medium projected population for each county in the District. It is important to note that Alachua, Baker, Jefferson, and Levy counties are split between two water management districts and significant portions of their populations are located outside the District. The residential and domestic water supply needs outside of the public supply service areas are self-supplied, mainly through private wells. These areas are projected to experience steady population growth over the planning period.

Table 2-2. Bureau of Economic and Business Research Medium Population Projections.

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	253,400	269,900	283,200	296,000	308,000	54,600
Baker	26,400	28,400	30,200	31,900	33,500	7,100
Bradford	29,600	30,900	32,200	33,400	34,500	4,900
Columbia	67,700	72,700	77,300	81,800	85,900	18,200
Dixie	16,300	17,500	18,600	19,600	20,600	4,300
Gilchrist	17,800	19,700	21,500	23,200	24,900	7,100
Hamilton	14,900	15,400	15,800	16,200	16,600	1,700
Jefferson	14,700	15,300	15,800	16,300	16,700	2,000
Lafayette	9,200	10,100	10,500	10,800	11,100	1,900
Levy	41,400	45,200	48,600	52,000	55,100	13,700
Madison	20,300	21,000	21,700	22,300	22,900	2,600
Suwannee	42,800	46,100	49,100	52,000	54,700	11,900
Taylor	22,900	23,900	24,800	25,700	26,500	3,600
Union	16,100	16,900	17,600	18,400	19,100	3,000
Total	**593,500**	**633,000**	**666,900**	**699,600**	**730,100**	**136,600**

4.0 Public Water Supply Methodology and Demand Projections

The public supply demand projections were determined by multiplying the average gross per capita water use rate by the projected population for each five-year increment (Table 2-1). Table 2-3 is the projected public supply water demand for the major public supply utilities in the District for the planning period (those that use more than 0.1 million gallons per day). The table was included to provide perspective on the potential for growth for all of the major population centers in the District. The table shows that Gainesville Regional Utilities is by far the largest water user and is projected to increase its use by approximately 5.5 million gallons per day during the planning period. Much of this increase will not be supplied by groundwater produced in the District because most of Gainesville Regional Utilities' groundwater production occurs in the St. John's River Water Management District.

Table 2-4 shows the increase in demand for all public and private supply utilities in each county regardless of their magnitude of use. For the counties that are split between water

Table 2-3. Low-Range Public Supply Demand Projections for the Planning Period for Utilities[1].

Utility Owner	Public Water Supply Service Area Name	Water Management District	2010	2015	2020	2025	2030	Planning Period Increase
Advent Village	Advent Village	SRWMD	0.148	0.148	0.148	0.148	0.148	0
City Of Alachua	Alachua, City Of	SRWMD	0.846	0.918	0.978	1.032	1.086	0.24
City Of Alachua	Turkey Creek Utilities	SRWMD	0.564	0.612	0.652	0.688	0.724	0.16
City Of Archer	Archer, City Of	SRWMD	0.142	0.153	0.161	0.169	0.176	0.034
City Of Chiefland	Chiefland, Town Of	SRWMD	0.42	0.441	0.462	0.48	0.498	0.078
City Of High Springs	High Springs, City Of	SRWMD	0.467	0.499	0.525	0.55	0.573	0.106
City Of Jasper	Jasper, City Of	SRWMD	0.673	0.673	0.673	0.673	0.673	0
City Of Lake Butler	Lake Butler, City Of	SRWMD	0.259	0.259	0.259	0.259	0.259	0
City Of Lake City	Brandon-Brent/Verndale	SRWMD	0.024	0.026	0.028	0.028	0.028	0.004
City Of Lake City	Lake City, City Of	SRWMD	3.816	4.008	4.186	4.368	4.524	0.708
City Of Lake City	Seally Pine Ridge S/D	SRWMD	0.028	0.03	0.032	0.034	0.036	0.008
City Of Lawtey	Lawtey, Town Of	SRWMD	0.206	0.218	0.23	0.241	0.251	0.045
City Of Madison	Madison, City Of	SRWMD	1.149	1.185	1.224	1.254	1.287	0.138
City Of Newberry	Newberry, City Of	SRWMD	0.62	0.676	0.72	0.768	0.812	0.192
City Of Perry	Perry, City Of	SRWMD	1.656	1.668	1.68	1.688	1.7	0.044
City Of Starke	Starke, City Of	SRWMD	0.897	0.918	0.942	0.963	0.984	0.087
Gainesville Regional Utilities	Gainesville Regional Utilities	SJRWMD[2]	30.81	32.91	34.56	35.475	36.345	5.535
Jefferson Communities	Jefferson Communities	NWFWMD[3]	0.189	0.189	0.189	0.189	0.189	0
City of Live Oak	Live Oak, City Of	SRWMD	1.173	1.227	1.277	1.325	1.37	0.197
City of Monticello	Monticello, City Of	NWFWMD[3]	0.704	0.736	0.76	0.788	0.808	0.104
Town Of Branford	Branford, Town Of	SRWMD	0.123	0.135	0.144	0.153	0.162	0.039
Town Of Bronson	Bronson, Town Of	SRWMD	0.228	0.252	0.276	0.3	0.321	0.093
Town Of Cedar Key	Cedar Key, Town Of	SRWMD	0.159	0.173	0.186	0.198	0.21	0.051
Town Of Cross City	Cross City, City Of	SRWMD	1.154	1.254	1.346	1.43	1.514	0.36
Town Of Fanning Springs	Fanning Springs, Town Of	SRWMD	0.14	0.156	0.168	0.18	0.192	0.052
Town Of Greenville	Greenville, City Of	SRWMD	0.128	0.128	0.128	0.128	0.128	0
Town Of Jennings	Jennings, Town Of	SRWMD	0.128	0.128	0.128	0.128	0.128	0
Town Of Mayo	Mayo, City Of	SRWMD	0.213	0.213	0.213	0.213	0.213	0
Town Of Suwannee	Suwannee, Town Of	SRWMD	0.1	0.1	0.1	0.1	0.1	0
Town Of Trenton	Trenton, Town Of	SRWMD	0.231	0.231	0.231	0.231	0.231	0
Town Of White Springs	White Springs, City Of	SRWMD	0.13	0.13	0.13	0.13	0.13	0

[1] Quantities are shown in million gallons per day.
[2]The total increase during the planning period is 8.3 mgd. Most of this increase is attributed to Gainesville Regional Utilities and most of this will occur in the St. John's River Water Management District.
[3]Indicates that public supply service area extends into Suwannee River Water Management District, but some or all withdrawal facilities may be located outside of the District.

management districts, only the portion of their groundwater withdrawals that are produced in the District are included. The table shows an increase of approximately 4.08 million gallons per day, or 17.5 percent. In most of the counties in the District, demand is projected to increase substantially during the planning period. Public water supply demands in Alachua, Columbia, Dixie, Levy, and Suwannee Counties are each projected to grow by more than 30 percent during the planning period.

Table 2-4. Low-Range Public Supply Demand Projections for the Planning Period by County[1].

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	3.21	3.45	3.65	3.85	4.03	0.83
Baker	0.27	0.30	0.32	0.35	0.37	0.10
Bradford	2.16	2.26	2.35	2.37	2.53	0.37
Columbia	5.46	5.72	5.96	6.20	6.41	0.95
Dixie	1.49	1.61	1.72	1.81	1.91	0.43
Gilchrist	0.35	0.35	0.35	0.35	0.36	0.01
Hamilton	1.59	1.61	1.62	1.63	1.64	0.05
Jefferson	0.22	0.23	0.23	0.24	0.25	0.03
Lafayette	0.38	0.40	0.41	0.42	0.43	0.04
Levy	1.27	1.36	1.44	1.51	1.58	0.31
Madison	1.49	1.53	1.58	1.62	1.65	0.16
Suwannee	2.43	2.58	2.71	2.83	2.95	0.51
Taylor	2.31	2.38	2.44	2.49	2.54	0.23
Union	0.66	0.68	0.69	0.71	0.72	0.05
Total	**23.30**	**24.44**	**25.47**	**26.38**	**27.37**	**4.08**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Section 2. Low-Range Domestic Self-Supply Demand Projections

1.0 Domestic Self-Supply Base Data Development

Domestic self-supplied demand projections were developed by applying census tract growth rates established from US Census and Bureau of Business Economic Research data, in a manner similar to the public supply projection methodology. The census tract population projections were multiplied by domestic self-supply estimated per capita averages to determine groundwater demands for each five-year increment of the planning period. Table 2-5 is the projected domestic self supply water demand for the planning period. The table shows that demand will increase by 4.98 million gallons per day, or 26.4 percent.

Section 3. Low-Range Agricultural Demand Projections

Estimates of agricultural groundwater use within the District were produced by the District and US Geological Survey for 2005 for use in the North Florida Model (Table 2-6). For the low-range projections, agricultural demands were held at the estimated year 2005 quantities for the planning period. This decision was based on the fact that in the South Florida, Southwest, and St. John's River Water Management Districts, agricultural activities are expected to decline over the next several decades due to displacement of agricultural lands by urban development, the North American Free Trade Agreement and other global competition issues, and destructive insect and disease outbreaks.

Table 2-5. Low-Range Domestic Self-Supply Demand Projections[1].

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	3.32	3.57	3.78	3.97	4.16	0.83
Baker	0.03	0.04	0.04	0.04	0.05	0.01
Bradford	1.70	1.79	1.87	1.94	2.01	0.31
Columbia	3.64	3.98	4.29	4.59	4.86	1.22
Dixie	0.94	1.01	1.08	1.14	1.21	0.26
Gilchrist	1.01	1.11	1.21	1.30	1.39	0.39
Hamilton	0.69	0.71	0.74	0.76	0.79	0.10
Jefferson	0.38	0.39	0.41	0.42	0.43	0.05
Lafayette	0.57	0.62	0.65	0.68	0.70	0.13
Levy	1.34	1.46	1.57	1.67	1.77	0.43
Madison	1.18	1.23	1.28	1.33	1.37	0.19
Suwannee	2.32	2.51	2.68	2.85	3.01	0.68
Taylor	1.07	1.12	1.18	1.23	1.28	0.21
Union	0.68	0.72	0.75	0.78	0.82	0.14
Total	**18.87**	**20.26**	**21.53**	**22.70**	**23.85**	**4.98**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Table 2-6. Low-Range Agricultural Demand Projections[1].

County	2010 - 2030
Alachua	19.69
Baker	0.00
Bradford	0.95
Columbia	5.74
Dixie	1.86
Gilchrist	13.96
Hamilton	19.33
Jefferson	8.72
Lafayette	7.01
Levy	14.47
Madison	11.35
Suwannee	20.77
Taylor	1.86
Union	1.73
Total	**127.44**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Section 4. Low-Range Industrial/Commercial/Institutional Demand Projections

1.0 Base Data Development and Projection Methodology

Industrial/commercial/institutional groundwater users were extracted from the North Florida Model dataset. The baseline industrial/commercial/institutional demands from the North Florida Model area were generated from District and US Geological Survey water

use estimates for the year 2000. The demands were updated for the planning period through a "growth" or "no growth," determination that was based on the likelihood of an increase in water demand. Institutional entities such as schools and prisons were assigned growth rates based on intersecting census tract growth trends, similar to the method used for development of the public supply data base. Other institutional entities such as military bases, which are not expected to grow, were assigned a "no growth" designation and groundwater demands were held at the year 2000 estimates. For entities expected to grow concurrently with population growth, such as religious institutions, schools, and prisons, growth rates were assigned based on census tract growth trends, in a manner similar to how public supply growth trends were calculated.

2.0 Industrial/Commercial/Institutional Demand Projections

Table 2-7 is the projected industrial/commercial/institutional demand for the planning period. The table shows that demands are projected to increase during the planning period for most of the counties in the District. Counties with the greatest projected increases are Columbia, Hamilton, and Suwannee. Districtwide, industrial/commercial/institutional demands are projected to increase by 0.97 million gallons per day or 1.1 percent for the planning period. Bottled water demands are reflected in the industrial/commercial/institutional projections and account for approximately 1.7 percent of the total demand for this use sector by the year 2030.

Table 2-7. Low-Range Industrial/Commercial/Institutional Demand Projections[1].

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	1.72	1.72	1.73	1.73	1.74	0.02
Baker	0.00	0.00	0.00	0.00	0.00	0.00
Bradford	1.39	1.39	1.39	1.39	1.39	0.00
Columbia	0.65	0.69	0.73	0.77	0.80	0.15
Dixie	0.28	0.29	0.30	0.31	0.32	0.04
Gilchrist	0.36	0.36	0.37	0.38	0.38	0.02
Hamilton	34.78	34.86	34.92	34.98	35.05	0.27
Jefferson	0.12	0.12	0.12	0.12	0.12	0.00
Lafayette	0.08	0.08	0.08	0.08	0.09	0.01
Levy	0.24	0.24	0.25	0.25	0.25	0.01
Madison	0.80	0.80	0.80	0.80	0.80	0.00
Suwannee	1.91	2.02	2.12	2.21	2.30	0.39
Taylor	42.17	42.19	42.20	42.21	42.22	0.05
Union	0.22	0.22	0.23	0.23	0.23	0.01
Total	**84.72**	**84.98**	**85.24**	**85.46**	**85.69**	**0.97**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Section 5. Low-Range Thermo-Electric Power Generation Demand Projections

1.0 Base Data Development

To project the quantities of water needed for power generation facilities during the planning period, a spatially enabled database for all electricity-producing facilities within the North Florida Model area was created. Each facility was attributed with historical water use, generating capacity (megawatts), planned capacity expansion, planned expansion date, type (turbine, combined cycle, steam), fuel source (coal, petroleum coke, natural gas, oil), and water source (ground, surface or reclaimed). Attribute data was compiled from the water use permit databases, interviews with suppliers, and information from the U.S Department of Energy, Energy Information Administration, and the Florida Public Service Commission.

The average daily water use per power generation capacity unit (gallons per megawatt) for various power generation types and fuel sources was calculated. This value was used as a proxy to project water use. For power plant types that lacked comparable examples, proxies were developed from the Department of Energy Published values (Stiegel 2005).

The Florida Public Service Commission requires that each power generating utility produce detailed 10-year site plans for its facilities. These include plans to expand the power generation capacity of the facility. The 2006 10-year site plans for each electric utility in the North Florida Model area were downloaded from the Florida Public Service Commission website. Most utilities detailed the exact locations and capacity of their planned expansion. However, some expansions lacked details in their plans and required additional research.

For power generating facilities with a planned capacity expansion, power generation capacity projections, in megawatts, were interpolated between the existing capacity and the planned capacity, as detailed in the 10-year site plan. The projection of power generation capacities beyond the planned expansion (2016) was done with a linear extrapolation from the existing and planned expansion date.

2.0 Power Generation Demand Projection Methodology

Water demand was projected for the planning period by multiplying a facility's capacity by the historical value of gallons per megawatt. For facilities where water use data was unavailable, the average values for facilities of the same type and fuel source were used. Water use values for facilities with no planned expansion were kept constant at 2005 levels.

Water used for once-through cooling and recirculation and for all other uses associated with thermoelectric power generation was identified and categorized. This distinction was made because the use of water for once-through cooling and recirculation is generally considered to be non-consumptive, since it is typically returned to the same source from which it was withdrawn without an appreciable decrease in quantity. Only uses other than those for once-through cooling and recirculation are considered in the total water use reported.

For the low-range demand projections, an increase of approximately 1.48 million gallons per day is projected between 2010 and 2030. Currently, there are only two power generation facilities within the District using groundwater for cooling purposes. The other power generation facilities within the District use once-through cooling systems, which utilize river water for non-consumptive cooling purposes. Table 2-8 is the projected thermo-electric power demand for the planning period.

Table 2-8. Low-Range Thermo-Electric Power Generation Demand Projections[1].

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	2.52	2.88	3.24	3.61	3.98	1.46
Bradford	0.00	0.00	0.00	0.00	0.00	0.00
Columbia	0.00	0.00	0.00	0.00	0.00	0.00
Dixie	0.00	0.00	0.00	0.00	0.00	0.00
Gilchrist	0.00	0.00	0.00	0.00	0.00	0.00
Hamilton	0.00	0.00	0.00	0.00	0.00	0.00
Jefferson	0.00	0.00	0.00	0.00	0.00	0.00
Lafayette	0.00	0.00	0.00	0.00	0.00	0.00
Levy	0.00	0.00	0.00	0.00	0.00	0.00
Madison	0.07	0.07	0.08	0.08	0.08	0.01
Suwannee	0.00	0.00	0.00	0.00	0.00	0.00
Taylor	0.00	0.00	0.00	0.00	0.00	0.00
Union	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2.59**	**2.95**	**3.32**	**3.69**	**4.06**	**1.48**

[1]Quantities are shown in million gallons per day.

Section 6. Low-Range Recreational Demand Projections

Baseline estimates of recreational water uses were generated from District water use estimates for the year 2000. Recreational self-supplied usage was projected to increase in a pattern concurrent with projected population growth. Table 2-9 is the projected recreational demand for the planning period. Demand is projected to increase 0.4 million gallons per day, or 22.2 percent. By county, overall recreational water use is very low compared to that of the adjacent water management districts, with no county projected to be using more than 0.4 million gallons per day by 2030. The majority of this increase will likely be for irrigation of lawns, new golf courses, and new recreational/sports complexes and parks.

Table 2-9. Low-Range Recreational Demand Projections[1].

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	0.28	0.31	0.34	0.37	0.40	0.12
Bradford	0.31	0.33	0.34	0.36	0.37	0.06
Columbia	0.36	0.38	0.39	0.39	0.40	0.04
Dixie	0.00	0.00	0.00	0.00	0.00	0.00
Gilchrist	0.00	0.00	0.00	0.00	0.00	0.00
Hamilton	0.00	0.00	0.00	0.00	0.00	0.00
Jefferson	0.23	0.24	0.25	0.26	0.27	0.04
Lafayette	0.00	0.00	0.00	0.00	0.00	0.00
Levy	0.24	0.26	0.28	0.30	0.31	0.07
Madison	0.21	0.22	0.22	0.23	0.23	0.02
Suwannee	0.09	0.10	0.11	0.11	0.12	0.03
Taylor	0.08	0.09	0.09	0.10	0.10	0.02
Union	0.00	0.00	0.00	0.00	0.00	0.00
Total	**1.80**	**1.93**	**2.02**	**2.12**	**2.20**	**0.40**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Section 7. Summary of Low-Range Demand Projections

Table 2-10 is a summary of the low range demand projections for the public supply, agricultural, domestic self supply, industrial/commercial/institutional, thermo-electric power generation and recreational water use categories for the planning period in the District. The Table shows that water use is projected to increase by 11.82 million gallons per day, or 4.4 percent.

Table 2-10. Low-Range Demand Projections for All Use Categories.

Water-Use Category	2010	2015	2020	2025	2030	Planning Period Increase
Public Supply	23.30	24.44	25.47	26.38	27.37	4.08
Agricultural	127.46	127.46	127.46	127.46	127.46	0.00
Domestic Self Supply	18.87	20.19	21.45	22.63	23.76	4.89
Industrial/Commercial/Institutional	84.72	85.00	85.24	85.47	85.70	0.98
Thermo-Electric Power Generation	2.59	2.95	3.32	3.69	4.06	1.48
Recreational	1.81	1.92	2.02	2.11	2.20	0.40
Total	**258.73**	**261.96**	**264.95**	**267.74**	**270.55**	**11.82**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Part 3. High-Range Demand Projections

The high-range demand projections were developed from District staff's knowledge of potential new residential developments, agricultural operations, industrial parks, and power generating facilities. The high-range projections were developed in response to concerns that the low-range projections might not adequately address a potential peak growth scenario. High-range projections were developed for the public supply, agricultural, industrial/commercial/institutional,

and thermo-electric power generation use categories. High-range projections were not developed for the domestic self supply and recreational use categories due to a lack of data to indicate the potential for increases above the low-range projections.

Section 1. High-Range Public Supply Demand Projections

High-range public supply demands were developed by updating the low-range demands with data regarding potential developments which may require groundwater for public supply needs. Data used to develop the high-range projections was collected from Developments of Regional Impacts program and municipal planning data and from information collected by District staff during planning and permitting meetings and correspondence. Demands for specific potential public supply projects were added to the low-range public supply projections to arrive at the high-range demand projections. Table 2-11 is the high-range demand projections. The table shows an increase for the planning period of 10.49 million gallons per day, or 45 percent.

Table 2-11. High-Range Public Water Supply Demand Projections[1].

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	3.21	3.49	3.73	3.96	4.18	**0.97**
Baker	0.27	0.30	0.32	0.35	0.37	**0.10**
Bradford	2.16	2.26	2.35	2.37	2.53	**0.37**
Columbia	5.46	5.79	6.11	6.43	6.71	**1.25**
Dixie	1.49	1.86	2.22	2.56	2.71	**1.22**
Gilchrist	0.35	0.45	0.56	0.67	0.69	**0.34**
Hamilton	1.59	1.61	1.62	1.63	1.64	**0.05**
Jefferson	0.22	0.23	0.23	0.24	0.25	**0.03**
Lafayette	0.38	0.40	0.41	0.42	0.43	**0.05**
Levy	1.27	2.16	1.59	1.69	1.78	**0.51**
Madison	1.49	1.55	1.61	1.65	1.70	**0.21**
Suwannee	2.43	2.71	2.97	3.23	3.48	**1.05**
Taylor	2.31	2.88	4.19	5.24	6.46	**4.15**
Union	0.66	0.71	0.79	0.83	0.85	**0.19**
Total	**23.29**	**26.40**	**28.70**	**31.27**	**33.78**	**10.49**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Section 2. High-Range Agricultural Demand Projections

The low-range agricultural demands were based on the assumption that agricultural demands would not increase over the planning period. This assumption was used because agricultural activities and planted acreage have generally exhibited a declining trend on a statewide basis in recent years. Recently, however, several large agricultural operations have located or expanded their operations within the District. The agricultural high-range demand projections were developed in response to the need to account for further potential growth in the agricultural category. The high-end demands for the planning period were held to the US Geological Survey agricultural projections, which were developed in conjunction with District staff. Table 2-12 is the high-range demand projections for agriculture. The table shows an increase for the planning period of 29.3 million gallons per day, or 21.8 percent.

Table 2-12. High-Range Agricultural Demand Projections[1].

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	20.59	21.82	22.74	21.20	20.28	**-0.31**[2]
Baker	0.00	0.00	0.00	0.00	0.00	**0.00**
Bradford	0.95	0.95	0.95	0.95	0.95	**0.00**
Columbia	5.74	5.74	5.74	5.74	5.75	**0.01**
Dixie	2.03	2.29	2.43	2.63	2.76	**0.73**
Gilchrist	14.18	15.69	16.99	16.99	16.99	**2.81**
Hamilton	20.67	23.52	25.57	27.05	28.42	**7.75**
Jefferson	8.75	9.01	9.17	9.17	9.17	**0.42**
Lafayette	7.63	8.58	9.30	9.77	10.25	**2.62**
Levy	15.28	15.95	16.61	17.73	18.62	**3.34**
Madison	12.45	13.74	15.03	15.89	16.75	**4.30**
Suwannee	22.71	25.25	27.29	28.82	30.34	**7.63**
Taylor	1.86	1.86	1.86	1.86	1.86	**0.00**
Union	1.73	1.73	1.73	1.723	1.73	**0.00**
Total	**134.55**	**146.11**	**155.39**	**159.51**	**163.85**	**29.30**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.
[2]The total for Alachua County is negative due to predicted urbanization of agricultural areas.

Section 3. High-Range Industrial/Commercial/Institutional Demand Projections

District staff developed data regarding potential industrial/commercial/institutional facilities, including several commercial and industrial parks from information provided by developers. Though the development of many of these potential industrial/commercial/institutional projects is uncertain, it is important to estimate the potential high-range groundwater demand represented by each facility. To estimate the high-range demand, specific potential projects that may be developed during the planning period were added to the low-range industrial/commercial/institutional demand projections. Table 2-13 is the high-range demand projections for the industrial/commercial/institutional water use category. The table shows an increase for the planning period of 4.34 million gallons per day, or 5.1 percent.

Section 4. High-Range Thermo-Electric Power Generation Demand Projections

Several power companies have developed tentative plans or are in the process of obtaining the appropriate certifications to construct thermo-electric power generation facilities in the District during the planning period. As many of these facilities are still in the planning phases, they are not included in the Florida Public Service Commission's 10-year utility plans. Additionally, District approval of at least one of the facilities was granted after the low-range projections for the Water Supply Assessment were developed. The potential demand for each facility was determined through permitting pre-application meetings and other preliminary discussions and correspondence with District staff. Table 2-14 is the high-range demand projections for thermo-electric power generation. The table shows an increase for the planning period of 14.77 million gallons per day.

Table 2-13. High-Range Industrial/Commercial/Institutional Demand Projections[1].

County	2010	2015	2020	2025	2030	Planning Period Increase
Alachua	1.72	1.76	1.81	1.85	1.90	**0.18**
Baker	0.00	0.00	0.00	0.00	0.00	**0.00**
Bradford	1.39	1.49	1.59	1.64	1.69	**0.30**
Columbia	0.65	0.94	1.23	1.72	2.30	**1.65**
Dixie	0.28	0.29	0.30	0.31	0.32	**0.04**
Gilchrist	0.36	0.97	1.38	1.39	1.40	**1.04**
Hamilton	34.78	34.91	35.02	35.13	35.25	**0.47**
Jefferson	0.20	0.20	0.21	0.21	0.21	**0.01**
Lafayette	0.08	0.08	0.08	0.08	0.09	**0.01**
Levy	0.24	0.24	0.25	0.25	0.25	**0.01**
Madison	0.80	0.80	0.80	0.80	0.80	**0.00**
Suwannee	1.91	2.04	2.15	2.27	2.38	**0.47**
Taylor	42.17	42.19	42.20	42.21	42.22	**0.05**
Union	0.22	0.25	0.28	0.30	0.33	**0.11**
Total	**84.80**	**86.16**	**87.30**	**88.16**	**89.14**	**4.34**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Table 2-14. High-Range Thermoelectric Power Generation Demand Projections[1].

County	`2010	2015	2020	2025	2030	Planning Period Increase
Alachua	2.52	4.28	4.64	5.01	5.37	2.86
Bradford	0.00	0.00	1.20	1.20	1.20	1.20
Columbia	0.00	0.00	0.00	0.00	0.00	0.00
Dixie	0.00	0.00	0.00	0.00	0.00	0.00
Gilchrist	0.00	0.00	4.00	5.00	5.00	5.00
Hamilton	0.00	5.20	5.20	5.20	5.20	5.20
Jefferson	0.00	0.00	0.00	0.00	0.00	0.00
Lafayette	0.00	0.00	0.00	0.00	0.00	0.00
Levy	0.00	0.00	0.00	0.00	0.00	0.00
Madison	0.07	0.07	0.08	0.08	0.08	0.01
Suwannee	0.00	0.00	0.50	0.50	0.50	0.50
Taylor	0.00	0.00	0.00	0.00	0.00	0.00
Union	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2.59**	**9.55**	**15.62**	**16.99**	**17.36**	**14.77**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the Suwannee River Water Management District portion of the counties. Quantities are shown in million gallons per day.

Section 5. Summary of High-Range Demand Projections

Table 2-15 is a summary of the high-range demand projections for the public supply, agricultural, industrial/commercial/institutional, and thermo-electric power generation water use

Table 2-15. High-Range Demand Projections for All Use Categories[1].

Water-Use Category	2010	2015	2020	2025	2030	Planning Period Increase
Public Supply	23.30	26.39	28.69	31.26	33.79	10.49
Agricultural	134.54	146.11	155.39	159.51	163.85	29.31
Domestic Self Supply	18.87	20.19	21.45	22.63	23.76	4.89
Industrial, Commercial, & Institutional	84.80	86.17	87.31	88.17	89.13	4.34
Thermo-Electric Power Generation	2.59	9.55	15.62	16.99	17.36	14.77
Recreational	1.81	1.92	2.02	2.11	2.20	0.40
Total	**265.89**	**290.32**	**310.47**	**320.68**	**330.08**	**64.19**

[1]Quantities are shown in million gallons per day.

categories for the planning period in the District. The table shows that water use could increase from 265.9 million gallons per day in 2010 to 330.1 in 2030; a total of 64.19 million gallons per day, or 19.5 percent.

Part 1. Introduction

The purpose of this Chapter is to identify areas in the District where both current and projected groundwater withdrawals in the North Florida Model area (Figure 1-2) are causing or will cause unacceptable impacts to rivers and springs during the planning period. Areas where the model predicts that established minimum flows or interim flow constraints for rivers and springs have been or will be exceeded during the planning period may be designated as Water Supply Planning Regions, depending on the severity of the impacts and how early in the planning period they are predicted to occur. Within these areas, it is assumed that development of additional groundwater supplies to meet future demands will be restricted. An evaluation of the potential impacts to lakes and wetlands is being conducted and the results will be included in the appropriate Regional Water Supply Plans.

The Suwannee River Water Management District is required to ensure that sufficient water is available for all existing and future reasonable-beneficial uses and natural systems, and to avoid the adverse effects of competition for water supplies. Therefore, a Regional Water Supply Plan will be developed for designated Water Supply Planning Regions. A Regional Water Supply Plan includes alternative water supply and water resource development project options and water conservation strategies sufficient to meet projected water supply demand during the planning period. Within one year of receiving the water supply planning region designation, the area will also be designated as a Water Resource Caution Area. A Water Resource Caution Area is where existing sources of water will not be adequate to satisfy future water demands and sustain water resources.

Part 2. Methodology

Predicting the degree of current and future impacts from groundwater withdrawals was accomplished using the District's North Florida steady-state groundwater flow model. The projected groundwater demands for the 2010 to 2030 planning period in the North Florida Model area, including simulations using the District's low range and high range demand projections, were incorporated into the model and the resulting changes in flow in rivers and springs were analyzed in five-year increments. A key assumption of the modeling was that all of the projected demands in the model area during the planning period would be met by groundwater from the Upper Floridan aquifer.

The North Florida Model area includes all of the District, the majority of eight counties in Georgia, the majority of the nine northern-most counties in the St. John's River Water Management District, parts of the three northern-most counties in the Southwest Florida Water Management District and parts of the three eastern-most counties in the Northwest Florida Water Management District (Figure 1-2).

It is important to understand the distribution of groundwater withdrawals throughout the model area because the distribution has important implications for water resource impacts in the District. Figure 3-1 displays the portion of current and projected demand in the model area for the planning period that will occur in the Suwannee River, St. John's, Southwest, and Northwest Florida Water Management Districts and Georgia. The most important detail of the graph is that the magnitude of groundwater withdrawals occurring in the St. John's River Water Management

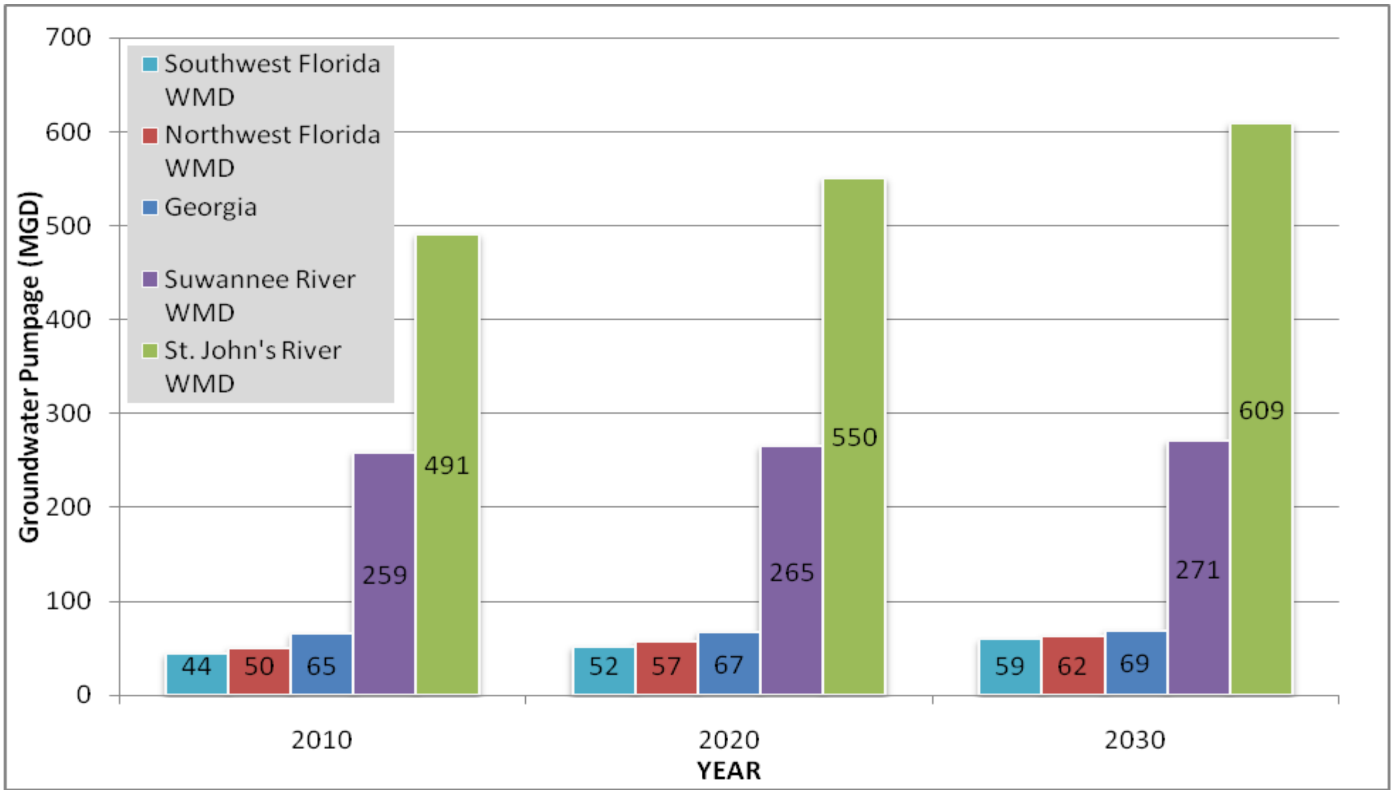


Figure 3-1. North Florida Model Area Water Demand Projections.

District's northern-most nine counties is significantly larger than the withdrawals in the entire Suwannee River Water Management District. The model predicted the impact of the projected groundwater withdrawals on surficial aquifer system water levels and potentiometric surface of the Upper Floridan aquifer. The model relates changes in the water table or potentiometric surface to flow at gages in rivers. This allows reductions in springflow and streamflow resulting from water table or potentiometric surface declines to be predicted. The reductions in flow in rivers and springs can then be compared to established minimum flows or interim flow constraints to determine whether the constraints will be exceeded during the planning period. Interim flow constraints are either draft minimum flows or estimates of minimum flows based on existing data and knowledge from District staff, consultants, and staff of other water management districts.

Section 1. Minimum Flows and Levels

1.0 Statutory and Regulatory Framework

The District is working to protect and conserve Florida's water resources through the State of Florida's statutorily mandated minimum flows and levels program. Establishing minimum flows and levels is part of the District's planning for adequate water supplies while also protecting water resources from significant harm. The District currently has minimum flows in place for several rivers and springs, and is planning the implementation of many more minimum flows and levels within the planning period. Minimum flows and levels are the minimum water levels and/or flows adopted by the District Governing Board

as necessary to prevent significant harm to the water resources or ecology of an area resulting from water withdrawals. They define how much water levels and flows may change and still prevent significant harm. Minimum flows and levels take into account the ability of water resource-dependent communities to adjust to changes in hydrologic conditions and allow for an acceptable level of change to occur and they identify a range of water levels and/or flows above which water may be permitted for consumptive use. In addition, minimum flows and levels protect non-consumptive uses of water. Non-consumptive uses include the water necessary for navigation and recreation and for fish and wildlife habitat and other natural resources (Chapter 62-40, Florida Administrative Code).

The establishment of minimum flows and levels is required by the State Legislature under Subsection 373.042(2), Florida Statutes and is required by the state Comprehensive Plan, and the water resources implementation rule (Chapter 62-40.473, Florida Administrative Code). The Districts are authorized by statute to calculate minimum flows and levels using the best available meteorological, hydrological, and ecological data. These data typically include an historical range of drought and flood conditions.

Minimum flows and levels are adopted as water management district rules (Chapter 40B-8, Florida Administrative Code) by the Governing Board of the District. Adoption is a four- to six-month process that involves public workshops, review by the Florida Department of Environmental Protection, and publication in the Florida Administrative Weekly.

Minimum flows and levels are to be reviewed periodically and revised as necessary under Subsection 373.0421(3), Florida Statutes. The minimum flows and levels program provides technical support for water supply planning, and permitting criteria for the water use permitting program (Chapter 40B-2, Florida Administrative Code) and the environmental resource permitting program (Chapter 40B-4, Florida Administrative Code). Minimum flows and levels apply to decisions affecting permit applications, declarations of water shortages and assessments of water supply sources.

The District's Governing Board is required to develop recovery or prevention strategies in those cases where a water resource currently exceeds or is predicted to exceed, within the 20-year planning period, an established minimum flow or level. The recovery strategy ensures that water will continue to be available to supply reasonable and beneficial uses either through projects that will raise groundwater levels to allow more groundwater withdrawals to be permitted or through the development of alternative water supplies.

2.0 Priority Setting Process

In accordance with the requirements of Section 373.042, Florida Statutes, the District has established and annually updates a list of priority ground and surface water resources for which minimum flows and levels will be set. As part of determining the priority list and schedule, the factors listed below are considered.

- The importance of the water resource to the District.
- The existence of or potential for significant harm to the water resources or ecology of the District.

- The required inclusion of all first magnitude springs and all second magnitude springs within state or federally owned lands purchased for conservation purposes.
- The availability of historic hydrologic records (flows and levels) sufficient to allow statistical analysis and calibration of computer models when selecting particular water resources in areas with many water resources.
- The proximity of minimum flows and levels already established for nearby water bodies.
- The possibility that the water resource may be developed as a potential water supply in the foreseeable future.
- The value of developing a minimum flow or level for regulatory purposes or water use permit evaluation.

3.0 Existing and Proposed Minimum Flows and Levels

The District's Governing Board has adopted minimum flows and levels for several water resources. Table 3-1 contains the District's current priority list showing both established and proposed minimum flows and levels for water resources in the District.

4.0 Interim Flow Constraints

The District's minimum flow and level establishment program is an ongoing process. Where minimum flows have not yet been developed for priority water resources, interim flow constraints have been developed. These interim constraints are estimates of the degree of flow reduction that would result in significant harm to a river or spring.

The established minimum flows and interim flow constraints were used to evaluate the impact of future groundwater withdrawals on rivers and springs and to estimate potential water availability from the resource for future consumptive uses. For the purposes of this Water Supply Assessment, both the established minimum flows and the interim flow constraints were applied to the major rivers and springs in the District. As a general rule, an interim flow constraint is set at 90% of the historic or baseline flow to preserve riparian habitats and allow fish passage. This means that 90% of the time the actual flow equals or exceeds the historical flow. Table 3-2 shows the allowable river and spring flow reductions resulting from groundwater withdrawals based on established minimum flows and interim flow constraints (shown as a percent of the total flow duration curve) for river and spring systems used in this analysis.

Table 3-1. Proposed 2011 Minimum Flow and Level Priority List[1].

Basin	**Rivers**		**Schedule**
Santa Fe	Lower Santa Fe		2011
Suwannee	Middle Suwannee		2012
Suwannee	Alapaha, Upper Suwannee, Withlacoochee		2014
Aucilla	Aucilla, Wacissa		2016
Coastal	Steinhatchee, Econfina, Fenholloway		
Suwannee	Lower Suwannee		Established
Santa Fe	Upper Santa Fe		
Waccasassa	Waccasassa		
Basin	**Spring Systems**	**Magnitude**	**Schedule**
Santa Fe	Rum Island, COL 101974 Unnamed, Poe	2	2011
Santa Fe	Blue Hole, Ichetucknee Group, GIL 1012973 (Siphon Creek Rise), July, Columbia, ALA112971 (Treehouse), Hornsby, Santa Fe Rise, Devil's Ear (Ginnie Group)	1	
Suwannee	White	2	
Suwannee	Bell, Royal	3	2012
Suwannee	Hart, Rock Sink, Guaranto, Pothole, Otter, Branford, Little River, Ruth/Little Sulphur, Peacock, Bonnet, Allen Mill Pond, Charles	2	
Suwannee	Troy, Lafayette Blue	1	
Suwannee	Anderson, Lime, SUW923973 (Stevenson), SUW1017972 Unnamed, Suwannee	2	2014
Suwannee	Falmouth, Lime Run Sink, Alapaha Rise, Holton Creek Rise	1	
Withlacoochee	Suwanacoochee, Pot	2	
Aucilla	Nutall Rise, Wacissa Group	1	2016
Coastal	Big, TAY76992 – Unnamed	2	
Coastal	Steinhatchee Rise	1	
Suwannee	Fanning, Manatee	1	Established
Waccasassa	Levy (Bronson) Blue	3	
Withlacoochee	Madison Blue	1	
Basin	**Lakes**		**Schedule**
Santa Fe	Alligator, Altho, Ocean Pond, Butler, Crosby, Hampton, Palestine, Sampson, Santa Fe,		2015
Coastal	Andrews, Governor Hill		2015
Aucilla	Snead's Smokehouse		2015
Suwannee	Low		2015
Withlacoochee	Cherry		2015

[1] For additional information on established MFLs, refer to SRWMD Rule 40B-8.

Table 3-2. Allowable River and Spring Flow Reductions.

USGS Gage	Description	Rivers	Springs	MFL Rule	Draft MFL Document	Seasonal MFL	Comments
02313700	Waccasassa River nr Gulf Hammock	12.5%	10.0%	Yes	n/a	No	Local MFL
02315500	Suwannee River at White Springs	3.1%	0.0%	No	No	No	Interim Constraint; Projected from Ellaville; White Spring set to 0% due to existing impacts.
02317620	Alapaha River nr Jennings[1]	0%	n/a	No	Yes	No	Local MFL
02319302	Blue Spring nr Madison	n/a	10.7%	Yes	n/a	No	Local MFL; Based on 1982-2002 Baseline FDC shift at 90% from 78.4 to 70 cfs.
02319500	Suwannee River at Ellaville	3.1%	5.0%	No	Yes	Yes	Interim Constraint; April/May & September/October 0% available when flow below 1820 cfs (Sturgeon).
02320500	Suwannee River at Branford	10.5%	5.0%	No	Yes	No	Interim Constraint
02320700	Santa Fe River nr Graham	0%	n/a	Yes	n/a	No	Local MFL
02321500	Santa Fe River at Worthington Springs	0%	n/a	Yes	n/a	No	Local MFL
02322500	Santa Fe River nr Ft. White	4.7%	4.7%	No	Yes	No	Interim Constraint
02322700	Ichetucknee River at Hwy 27 nr Hildreth	4.1%	4.1%	No	Yes	No	Interim Constraint
02323500	Suwannee River nr Wilcox	12.7%	10.0%	Yes	n/a	Yes	Local MFL; November through April, inclusive is a 11.8% shift (Manatee).
Multiple	All others in District[2]	10.0%	5.0%	No	No	No	Interim Constraint

[1]Minimum flow for Alapaha River near Jennings is not adopted into rule.
[2]Any river gages or springs on river reaches not explicitly listed in this table were assessed using these constraints.

Section 2. North Florida Model

The North Florida Model, a three-dimensional, five-layer, steady-state groundwater flow model, was used to simulate the projected groundwater withdrawal rates in the model area and predict associated impacts for the planning period. The North Florida Model was first developed in 2005 and was further developed and modified in 2008 to serve as a water use permitting impact assessment tool for District regulatory staff. The five model layers correspond to the surficial aquifer system, the intermediate confining unit, the Upper Floridan aquifer, the Middle Confining unit, and the Lower Floridan aquifer. The model was calibrated to heads and flows of the drought conditions observed during 2001 through 2002. Calibration of the model to drought-year conditions encourages a conservative approach to allocating the water resources of the District,

as the District's permitting strategy includes permitting to 1-in-10 year drought conditions (Upchurch, 2008). Rainfall data were collected from 96 gages in and around the model area and baseline well pumping rates were derived from water use estimates for the year 2000. The groundwater level calibration was conducted using 47 Upper Floridan aquifer wells with reliable data from the District's Water Assessment Regional Network program. Additional model documentation along with copies of the model files can be found on the District's Groundwater Simulation Modeling Webpage (http://www.srwmd.state.fl.us/index.aspx?NID=125).

In 2009, groundwater withdrawal rates for the large portion of the model area outside of the District were updated using 2005 water use estimates and projections as baseline conditions in the model. For the District's portion of the model area, two sets of projected groundwater demands were ascribed to the wells represented in the model. As described in Chapter 2, the two data sets represent a "low-range" demand projection, based on established growth trends from within the study area and a "high-range" projection, based on data with a high degree of uncertainty relating to proposed new residential developments, power generating facilities, industrial parks, and agricultural operations. The low-range and high-range demand scenarios in the District, along with the demands from the remainder of the model area, were modeled using an approach in which impacts were simulated for each five-year increment of the planning period. The incremental modeling approach allows the District to understand which areas of the District may be impacted by groundwater withdrawals during a particular five-year increment. This is useful in determining when additional alternative water supplies will be needed and whether more stringent permitting regulations and detailed modeling or assessments may be required for those areas. For example, if the modeling demonstrates that water resources will be stressed in a certain portion of the District in 2020, a schedule for regulatory and financial planning related to developing alternatives within that region can be developed to prevent the predicted impacts from occurring.

An important feature of the North Florida Model is that it predicts the flux in flow at river gaging stations and springs that can result from the increased withdrawal of groundwater. As discussed previously, minimum flows have been established for several river and spring systems within the District. The determination of flux in rivers and springs for each five-year increment of the planning period is key to determining whether the minimum flows will be met. Since the model relates changes in the water table or potentiometric surface to flow at gages in rivers, reductions in streamflow/springflow resulting from these changes can be compared to established minimum flows and interim flow constraints.

1.0 Model Assumptions and Source Data

When reviewing the results of the water resource impact analysis, it should be noted that the North Florida Model is based on the assumptions listed below.

- Calibration to drought-year conditions. The potentiometric surface and river and spring flows used in model calibration represent the drought conditions observed from June 1, 2001 to May 31, 2002. These conditions are not necessarily representative of Districtwide hydrologic conditions during the 2005 baseline groundwater withdrawal scenario.
- Estimated groundwater withdrawal quantities. The groundwater quantities used for the 2005 baseline condition are largely based on estimated withdrawals that occur across the model area. A significant portion of the withdrawals in the model are

metered public supply quantities in the St. John's River Water Management District. However, most of the withdrawals for the other use categories are estimated, and as such, may introduce a significant level of uncertainty into the modeling results.

- Low-range/high-range groundwater withdrawal simulations. Simulations for each of the five-year increments during the planning period are based on the 2005 baseline estimates and the groundwater withdrawals that are projected to occur across the model area for the period from 2005 through 2030. For the model area outside the District, a standard groundwater withdrawal projection was used for each increment of the planning period. Low-range projections were developed only for the District and these were added to the standard projection for the rest of the model area. Simulations were then run for each five-year increment. Similarly, high range projections were developed only for the District. These were also added to the standard projection for the rest of the model area and the simulations were run again for each increment.
- Approximate and aggregated withdrawal locations. In many cases, wells in the model represent the total withdrawal quantities associated with multiple wells of the same use type. For example, domestic self-supply quantities were aggregated by Township-Range-Section and were ascribed to a single representative domestic self-supply well in the center of each section. Additionally, coordinates were not available for many of the wells within the model area, and in these cases, the withdrawal quantities were also ascribed to the centroid of each section.
- Surface water withdrawals. Surface water withdrawals are not represented within the model area. Although only a minor amount of surface water is consumptively used within the District, more substantial quantities of surface water may be used in the other water management districts. The effects of these withdrawals on regional hydrologic conditions were not considered in the version of the North Florida Model used in this Water Supply Assessment.

Part 3. Projected Incremental Impacts for the Planning Period

Section 1. Upper Floridan Aquifer

Figures 3-2 and 3-3 show the predicted cumulative Upper Floridan aquifer drawdown in 2030 for the low-range and high-range groundwater withdrawal simulations respectively. The predicted drawdowns are shown as a cumulative decline from the year 2005 Upper Floridan aquifer potentiometric surface, which was used as the baseline aquifer condition in the model. An examination of the figures reveals very little difference between the predicted low-range and high-range drawdowns. This is because the high-range 2030 projected demand is only 59.5 mgd higher than the low range projection. This quantity is dispersed across the entire area of the District and is only 5 percent of the total 2030 groundwater withdrawal quantity in the model area (approximately 1.1 billion gallons per day).

Both figures show identical areas of significant drawdown in the St. John's River Water Management District related to the projected groundwater withdrawals in Clay, Duval, and St. John's Counties. The only significant difference between the figures is that the high-range withdrawal scenario (Figure 3-3) exhibits small-scale localized areas of drawdown that result from proposed industrial and residential developments that are not part of the low-range scenario.

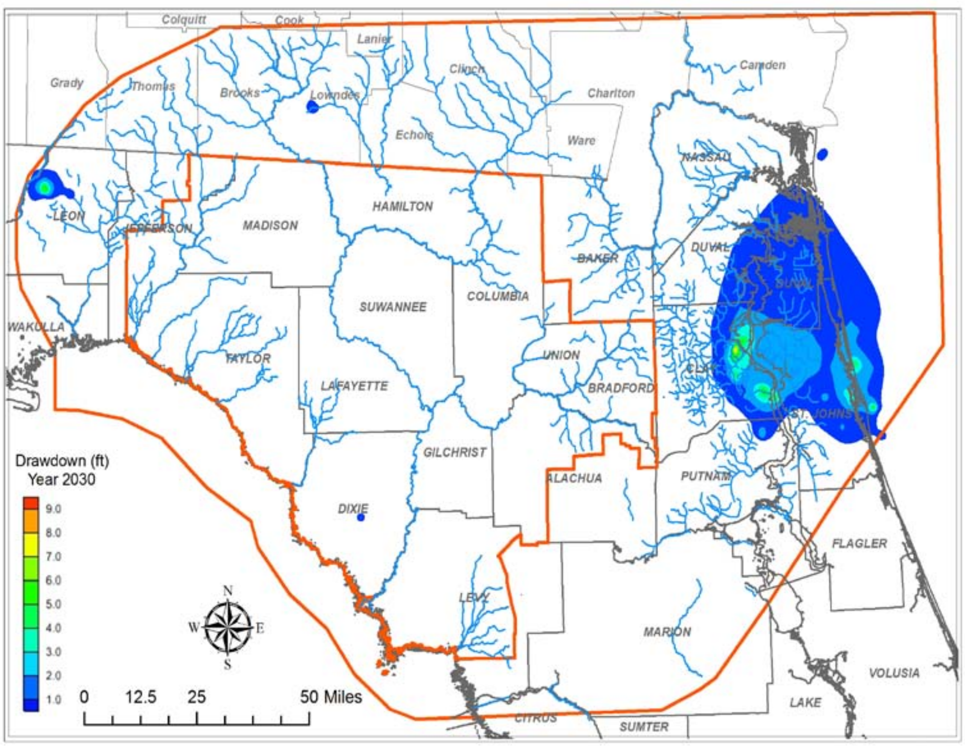


Figure 3-2. Predicted Cumulative 2030 Upper Floridan Aquifer Drawdown for the Model Area - Low-Range Groundwater Withdrawal Simulation.

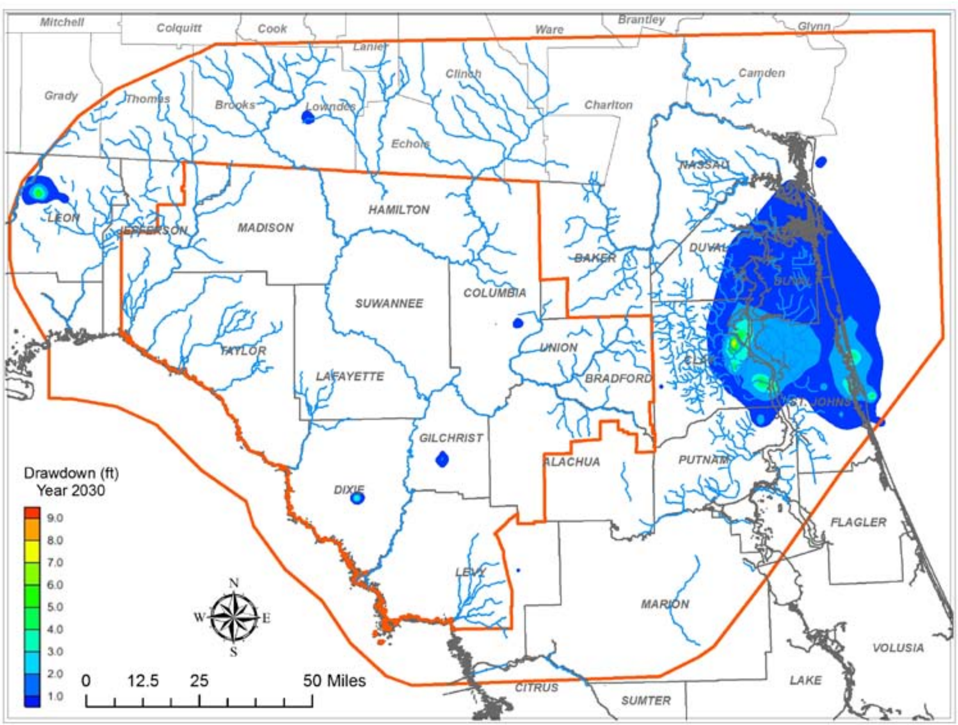


Figure 3-3. Predicted Cumulative 2030 Upper Floridan Aquifer Drawdown for the Model Area - High-Range Groundwater Withdrawal Simulation.

Section 2. Surficial Aquifer System

The surficial aquifer system occurs within the unconsolidated sands and clays that overlie the intermediate confining unit in portions of the District. It is generally present only where the Upper Floridan aquifer exists under semi-confined or confined conditions. The North Florida Model was used to predict cumulative declines from the year 2005 water table, which is the baseline aquifer condition in the model. In both the low and high-range simulations, no appreciable drawdowns were observed in the water table through the year 2030.

Section 3. Rivers

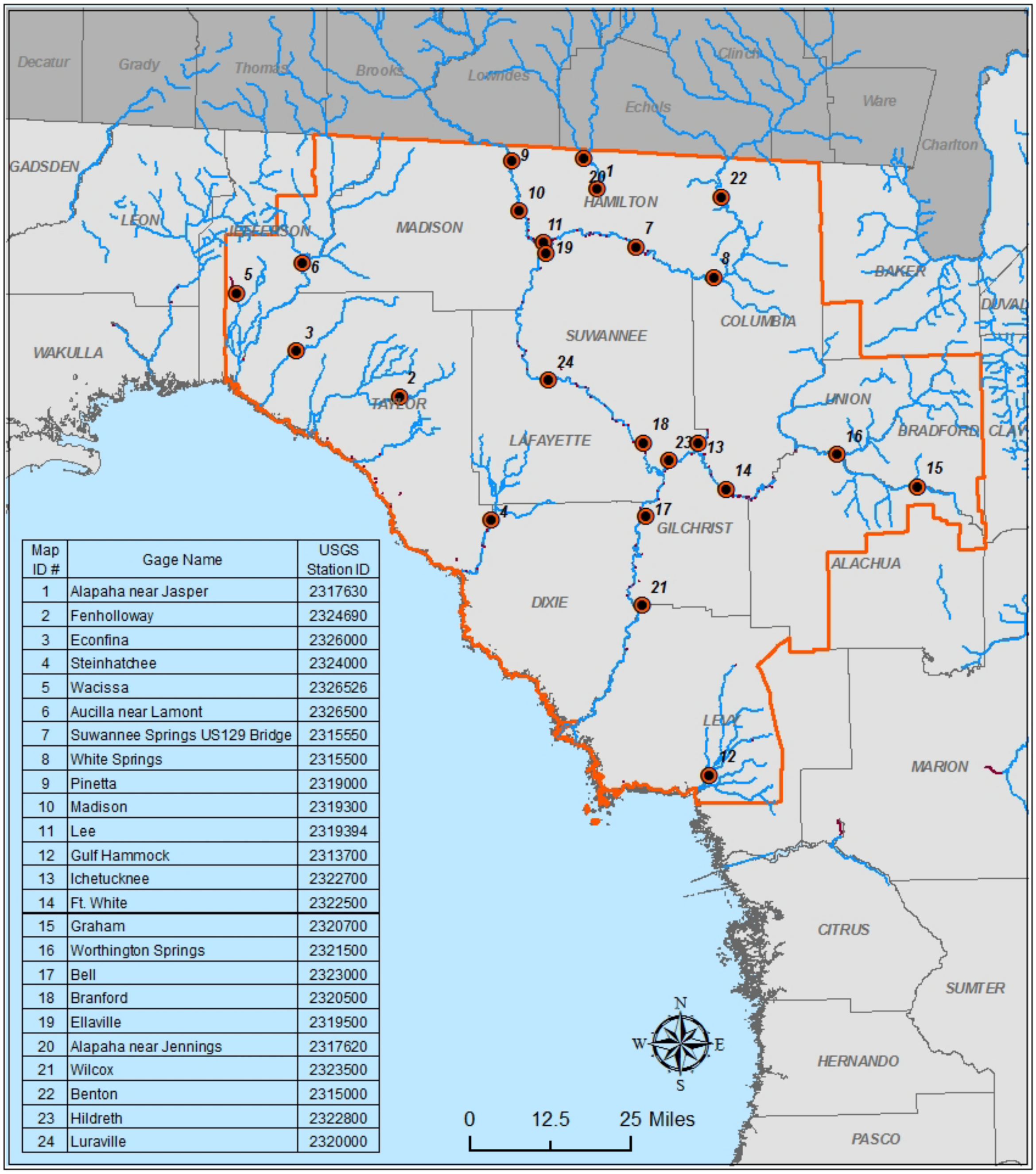
The North Florida Model was used to analyze the impacts of increased groundwater withdrawals on river discharge. Predicted incremental declines in river flow, calculated from the flux in river cells, were subtracted from the baseline flow duration curve (calculated using period of record data through the year 2005). This calculation was replicated for each five year increment of the planning period using the low-range groundwater withdrawal simulation. These calculations yield a predicted flow duration curve for each five-year increment during the planning period. The predicted flow duration curves were then compared with established minimum flow and interim flow constraints at 24 gages in rivers across the District (Figure 3-4). The comparison enables the determination of future minimum flow compliance, and also aids in the determination of surface water availability for consumptive purposes during the planning period.

It is important to note that the primary purpose of determining whether flow constraints will be exceeded through this process is for water supply planning purposes. Areas where exceedances are predicted to occur may be included in a water supply planning region where additional planning will be initiated to ensure that water supplies will be adequate and natural systems protected. The exceedances are not used in the water use permitting process because the flow values used to determine exceedances are statistical representations of the flow record at each river gage in the model that cannot be compared to actual flow values at any given point in time.

There are a number of other gaged (and ungaged) rivers and streams within the District for which declines in flow were not simulated in support of this assessment, including the New River, Olustee Creek, and Spring Warrior Creek. Staff will evaluate the feasibility of simulating these water resources during the next update of the North Florida Model.

Based on the results of the groundwater modeling shown in Table 3-3, a number of rivers are predicted to exceed their established minimum levels or their interim flow constraints. Additionally, Table 3-3 shows that minor flow declines are predicted to occur in most of the other river systems in the District; however, none will result in exceedances of the established minimum flows or interim flow constraints. Rivers that are predicted to exceed their established minimum flows during the planning period are listed below.

- The Upper Santa Fe River at Worthington Springs - predicted to exceed during the 2010–2015 interval. Even though flow declines are not predicted for the Upper Santa Fe at Graham during the planning period, the allowable flow decline is 0.0 percent; therefore, no additional surface water will be available during low-flow periods and additional



Map ID #	Gage Name	USGS Station ID
1	Alapaha near Jasper	2317630
2	Fenholloway	2324690
3	Econfina	2326000
4	Steinhatchee	2324000
5	Wacissa	2326526
6	Aucilla near Lamont	2326500
7	Suwannee Springs US129 Bridge	2315550
8	White Springs	2315500
9	Pinetta	2319000
10	Madison	2319300
11	Lee	2319394
12	Gulf Hammock	2313700
13	Ichetucknee	2322700
14	Ft. White	2322500
15	Graham	2320700
16	Worthington Springs	2321500
17	Bell	2323000
18	Branford	2320500
19	Ellaville	2319500
20	Alapaha near Jennings	2317620
21	Wilcox	2323500
22	Benton	2315000
23	Hildreth	2322800
24	Luraville	2320000

Figure 3-4. River Gages Assessed Using the North Florida Model.

groundwater development in the surrounding region may cause the established minimum flow for this gage to be exceeded.

- The Waccasassa River at Gulf Hammock - predicted to exceed during the 2010–2015 interval. However, District staff believes that problems with the model in the vicinity of the river raise questions about the validity of the prediction. The District is currently revising the North Florida Model and is evaluating the issue as part of this process.

Table 3-3. Listing of Impacts at Minimum Flow Gages for Rivers in the District.

River Gage[1]	Established Minimum Flow?	Allowable Percent Decline	*Cumulative Decline in Flow (cfs) from Baseline Flow Duration Curve (through 2005)*					Time Increment When Flow Constraint Exceeded
			2005-2010	2010-2015	2015-2020	2020-2025	2025-2030	
Aucilla R. Lamont	No	10.0	0.01	0.02	0.03	0.05	0.06	2010 – 2015
Econfina R.	No	10.0	0.00	0.02	0.03	0.04	0.05	Not Exceeded
Steinhatchee R.	No	10.0	0.03	0.04	0.06	0.07	0.08	Not Exceeded
Suwannee R. Benton	No	10.0	0.08	0.16	0.24	0.31	0.40	Not Exceeded
Suwannee R. White Springs	No	3.1	0.14	0.27	0.39	0.50	0.64	2010 – 2015
Suwannee R. Suwannee Springs US129 Bridge	No	10.0	0.67	1.23	1.74	2.24	2.80	Not Exceeded
Alapaha R. Jennings	Yes	0.0	0.04	0.09	0.13	0.18	0.22	2010 – 2015
Withlacoochee R. Pinetta	No	10.0	0.26	0.56	0.86	1.15	1.44	Not Exceeded
Withlacoochee R. Madison	No	10.0	0.30	0.65	1.01	1.35	1.69	Not Exceeded
Suwannee R. Lee	No	10.0	0.44	0.95	1.44	1.91	2.38	Not Exceeded
Suwannee R. Ellaville	Yes	3.1	1.69	3.25	4.68	6.07	7.56	Not Exceeded
Suwannee R. Luraville	No	10.0	1.81	3.46	4.96	6.41	7.96	Not Exceeded
Suwannee R. Branford	Yes	10.5	2.43	4.47	6.31	8.08	9.95	Not Exceeded
Santa Fe R. Graham	Yes	0.0	0.00	0.00	0.00	0.00	0.00	Not Exceeded
Santa Fe R. Worthington Springs	Yes	0.0	0.03	0.06	0.08	0.10	0.12	2010 – 2015
Santa Fe R. Ft. White	Yes	4.7	6.57	9.94	12.84	14.79	17.12	2025 – 2030
Ichetucknee	Yes	4.1	1.03	1.63	2.20	2.68	3.18	Not Exceeded
Santa Fe R. Hildreth	No	4.7	8.17	12.47	16.24	18.92	22.01	Not Exceeded
Suwannee R. Bell	No	10.0	10.81	17.28	23.01	27.56	32.62	Not Exceeded
Suwannee R. Wilcox	Yes	12.7	11.16	17.85	23.77	28.49	33.74	Not Exceeded
Waccasassa R. Gulf Hammock	Yes	12.5	0.23	0.43	0.63	0.82	1.02	2010 – 2015

[1]The Fenholloway River is the only priority-listed river omitted from this analysis. The data records for the Fenholloway are highly altered due to wastewater discharges and additional study is needed prior to assessment. Due to on-going permitting actions, the conditions here may change; evaluation will be reviewed prior to the next assessment by the District.

Interim flow constraints have been developed for rivers that do not yet have established minimum flows. Rivers that are predicted to exceed interim flow constraints during the planning period are listed below.

- The Upper Suwannee River at White Springs - predicted to exceed during the 2010–2015 interval.
- The Lower Santa Fe River at Ft. White - predicted to exceed during the 2025–2030 interval.
- The Alapaha River at Jennings - predicted to exceed during the 2010–2015 interval.
- The Aucilla River at Lamont - predicted to exceed during the 2010-2015 increment. However, the exceedance is at the extreme low-flow end of the flow duration curve. In addition, the river is located in the far western portion of the District where impacts from groundwater withdrawals are minimal. The District will conduct additional investigations in the area prior to making a determination as to the seriousness of the impacts.

Section 4. Springs

Springs in the District with established minimum flows or interim flow constraints that were assessed using the North Florida Model are shown in Figure 3-5. Springs were assessed by calculating the decline in flow determined from the model runs for each five-year increment of the planning period. Predicted declines in springflow were compared to the springflow values used in the model calibration to determine the predicted percent decline. The predicted percent declines were compared to established minimum flows or interim flow constraints for springs (Table 3-2) to determine if and when exceedances would occur. Based on the results of the low-range groundwater withdrawal simulations, the flow of two springs is predicted to decline below established minimum flows or interim flow constraints during the planning period (Table 3-4). The table shows that the interim flow constraints for Hornsby Spring and the Santa Fe River Rise, located along the Lower Santa Fe River, are predicted to be exceeded during the 2015-2020 and 2025-2030 intervals respectively.

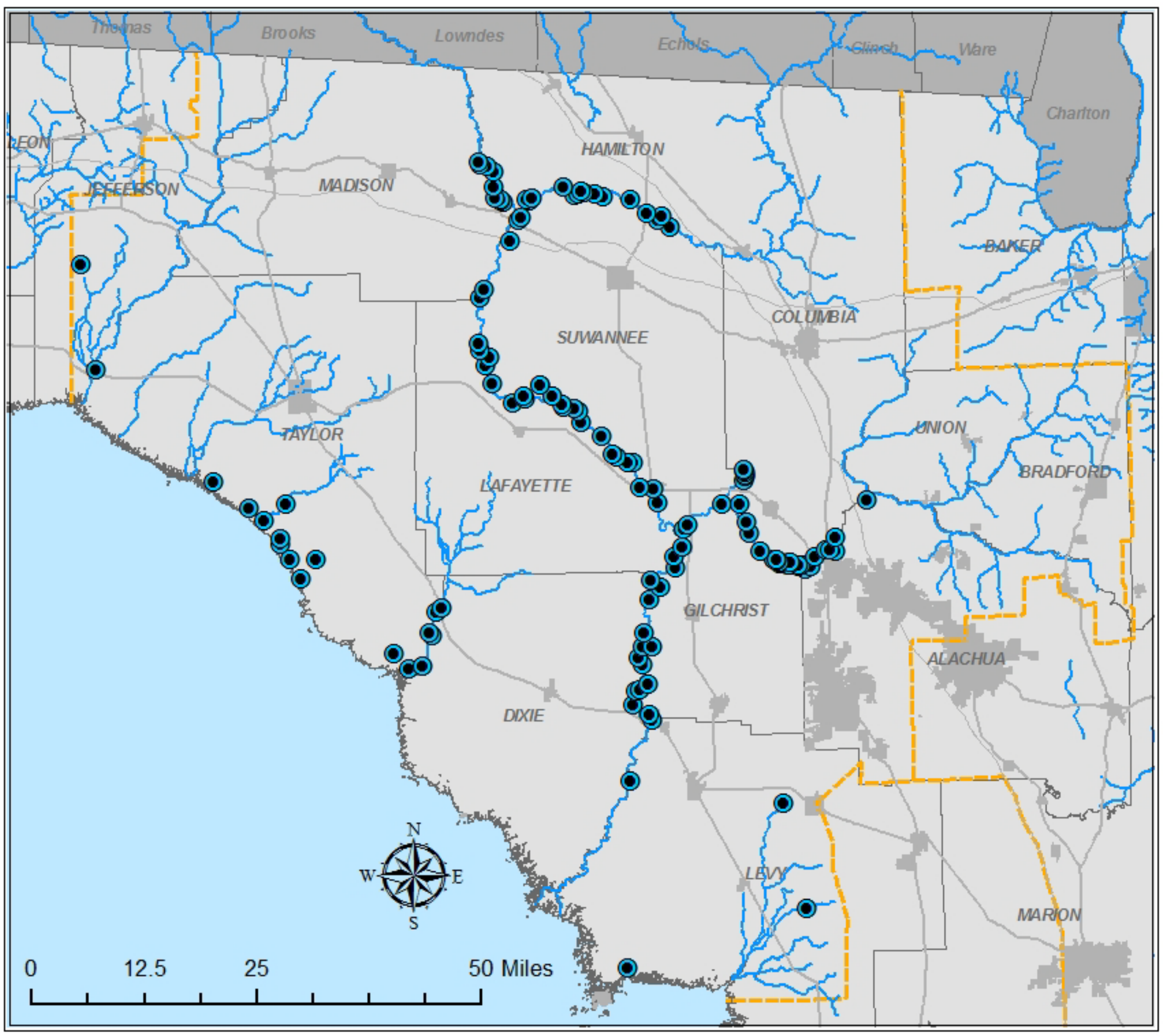


Figure 3-5. Springs with Established Minimum Flows or Interim Flow Constraints Assessed Using the North Florida Model.

Table 3-4. Springs Predicted to Exceed Established Minimum Flows or Interim Flow Constraints During the Planning Period.

Spring Name	2005 Baseline Springflow (cfs)	Allowable Percent Decline	Cumulative Percent Decline in Springflow for each Time Increment from 2005					Time Increment when Flow Constraint Exceeded
			2005 - 2010	2005 - 2015	2005 - 2020	2005 - 2025	2005 - 2030	
Hornsby Spring	3.93	4.7	4.04	6.06	7.83	8.97	10.36	2015-2020
Santa Fe Rise	44.86	4.7	1.89	2.85	3.67	4.20	4.86	2025-2030

Part 4. Identification of Current and Future Impacted Areas

Recent investigations have indicated that the water resources of the eastern and northeastern portions of the District are in decline. This trend is especially evident in the potentiometric surface of the Upper Floridan aquifer, which has declined significantly from pre-development conditions. Pre-development is defined as the period immediately prior to the onset of significant groundwater withdrawals. For the purposes of this Water Supply Assessment, pre-development is considered to be approximately the 1930s. The magnitude of the decline in the potentiometric surface was determined using the US Geological Survey 1936 pre-development potentiomentric surface map and data from the District's Sentinel Monitor Well Network and other monitor wells. Figure 3-6 shows the locations of the District's Sentinel Monitor Wells. Wells highlighted in red are those with statistically significant declining trends. Most of these are located in the northeastern-most portion of the District. Wells highlighted in green do not have declining trends and are generally located further to the west. There are exceptions to the distribution of wells with and without trends. The well in Suwannee County near the Suwannee River shows a declining trend, but is surrounded by wells that are not showing trends. The declining trend in this well could be the result of local large-magnitude groundwater withdrawals. Another exception is the well in Bradford County that does not show a trend but is surrounded by wells that show declining trends. District staff are investigating this well to determine whether the data may have been compromised by well construction problems. The Hydrographs for all 18 Sentinel Wells are located in Appendix A. Note that the numbers shown atop each well in Figure 3-6 relate to the figure numbers in Appendix A.

Figure 3-7 illustrates the southwestward migration of the groundwater basin divide resulting from the potentiometric decline that occurred from pre-development through 2005. The divide has migrated more than 35 miles to the southwest over the past 70 years. The result of this migration is a decrease in the size of the groundwater contributing area to the eastern Suwannee River Water Management District by more than 20 percent or 1,900 square miles. This decrease is apparently a result of groundwater withdrawals originating in the District, the St. John's River Water Management District, and the State of Georgia. Additional potentiometric surface declines have occurred in other areas of the District. However, these declines are much less significant than those in the northeastern portion of the District.

Figure 3-8 illustrates the magnitude of the decline in average potentiometric levels from 1981 to the present that is responsible for a portion of the migration of the groundwater divide depicted in Figure 3-7. The figure shows potentiometric levels for a 28 mile long cross section through

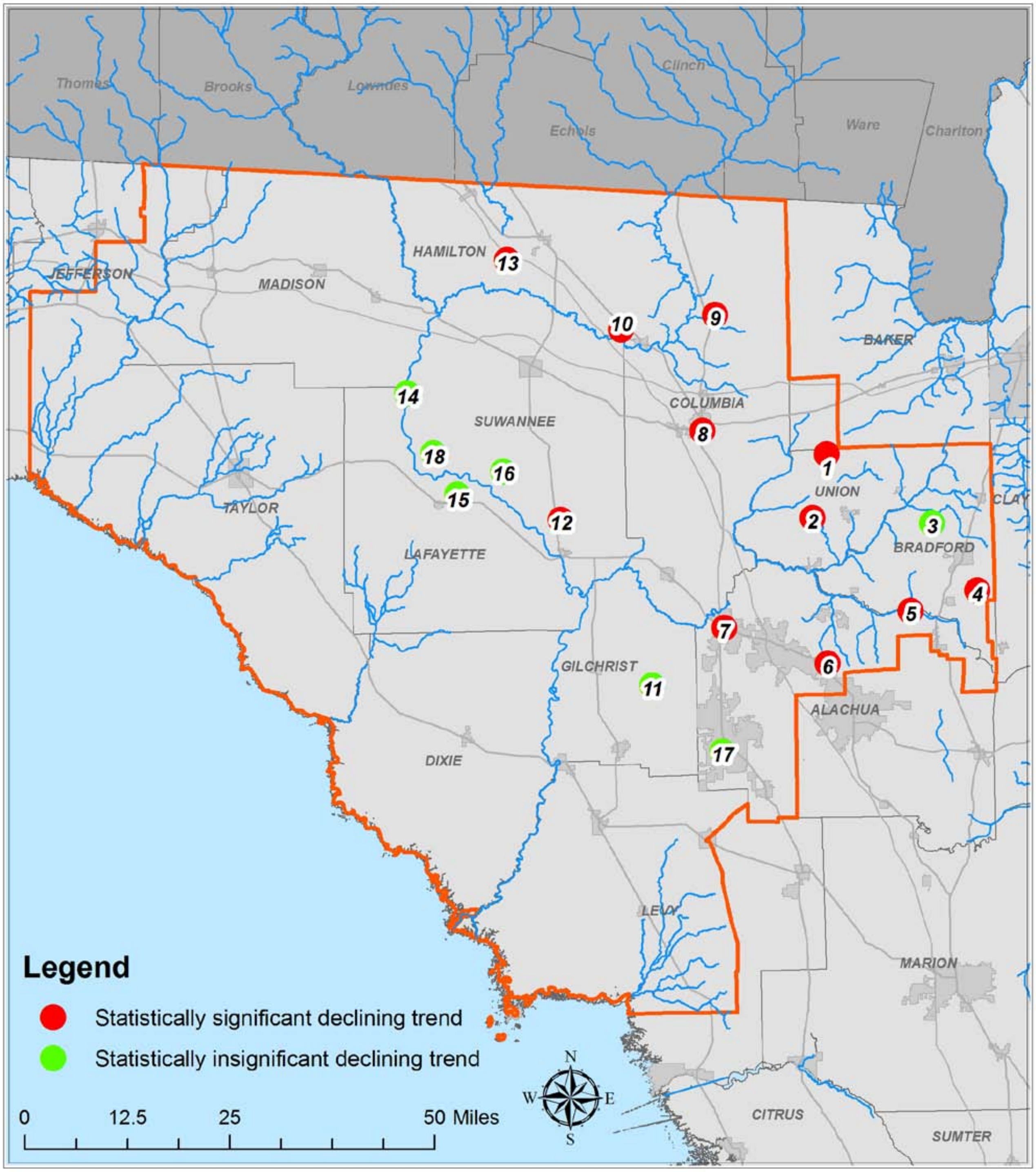


Figure 3-6. The District's Sentinel Monitor Well Network.

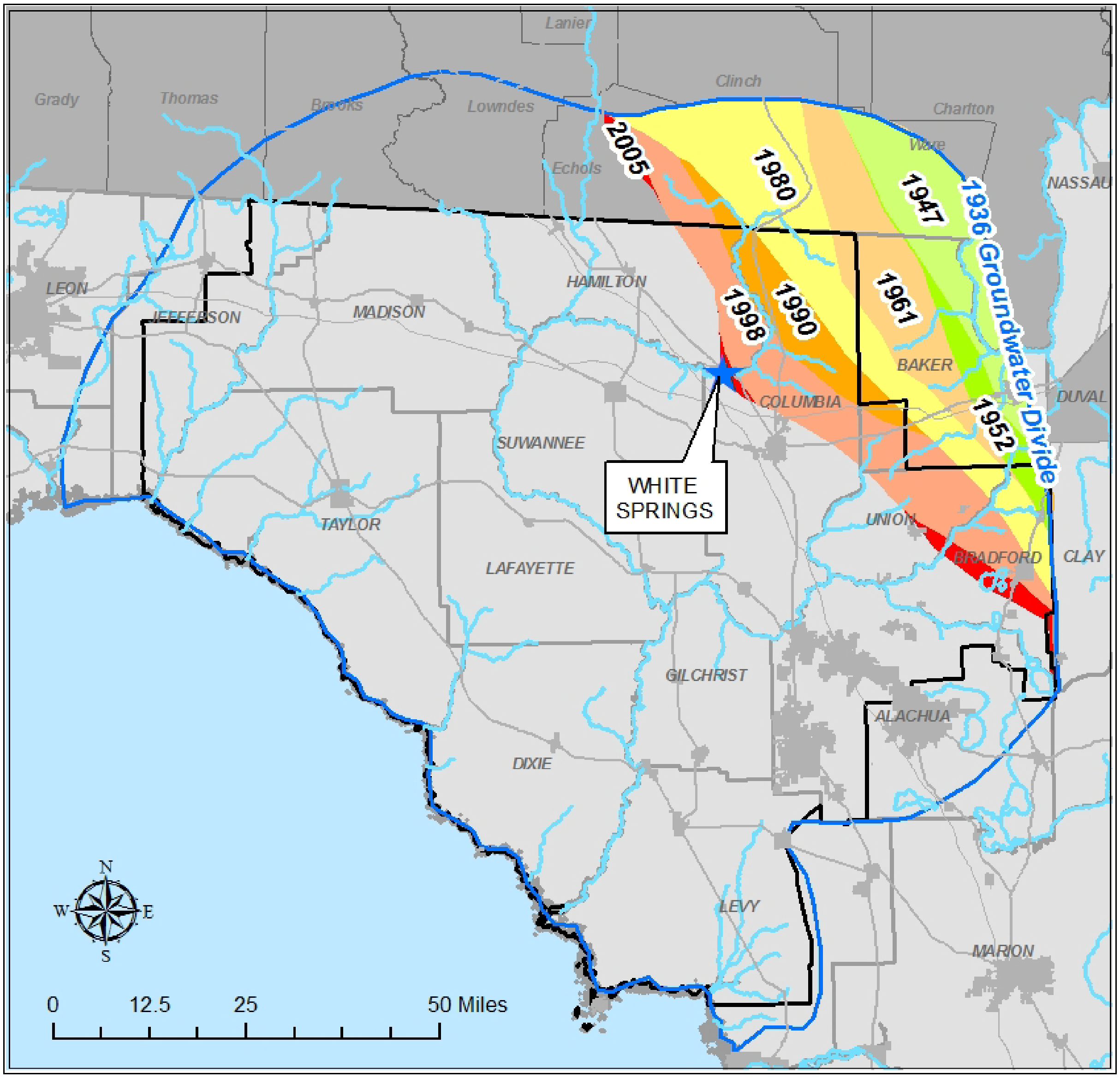


Figure 3-7. Migration of the Groundwater Basin Divide in the Northeastern Portion of the District.

the Upper Floridan aquifer based on groundwater levels in three wells from the District's groundwater monitoring network. Average groundwater levels from each well for each five year increment between 1981 and 2010 were analyzed for trends. The analysis indicates that the potentiometric surface of the Upper Floridan aquifer across section A-A' has experienced a cumulative drawdown of approximately six feet over the past 29 years. This decline is in addition to significant drawdown that occurred prior to 1981. Unfortunately, the magnitude of this drawdown cannot be accurately calculated because the necessary data were not collected.

The decline in the potentiometric surface in the northeastern District is suspected to have impacted a number of rivers, and springs to the degree that they are not currently meeting their

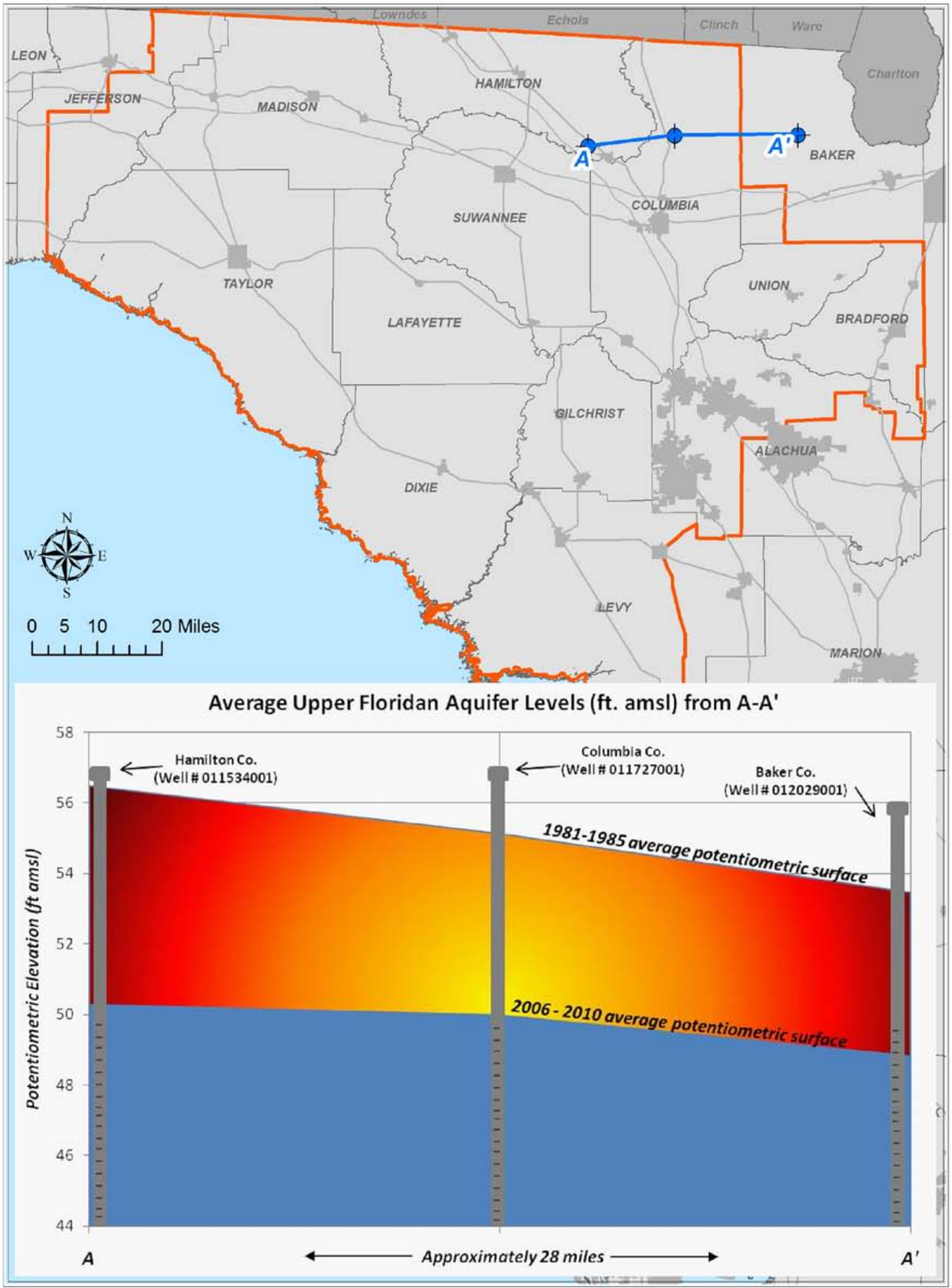


Figure 3-8. Potentiometric Surface Decline Across Section A-A' Associated with the Southwestward Migration of the Groundwater Basin Divide Shown in Figure 3-7.

established minimum flows or interim flow constraints or they will not meet them at some point during the planning period. As a result, it is recommended that the District designate specific areas in the northeastern portion of the District as Water Supply Planning Regions. Within one year of designating these areas as Water Supply Planning Regions, they will also be designated as Water Resource Caution Areas. A Water Resource Caution Area is where existing sources of water (groundwater) will not be adequate to satisfy future water demands and sustain water resources. Regional Water Supply Plans must be developed for the Water Supply Planning Regions because the District is required to ensure that sufficient water is available for all existing and future reasonable-beneficial uses and the natural systems. The Regional Water Supply Plans will identify alternative water supply and water resource development project options and water conservation strategies sufficient to meet projected water supply demand. In addition, the Regional Water Supply Plans must contain a recovery strategy for water resources that currently do not meet their established minimum flow and levels or interim flow constraints or a prevention strategy for water resources that are projected to fall below these constraints at some point during the planning period. The recovery strategy will ensure that water will continue to be available to supply reasonable and beneficial uses either through projects that will raise groundwater levels to allow more groundwater withdrawals to be permitted or through the development of alternative supplies.

The areas in the northeastern portion of the District where Water Supply Planning Regions are recommended to be established include 1) the Upper Santa Fe River Basin, 2) the Lower Santa Fe River Basin, 3) the Upper Suwannee River Region, and 4) the Alapaha River Basin. Justification for designating these regions as Water Supply Planning Regions is presented in the following sections.

Section 1. Upper Santa Fe River Basin

Analysis of period of record river flow and groundwater level data for the Upper Santa Fe River Basin indicates a declining flow trend and a potential inability to meet the Upper Santa Fe River minimum flows during the planning period. In some areas of the Upper Santa Fe River Basin, Upper Floridan aquifer groundwater levels have declined more than 15 feet from pre-development conditions (Figure 3-9). Though the Upper Floridan aquifer is sufficiently confined across much of the Upper Santa Fe River Basin, localized breaches in the intermediate confining unit and the decrease in the potentiometric surface may be affecting the baseflow contribution to the Upper Santa Fe River.

The District has established minimum flows on the Upper Santa Fe River at the US Geological Survey Graham and Worthington Springs gages (Figure 3-9). The 2010 low-range demand simulation predicts that the minimum flow established at Worthington Springs will be exceeded during the 2010-2015 interval during low-flow conditions. The 2010 low-range demand simulation indicates that the Graham gage is essentially at the minimum flow threshold during low-flow conditions. Additional groundwater or surface water withdrawals in the vicinity of the river could cause the minimum flow to be exceeded during low-flow conditions. Although the model indicates that exceedance of the minimum flows at both sites may occur at low flow conditions during the next five years, there may still be quantities of river water available for withdrawal during higher flow conditions. Based on the data presented above, it is recommended that the District designate the Upper Santa Fe River Basin as a Water Supply Planning Region. Figure 3-10 shows the location and extent of the proposed Upper Santa Fe River Basin Water Supply Planning Region.

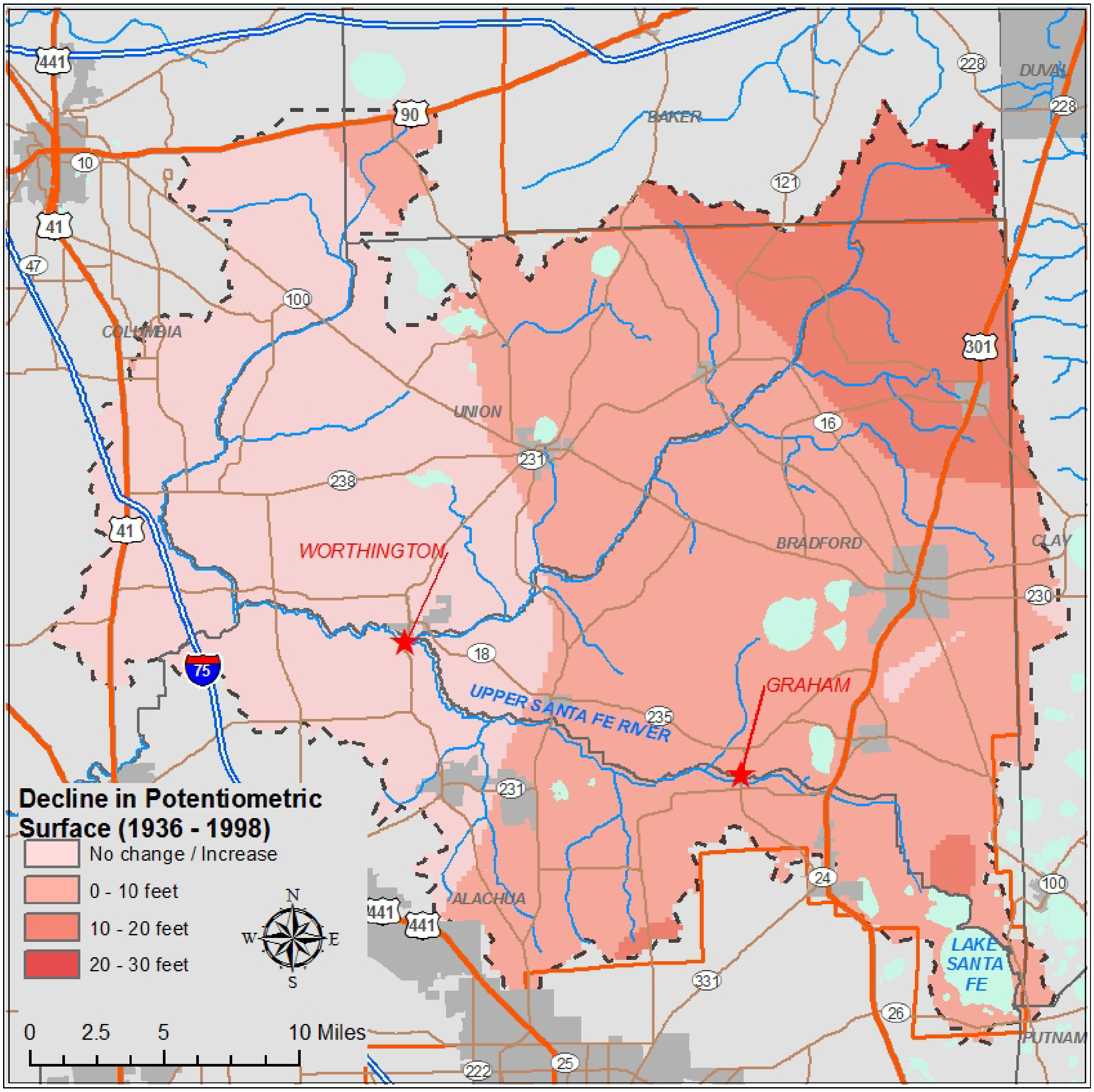


Figure 3-9. Upper Santa Fe River Basin Potentiometric Surface Decline from Pre-Development through 1998.

Section 2. Lower Santa Fe River Basin

Analysis of river and spring flow in the Lower Santa Fe River Basin indicates declining trends and an inability to meet spring and river interim flow constraints prior to the end of the planning period. The Lower Santa Fe River at Ft. White is predicted to exceed its interim flow constraint during the 2025-2030 increment. The interim flow constraints for Hornsby Spring and the Santa Fe River Rise, two second magnitude springs on the Lower Santa Fe River, are predicted to be

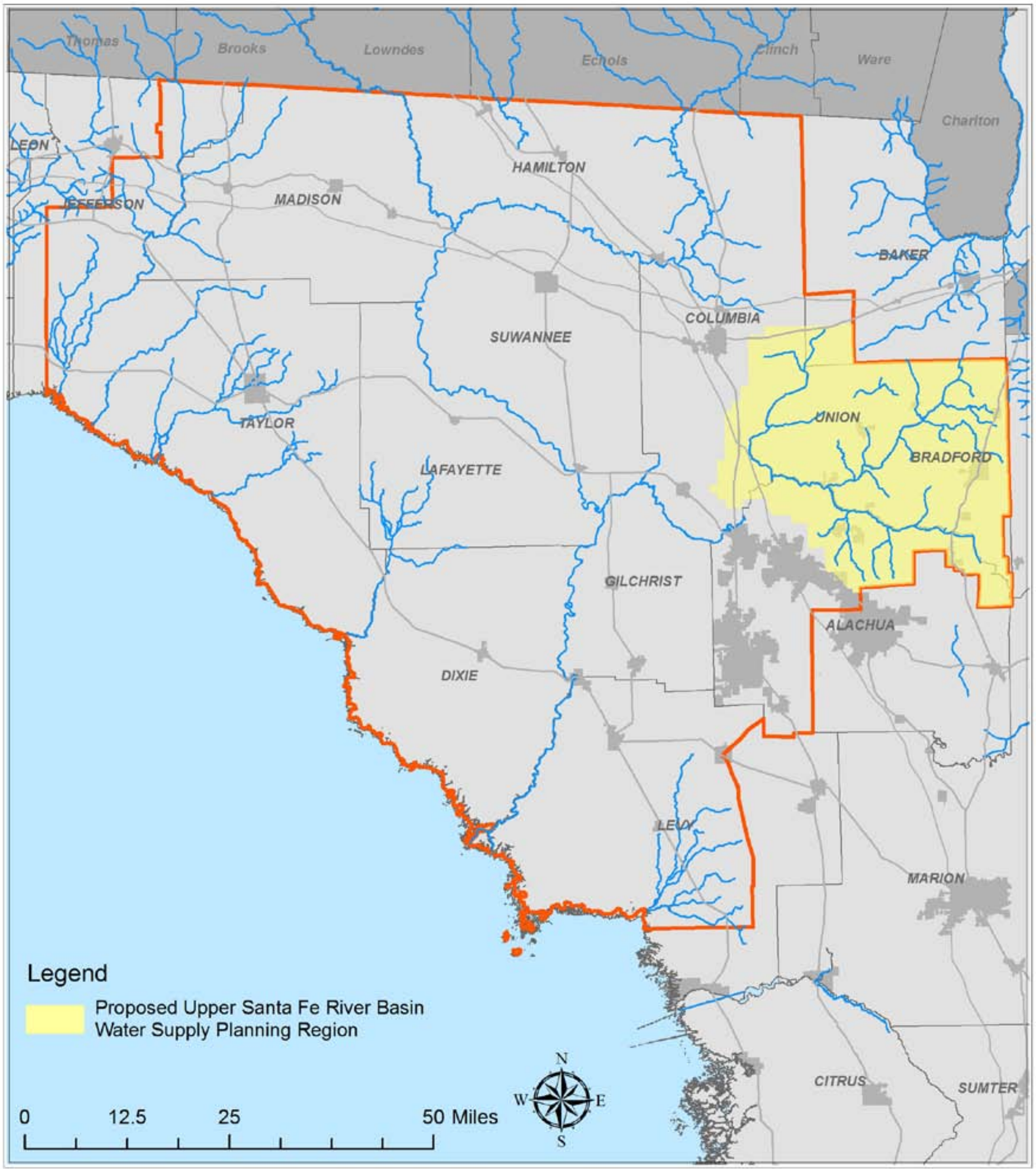


Figure 3-10. Proposed Upper Santa Fe River Basin Water Supply Planning Region.

exceeded during the 2015-2020 and 2025-2030 intervals respectively (Table 3-4). Based on the these data, it is recommended that the District designate the Lower Santa Fe River Basin as a Water Supply Planning Region. Figure 3-11 shows the location and extent of the proposed Lower Santa Fe River Basin Water Supply Planning Region.

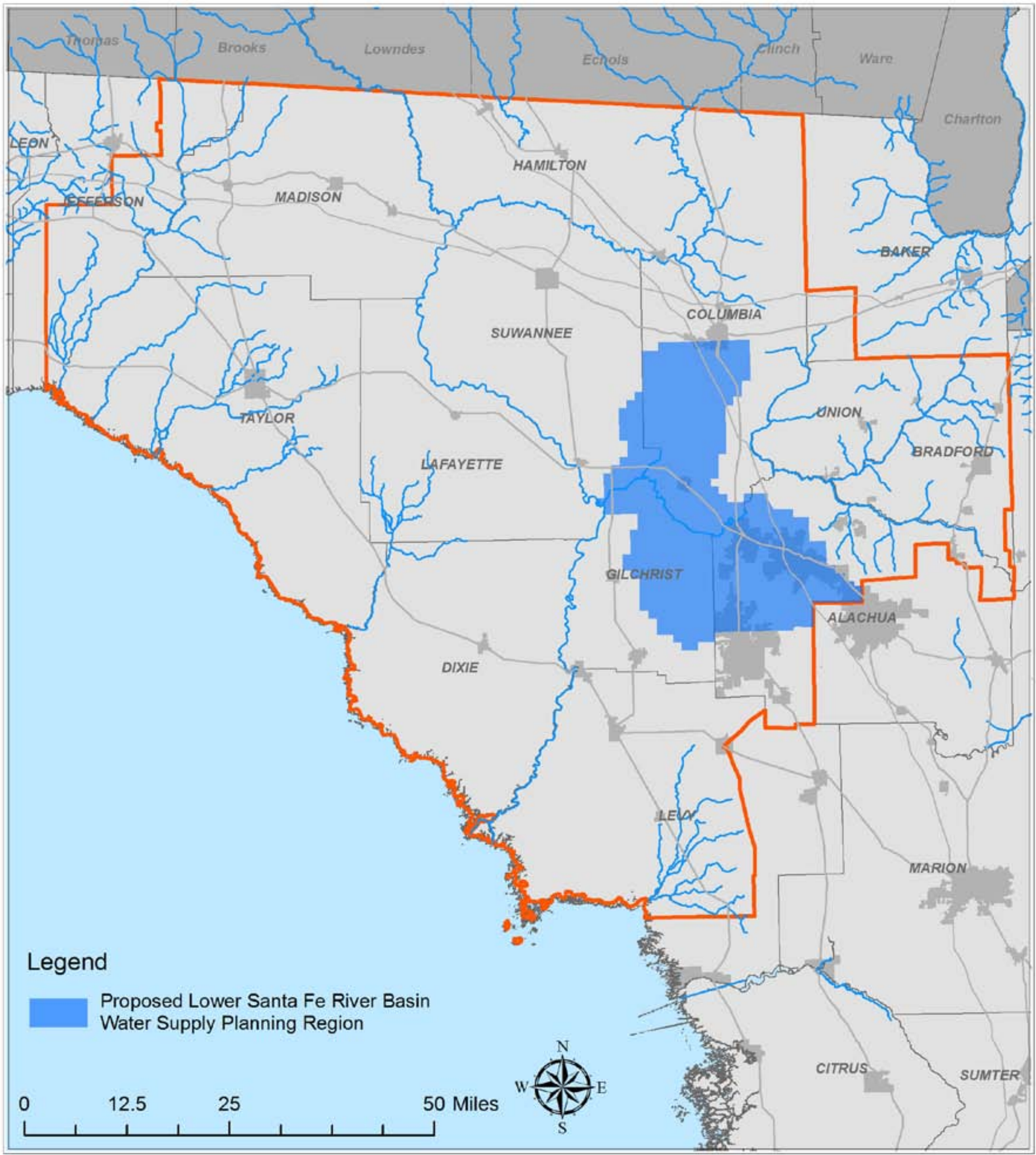


Figure 3-11. Proposed Lower Santa Fe River Basin Water Supply Planning Region.

Section 3. Upper Suwannee River

Analysis of the potentiometric surface of the Upper Floridan aquifer and historical discharge of White Springs indicates that Upper Suwannee River region has been significantly impacted by regional groundwater withdrawals. As shown in Figure 3-7 and as explained previously, the groundwater basin divide has migrated southwestward as a result of the potentiometric surface decline that occurred from pre-development through 2005. The divide has migrated more than 35 miles to the southwest over the past 70 years. The result of this migration is a decrease in

the size of the groundwater contributing area to the eastern Suwannee River Water Management District by more than 20 percent or 1,900 square miles.

A potential major consequence of the migration of the divide is the cessation of flow at White Springs. The migration of the groundwater basin divide may be causing flow in the Upper Floridan aquifer that once moved southwestward toward the spring and river to be redirected to the northeast. Figure 3-12 is a graph of the historical discharge of White Springs. Although discharge was measured infrequently, it is thought to have been a strong second magnitude spring prior to the onset of significant groundwater withdrawals. Modeling investigations conducted by the US Geological Survey and the St. John's River Water Management District assigned it an average discharge of 53.4 cubic feet per second. The spring apparently ceased regular discharge in the mid 1970s. Flow that has occurred since that time is likely related to drainage of water forced into the Upper Floridan aquifer during major Suwannee River flood events. Additionally, there are anecdotal accounts of flow declines and cessation of flow in other minor springs in the vicinity of White Springs. An additional impact in the region is the decline in flow in the Upper Suwannee River. Based on the modeling analysis, the Upper Suwannee River at White Springs will exceed its interim flow constraint during the 2010-2015 interval.

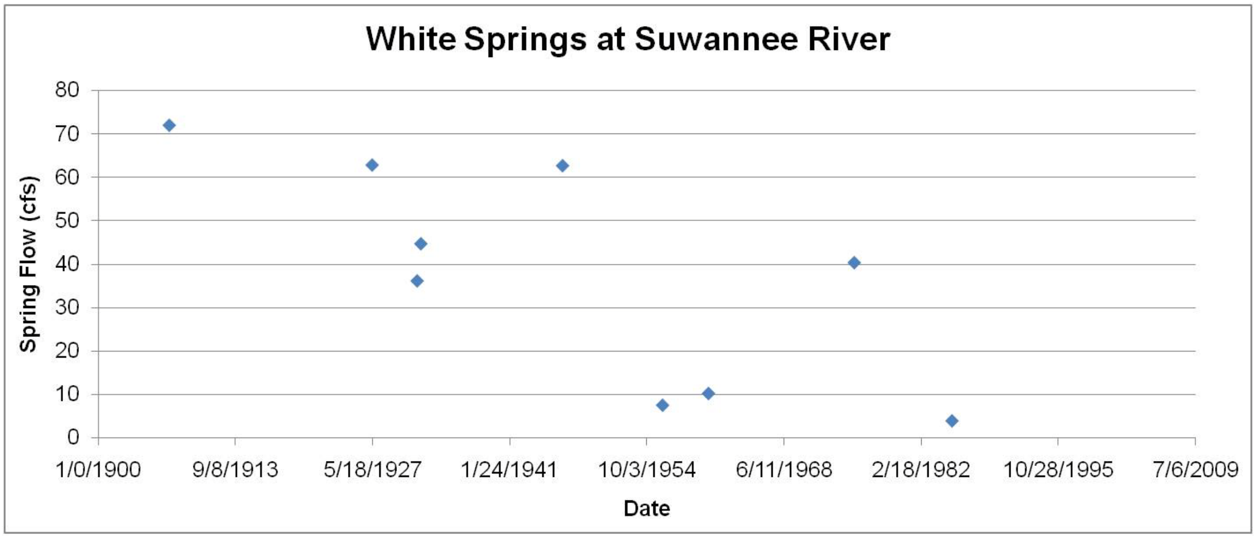


Figure 3-12. Historic Discharge of White Springs.

The District will conduct additional investigations to determine the full extent of impacts to surface and groundwater resources in the Upper Suwannee River region during the establishment of minimum flows and levels. Based on the data presented above, it is recommended that the District designate the Upper Suwannee River region as a Water Supply Planning Region. The area includes portions of the Upper Suwannee River Basin and the area encompassed by the migration of the groundwater basin divide, which extends to the Suwannee River/St. John's River Water Management District boundary. Figure 3-13 shows the extent of the proposed Upper Suwannee River Water Supply Planning Region.

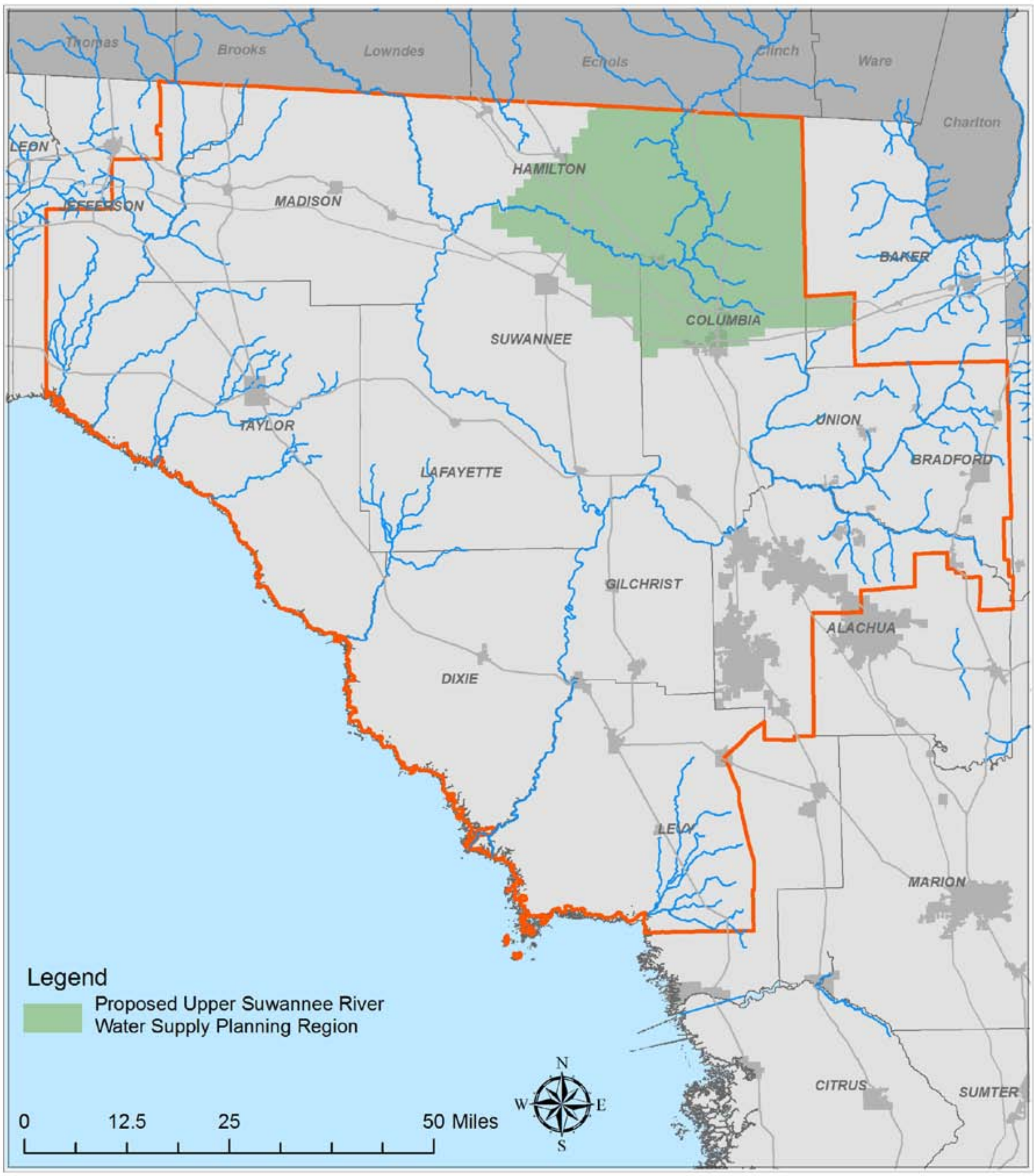


Figure 3-13. Proposed Upper Suwannee River Water Supply Planning Region.

Section 4. Alapaha River Basin

The modeling analysis predicts that the flow constraint at the Alapaha River Jennings gage will be exceeded during the 2010-2015 interval. Also, a Sentinel Network well in the Alapaha Basin indicates declining groundwater levels. Based on these data, it is recommended that the District designate the Alapaha River Basin as a Water Supply Planning Region. Figure 3-14 shows the location and extent of the proposed Alapaha River Basin Water Supply Planning Region. Figure 3-15 shows the location and extent of each of the proposed Water Supply Planning Regions.

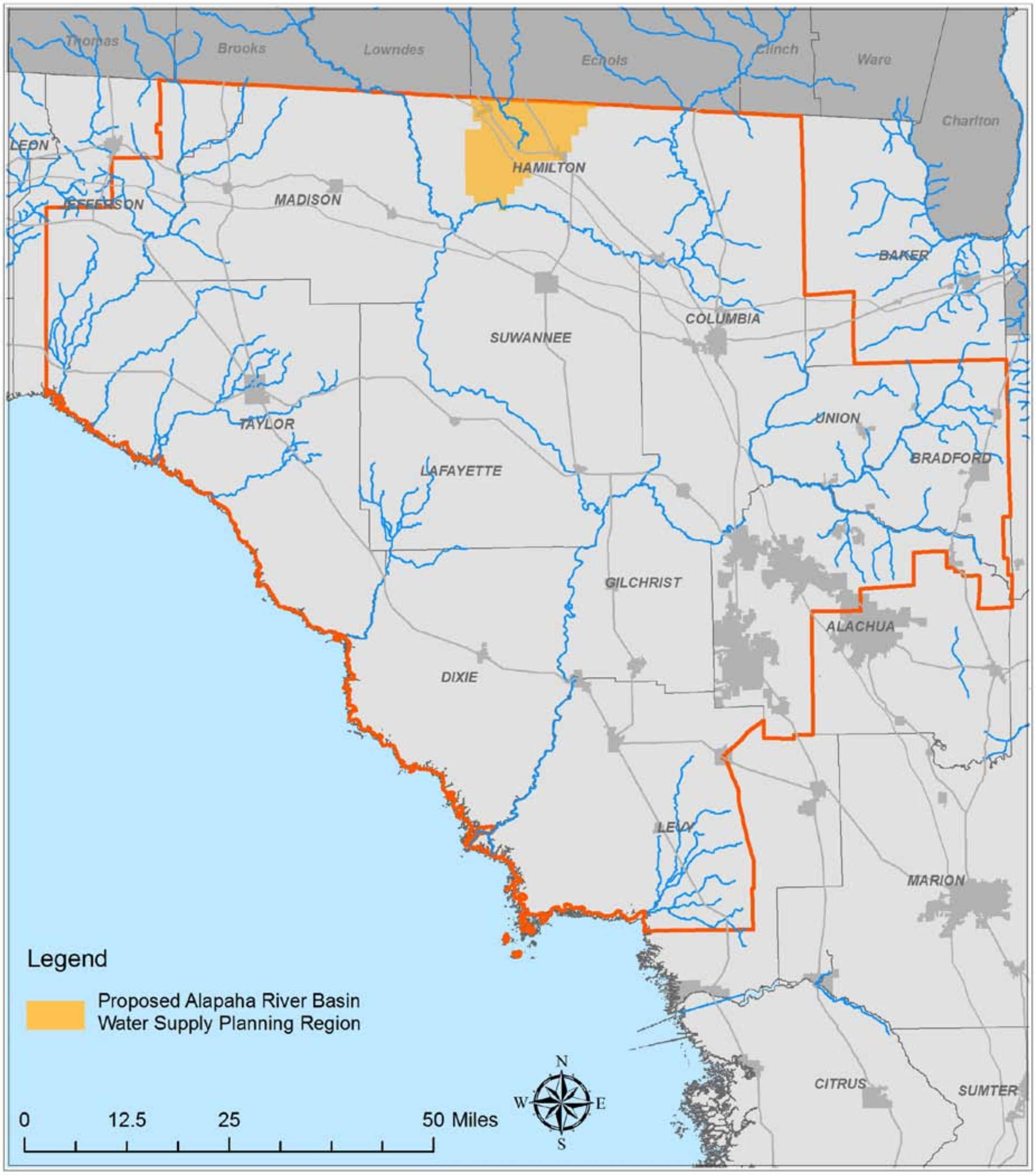


Figure 3-14. Proposed Alapaha River Basin Water Supply Planning Region.

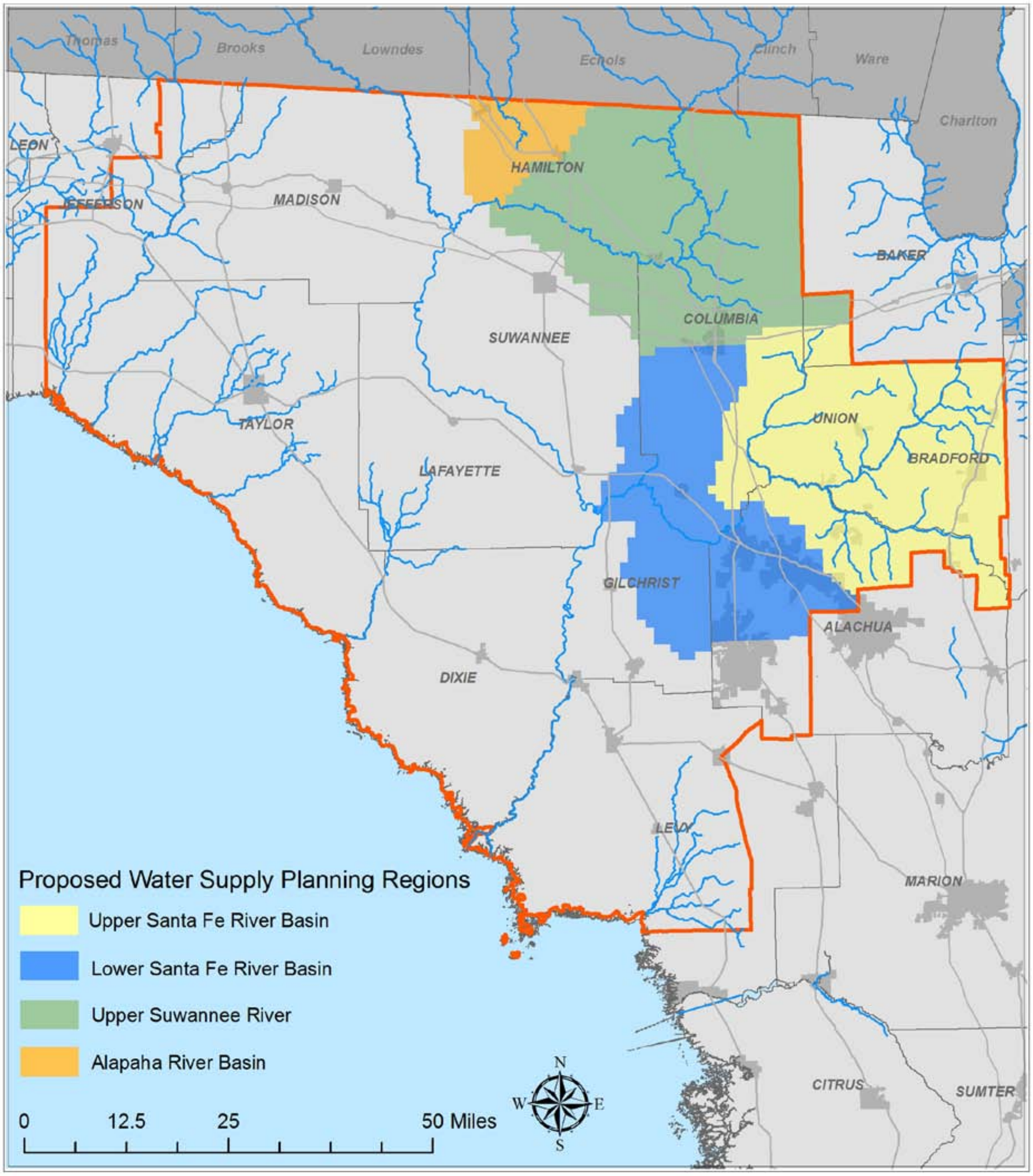


Figure 3-15. Proposed Water Supply Planning Regions.

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This Chapter presents the results of evaluations to quantify the amount of water that could potentially be available from alternative water sources and water conservation in the District to meet demands through 2030. Alternative water sources are defined as all sources of water other than fresh groundwater from the Upper Floridan aquifer. Alternative water sources will be of the greatest importance in areas where groundwater from the Upper Floridan aquifer is limited or projected to be limited prior to 2030. Alternative sources of water that were evaluated include surface water from rivers, reclaimed water, brackish groundwater, and seawater. Water conservation was also included in the evaluation even though it is a demand management method and not technically a source of water.

In addition to an evaluation of the availability of each source, additional information is provided including discussions of how sources could be developed by various water use categories, the most appropriate source for each use category, how storage options such as aquifer storage and recovery, aquifer recharge, and off-stream reservoirs could be used, planning level infrastructure requirements and conceptual costs, and permitting considerations.

Part 1. Alternative Sources

Section 1. Surface Water

Surface water obtained from rivers is increasingly being used for water supply as the sustainable yield of fresh groundwater resources is exceeded across the state. Although rivers within the District are not widely used for water supply purposes, they may be sustainably developed to provide water to meet future demands. However, it will not be possible to determine the quantity of surface water available from rivers in the District until minimum flows are established for each river.

The flow of many of the rivers in the District is highly variable between the winter and summer wet seasons and fall and spring dry seasons. During the dry season, the amount of water available to be harvested for water supply will be limited due to minimum flow constraints, currently being established, that will ensure that sufficient flow is available preserve the ecology of the rivers. However, during the wet seasons, very large quantities are potentially available, especially from the larger rivers such as the Suwannee. To optimize the use of the wet season flows, off-stream reservoirs and/or aquifer storage and recovery or aquifer recharge systems could be developed to store water in the wet season for use in the dry season when water is not available.

1.0 Surface Water Storage Options

1.1 Off-Stream Reservoirs

The principal method of storing river water in many parts of the country including Florida has been in-stream impoundments that back up a river into its watershed to create a reservoir. Because Florida lacks significant topographic relief, in-stream reservoirs tend to be shallow and therefore subject to substantial evaporative losses relative to their total volume. In-stream reservoirs have other draw backs including water quality issues, blocking of wildlife migration, and flooding of sensitive riverine and wetland habitats. For these reasons, it is unlikely that an in-stream impoundment of significant size will ever again be permitted in the state. Water suppliers are

therefore developing off-stream reservoirs, which are large constructed storage areas that are filled with water pumped from rivers during higher flow periods.

Off-stream reservoirs include an intake structure constructed in the river, a transmission pipeline from the intake to the reservoir, the reservoir itself, and a pump station to move the water through the pipeline. If the end user of the reservoir is a public supply system, the stored water would be pumped out of the reservoir for use during low-flow periods when diversions from the river would be reduced or eliminated due to minimum flow constraints. The water would be treated to potable water standards, and then entrained in the utility's distribution system. The Peace River Manasota Regional Water Supply Authority in the Southwest Florida Water Management District has recently completed an off-stream reservoir in DeSoto County with a capacity of 6 billion gallons. Table 4-1 shows the cost of this system, which can supply an annual average of 16.5 million gallons per day, including the river intake, off-stream reservoir, water treatment plant, and five miles of transmission pipeline.

Table 4-1. Cost of the Peace River Manasota Regional Water Supply Authority's Public Water Supply System[1].

Component	Capital Cost	Cost/mgd	Cost/1,000 Gallons
Off Stream Reservoir (6 billion gallon capacity)	$77,000,000	n/a	n/a
Water Treatment Plant And River Intake	$90,100,000	n/a	n/a
Five Miles of 20" Distribution Pipeline	$3,632,000	n/a	n/a
Total	$170,732,000	$10,347,394	$2.90

[1]Costs based on Southwest Florida Water Management District 2010 Regional Water Supply Plan, Southern Planning Region.

If the end user is a power plant or industrial facility that requires large quantities of water for cooling, water from a river could be used to fill a reservoir that would function as a cooling pond. Water in the reservoir is continuously circulated from the reservoir through the facility and since the water would not be consumptively used; the reservoir is replenished only to replace evaporative losses. During low flow periods when minimum flow constraints limit the availability of water to fill the reservoir from the river, groundwater could be used to maintain reservoir levels until sufficient quantities of river water become available. An example of this type of system is part of Florida Power and Light's 2,700 megawatt facility in Manatee County in the Southwest Florida Water Management District. Water withdrawn from the Little Manatee River is stored in a 3,500 acre cooling reservoir. The facility is permitted to withdraw up to an annual average of 8.5 million gallons per day, with maximum daily withdrawals limited to no more than 10 percent of the flow in the river. The facility has standby groundwater quantities that can be used when available flow in the river is not sufficient to maintain reservoir levels.

1.2 Aquifer Storage and Recovery

Aquifer Storage and Recovery is a method by which treated drinking water, treated surface water, groundwater or highly treated wastewater is injected into unconfined, confined, or semi-confined aquifers through a well for subsequent withdrawal from the same well when needed. Aquifer storage and recovery offers several significant advantages over conventional water storage methods including the ability to store large volumes of water at relatively low cost with little environmental impact and no evaporative losses. This reduces or eliminates the need to construct large, expensive surface reservoirs. If water stored in the aquifer is for potable supply, when it is withdrawn from storage it is disinfected, retreated if necessary, and pumped into the distribution system. Although there are currently no aquifer storage and recovery facilities located in the District, aquifer storage and recovery wells have been constructed at 30 sites in Florida, mostly by municipalities in coastal regions. Thirteen of the 30 sites are fully permitted and the total number of aquifer storage and recovery wells in Florida is approximately 65. Most of these sites store treated drinking water in brackish aquifers containing total dissolved solids concentrations from 700 to 20,000 milligrams per liter. Aquifer storage and recovery systems can usually be constructed at less than half the capital cost of other water supply/storage alternatives. Table 4-2 provides conceptual costs associated with constructing an aquifer storage and recovery facility.

Table 4-2. Conceptual Aquifer Storage and Recovery Costs[1].

100 Day Dry-Season Yield (million gallons/day)	Capital Cost (One ASR Well and Four Monitor Wells)	Cost/million gallons/day
1.5	$1,291,300	$860,866

[1]Costs based on Southwest Florida Water Management District 2010 Regional Water Supply Plan, Southern Planning Region, City of Bradenton System.

The success of an aquifer storage and recovery project is generally measured in terms of recovery efficiency which is the percentage of the original injected water recovered from the storage zone before water quality or impacts from the recovery phase (withdrawal) become unacceptable. One issue in particular is the mobilization of naturally occurring arsenic in the aquifer resulting from the interaction of the injected water with the aquifer’s limestone matrix. The Florida Department of Environmental Protection has initiated a process to allow for the continuation of aquifer storage and recovery projects while a solution to the arsenic issue is being developed. Two methods to prevent arsenic mobilization are currently in the testing phase. The first method, which involves removal of dissolved oxygen from injection water, is being tested at the City of Bradenton’s aquifer storage and recovery facility in Manatee County with results expected in 2010. The second method involves the addition of chemicals to the injection water to condition it so that it cannot dissolve the aquifer materials containing arsenic. This method has been successfully tested at a site in Volusia County.

1.3 Aquifer Recharge

Aquifer recharge is the process whereby treated surface water, storm water, or reclaimed water is directly or indirectly recharged into the Upper Floridan aquifer. The process involves pumping water into the aquifer through recharge or drainage wells. The purpose of direct recharge is to augment aquifer levels to allow for future groundwater withdrawals. Direct injection of surface water is being tested in Hardee County by CF Industries, a phosphate mining and processing company. When completed, this system will capture surface water on mined lands, treat it to potable standards in constructed treatment wetlands, then pump it into the Upper Floridan aquifer through recharge wells. Several western states have also utilized direct recharge for salinity barriers. The City of Las Vegas directly recharges an aquifer for potable water storage during winter months. The Orange County California Water District has utilized direct recharge of reclaimed water since 1977 to maintain a salinity barrier and to recharge the potable aquifer basin.

Indirect recharge is the process of discharging treated surface water, stormwater, or reclaimed water to the ground surface to infiltrate through the surficial aquifer system and ultimately into the Upper Floridan aquifer through wetlands, rapid infiltration basins, and seepage fields. Rapid infiltration basins paired with treatment wetlands are common in Florida for wastewater effluent disposal; however, more recently they are being used for aquifer recharge. The Water Conserve II Reclamation Facility jointly operated by the City of Orlando and Orange County is the largest reuse project in the world and a good example of how rapid infiltration basins can be implemented in Florida. While the primary focus is agricultural irrigation, approximately 40 percent of the 41 million gallons per day of wastewater sent to the site is discharged to 75 rapid infiltration basins for indirect recharge of the Upper Floridan aquifer. This method of recharge has also proven successful in the western United States for several decades. Table 4-3 shows the conceptual per unit cost to construct and operate a rapid infiltration basin system for indirect recharge of the Upper Floridan aquifer.

Table 4-3. Conceptual Indirect Aquifer Recharge Costs.

RIB Infiltration Rate (mgd)	Capital Cost	Cost/mgd	Cost/1,000 Gallons	Annual O&M
2	$26,000,000	$13,000,000	$4.90	$1,700,000

[1]Costs based on MWH “Feasibility of Using Reclaimed Water for Aquifer Recharge”, prepared for Southwest Florida Water Management District, January 2009 and Southwest Florida Water Management District ‘Estimating Reclaimed Water Capital Costs”, 2006.

2.0 Surface Water Use Strategies for Selected Water Use Categories

The following is a discussion of the potential for selected water use categories to use surface water, how they could use it, and the issues that would be encountered in developing surface water systems.

2.1 Public Supply Use of Surface Water

Public water supply systems in the state have used surface water to a much lesser degree than groundwater because groundwater is easier to access and much cheaper to treat to potable standards. However, a number of public water supply systems in the state, such as the City of Tampa, Manatee County, and the City of Punta Gorda have historically used surface water stored in relatively small in-stream reservoirs. The sustainable yield of fresh groundwater sources has been exceeded or is close to being exceeded in much of peninsular Florida. Therefore, a number of public water supply systems are developing surface water systems that are designed to withdraw water during high-flow periods for immediate treatment and distribution or send the water to storage in off-stream reservoirs or aquifer storage and recovery systems for use during low-flow periods when minimum flow constraints limit withdrawals. Since the cost of these projects can be in the hundreds of millions of dollars, the water utilities that are implementing them tend to have very large customer bases from which revenues are generated to provide the necessary funds. The development of surface water for public supply is probably not feasible in the District in the near term since the majority of public water supply systems are small, are currently using groundwater, and are not projected to experience significant growth during the planning period.

2.2 Agricultural Use of Surface Water

The primary source of water for agriculture in the District is fresh groundwater. However, as the availability of groundwater becomes limited, there may be certain circumstances where it will be feasible to use surface water for agricultural irrigation. As discussed previously, the ability to withdraw water from rivers will often be limited in the dry season. To overcome this limitation, it will be necessary to store wet-season flows for dry season use or develop a system that conjunctively uses surface water and groundwater.

The potential to store wet-season flows in large off-stream reservoirs for dry season use is not feasible for agriculture because of the high cost of reservoirs and pipelines necessary to store and distribute the water to agricultural operations in the vicinity. Smaller-scale reservoirs could be developed for a single large farm or several adjacent farms, but the cost may still be prohibitively high and a significant amount of land would have to be taken out of production for the reservoir.

Wet season river flows could also be stored through an aquifer recharge system. Such a system would involve pumping wet season river flows to treatment wetlands or rapid infiltration basins where water would be filtered and naturally disinfected prior to recharging the Upper Floridan aquifer. Aquifer levels could potentially be raised over large areas, which would make more groundwater available through existing wells to farmers throughout the region. Feasibility assessment considerations include potential water quality impacts to existing legal users and the recharge rate of land under consideration. The downside of this concept is its high cost. A system that could provide an annual average of 10 million gallons per day could cost in the range of $50 million, not including the purchase price of land for the rapid infiltration basins.

The option that may be most feasible is direct withdrawals by farms located directly adjacent or in the vicinity of a river. It is assumed that these farms would have backup groundwater wells when river flows are not available. The components of a surface water system include an intake structure and pump station, treatment system to filter and disinfect the water to prevent it from fouling the existing irrigation system, and pipelines to convey water from the intake to the head of the irrigation system. Because the cost of developing such a system would significantly exceed the cost of using groundwater, it could only be feasible under the circumstances listed below.

- Restrictions on groundwater use. Because groundwater is cheaper and easier to use than surface water, an agricultural water user would not voluntarily develop a surface water system unless it was not possible to obtain a permit for quantities of groundwater that were sufficient to supply the operation.
- Incentives. In areas where additional quantities of groundwater are available, agricultural growers would be more likely to participate in a program to develop surface water systems if financial incentives were provided to help offset development costs.
- Proximity to a river. The operation would need to be relatively near a river to reduce pumping and pipeline expenses.

Table 4-4 compares the capital cost of developing surface water and groundwater irrigation systems for a farm requiring a 2 million gallons per day supply.

Table 4-4. Comparison of Capital Costs for Surface Water and Groundwater Irrigation Systems for a Farm.

Irrigation System	Required Infrastructure	Capital Cost
Farm directly on river requiring 2 mgd	Intake, pump, fuel tank, filtration/disinfection system, 500 ft of 10 inch pipe	$115,500
Farm 2 miles from river requiring 2 mgd	Intake, pump, fuel tank, filtration/disinfection system, 10,560 ft of 10 inch pipe	$618,500[1]
Groundwater supply for farm requiring 2 mgd	12 inch diameter well cased 80 ft/open hole 80 ft, pump, fuel tank	$38,000

[1]Does not include pipeline easement costs

2.3 Industrial/Commercial/Institutional and Thermo-Electric Power Generation

Numerous industrial and power generation operations in the state use surface water primarily for cooling purposes. While a number of power generation facilities use seawater for cooling, some also use water directly from rivers. As discussed previously, the Florida Power and Light facility in Manatee County pumps water from the Little Manatee River to maintain water levels in an off-stream reservoir that is used to cool the facility. Industrial facilities in the District could use surface water in the ways listed below.

- Off-stream cooling reservoir: the reservoir would provide cooling water for a power plant or industrial facility. Reservoir water levels could be maintained through withdrawals from a river when needed. During low-flow periods when

flow constraints would not permit direct withdrawals, a backup groundwater system could be used.

- Upper Floridan aquifer storage and recovery: an industrial facility could withdraw surface water from a river when it is available, treat the water to potable standards in wetland treatment areas, then using an aquifer storage and recovery system, store the water in the Upper Floridan aquifer and recover it when needed. This system could be used to supply process water or augment a cooling reservoir.
- Lower Floridan aquifer storage and recovery: this option would use an aquifer storage and recovery system to store river water in the Lower Floridan aquifer. The advantage of this option is that wetland treatment areas would not be necessary because water in the Lower Floridan aquifer is of very low quality. Since very little is known about the existence, extent, or storage characteristics of the Lower Floridan aquifer within the District, extensive testing would be required to determine whether this option is feasible.

Section 2. Reclaimed Water

Reclaimed water, which typically consists of treated wastewater from municipal or industrial wastewater treatment plants, is widely used across Florida to reduce the demands on conventional water supply sources. To date, reclaimed water in Florida has only been used for non-potable purposes such as those listed below.

- landscape irrigation (golf courses, nurseries, botanical gardens, residential)
- agricultural irrigation (typically in drip or micro-jet systems)
- artificial augmentation, recharge, and restoration of surface waters, aquifers, or wetlands
- fire protection
- cooling or make-up water for power generation and other industrial processes

Several prisons and municipalities currently operate reclaimed water systems in the District (Table 4-5). The majority of the reclaimed water produced by these systems is "beneficially reused", meaning that it is utilized in a manner that offsets the use of potable water. An example of beneficial reuse is the use of highly-treated reclaimed water for commercial laundry washing at the Columbia Correctional Institution. In 2007, 0.14 million gallons per day of potable water was offset at this facility through the use of reclaimed water. Some wastewater utilities discharge excess reclaimed water to surface waters and sprayfields, or into rapid infiltration basins. Often, this is done during the wet season when abundant rainfall eliminates the need for supplemental irrigation. Discharge through rapid infiltration basins to the underlying aquifer enhances aquifer recharge.

There are a number of wastewater treatment facilities in the District that could be upgraded to provide additional reclaimed water capacity during the planning period. The rural and dispersed nature of the municipalities and water users within the District present a challenge in terms of transmitting the necessary quantities of reclaimed water from treatment facilities to potential users. Building the extensive pipelines and pumping infrastructure needed to transmit reclaimed water from the wastewater treatment plants to potential users would be cost-prohibitive for many of the municipalities in the District. The most feasible options to beneficially use reclaimed water are those in which the water can be used in close proximity to the wastewater treatment plant.

Table 4-5 Existing Reclaimed Water Systems[1].

Reuse System Name	County	Wastewater Treatment Capacity	Waste Water Treatment Plant Average Flow	Reuse Types[2]	Sub-Reuse Types[3]	Maximum Flow by Sub-Type	Beneficially Reused[4]
Alachua	Alachua	0.94	0.46	AI, PAA&LI	OC, GCI	0.32, 0.15	0.47
High Springs	Alachua	0.24	0.07	IND, AI	ATP, OC	0.03, 0.07	0.07
Newberry WWTF	Alachua	0.42	0.22	AI	OC	0.22	0.22
Baker Corr Inst	Baker	0.38	0.25	AI, GWR&IPR	OC, RIB	0.17, 0.10	0.17
Fla St Prison WWTF	Bradford	1.78	1.11	AI	OC	1.11	1.11
City of Starke	Bradford	1.65	0.71	AI, IND	OC, ATP	0.39, 0.10	0.39
Columbia Corr Inst	Columbia	0.53	0.34	TF, AI	NA, OC	0.14, 0.20	0.34
Lake City WWTF	Columbia	3.00	2.35	AI	OC	2.35	2.35
Lancaster Corr Inst	Gilchrist	0.12	0.11	AI	OC	0.11	0.11
Trenton WWTF	Gilchrist	0.20	0.13	AI	OC	0.13	0.13
Jennings	Hamilton	0.18	0.11	GWR&IPR	AF	0.11	0
Mayo	Lafayette	0.15	0.11	AI	OC	0.11	0.11
Mayo Corr Inst	Lafayette	0.21	0.17	GWR&IPR	RIB	0.17	0
Cedar Key	Levy	0.18	0.12	GWR&IPR, PAA&LI	AF, OPAA	0.10, 0.02	0.02
Chiefland	Levy	0.48	0.17	GWR&IPR	RIB	0.17	0
Town of Greenville	Madison	0.12	0.06	AI	OC	0.06	0.06
City of Madison	Madison	1.37	0.52	IND, AI	ATP, OC	0.70, 0.52	0.52
Advent Christ Home	Suwannee	0.21	0.05	GWR&IPR	RIB	0.05	0
Branford	Suwannee	0.12	0.06	AI	OC	0.06	0.06
Live Oak	Suwannee	1.25	0.76	AI	OC	0.76	0.76
City of Perry	Taylor	1.25	0.70	AI	OC	0.7	0.7
Taylor Corr Inst	Taylor	0.40	0.18	GWR&IPR	RIB	0.18	0
Lake Butler	Union	0.70	0.48	AI	OC	0.48	0.48
Total		**15.88**	**9.24**				**8.07**

[1]Data obtained from the Florida Department of Environmental Protection's 2007 Reuse Inventory. Quantities are shown in million gallons per day.
[2]Reuse Type Codes: AI = Agricultural Irrigation, PAA&LI = Public Access Areas & Landscape Irrigation, GWR&IPR = Groundwater Recharge & Indirect Potable Reuse, IND = Industrial, TF = Toilet Flushing
[3]Sub-Reuse Types: GCI = Golf Course Irrigation, RI = Residential Irrigation, OPAA = Other public access area irrigation (highway medians, etc.), OC = Other Crops (pasture, forage, non-edible, etc.), RIB = Rapid Infiltration Basins, AF = Absorption or Sprayfields, ATP = industrial reuse at treatment plant
[4]Quantity reused for beneficial purposes including: industrial supply, agricultural irrigation, and landscape irrigation. Discharge to RIBs, water bodies, absorption fields, and sprayfields is not included.

Table 4-6 shows the projected quantity of reclaimed water that will be produced in each county in 2030 and the quantity that will be available for beneficial use after subtracting the quantity that is currently being beneficially used. The projected availability is based on the assumption that all wastewater treatment plants will be upgraded to produce public access-quality reclaimed water.

Section 3. Brackish Groundwater

Brackish groundwater desalination is widely-used across portions of Florida to meet increasing potable water demands in water resource caution areas and in other regions with limited fresh groundwater availability. Typically, mineralized groundwater is withdrawn from the Upper or Lower Floridan aquifers or from brackish zones of the intermediate aquifer system and treated

Table 4-6. Year 2030 Projected Reclaimed Water Availability by County[1].

County	2010 Wastewater Flow	2010 Beneficial Reuse	2010 Reuse Availability	2030 Projected Wastewater Flow	2030 Projected Reuse Availability[1]
Alachua	0.75	0.75	0.00	1.62	0.87
Bradford	1.82	1.5	0.32	2.03	0.53
Columbia	2.69	2.69	0.00	3.16	0.47
Dixie	0.00	0.00	0.00	0.87	0.87
Gilchrist	0.24	0.24	0.00	0.24	0.00
Hamilton	0.11	0.00	0.11	0.57	0.57
Jefferson	0.00	0.00	0.00	0.06	0.06
Lafayette	0.28	0.11	0.17	0.28	0.17
Levy	0.29	0.02	0.27	0.66	0.64
Madison	0.58	0.58	0.00	0.8	0.22
Suwannee	0.87	0.82	0.05	1.25	0.43
Taylor	0.88	0.7	0.18	0.9	0.2
Union	0.48	0.48	0.00	0.48	0.00
Total	**8.99**	**7.89**	**1.1**	**12.92**	**5.03**

[1]For counties split by District boundaries, the quantities in the table are what is projected to be used only in the District's portion of the counties. Quantities are shown in million gallons per day.
[2]The 2030 projected reuse availability was determined by subtracting the 2010 beneficial reuse from the 2030 projected wastewater flow.

using reverse osmosis membrane technology to remove high levels of total dissolved solids and other mineral or environmental impurities. Reverse osmosis treatment of brackish groundwater produces a highly-mineralized brine solution bi-product that requires disposal, typically through a deep injection well or an ocean outfall. Additionally, reverse osmosis treatment requires relatively high energy inputs and operation and maintenance costs when compared to other alternative water supply strategies. Despite the concerns with costs and disposal requirements, brackish groundwater is a viable water supply option for areas with limited availability of conventional water sources.

Currently, there are no brackish groundwater treatment facilities in operation within the District. The high cost of treatment and brine disposal makes it is unlikely that brackish groundwater could be a viable alternative source option for the public supply, agricultural, or recreational use categories. However, brackish groundwater could potentially be used by certain elements of the industrial/commercial/institutional category. An example of such an application could be the use of brackish groundwater by a power generating facility or industrial operation. Brackish groundwater could be pumped from the Lower Floridan aquifer through production wells, circulated through an industrial facility for cooling, then disposed of in the Lower Floridan aquifer through injection wells. Costs for such an option could be low relative to the other water supply options presented in this assessment. The Lower Floridan aquifer in the District has only been penetrated by a few injection and exploration wells and has not been investigated for its water supply potential. It would therefore be necessary for each potential user to test the water quality and productivity of the aquifer at each site. Table 4-7 provides a conceptual cost of developing a brackish groundwater source from the Lower Floridan aquifer in north-central Florida.

Table 4-7. Conceptual Cost to Develop a Brackish Groundwater Supply for Industrial Cooling[1].

Quantity Available (mgd)	Capital Cost	Cost/mgd	Cost/1,000 Gallons	Annual O&M
2	$10,200,000	$5,100,000	$1.10[2]	Factored into unit cost

[1]The cost was developed by analyzing the costs of recently-developed similar systems in SWFWMD, SFWMD, and SJRWMD and adapting them based on the anticipated hydrogeologic and engineering concerns that would be encountered in the District. The costs do not include siting studies and feasibility studies, and treatability studies.
[2]Assumes no treatment required prior to use.

Section 4. Seawater Desalination

Seawater desalination in the District would involve withdrawing water directly from the Gulf of Mexico or an estuary and removing the salts and minerals to render it fit for potable uses. Typically, seawater desalination treatment involves flash distillation, membrane filtration, reverse osmosis, evaporative processes, or a combination of these methods. These treatment processes are generally very energy intensive and also have relatively high construction and operation and maintenance costs. Although seawater desalination is a viable option for producing potable water, it is generally cost prohibitive in regions where less expensive conventional or alternative water supplies exist.

Tampa Bay Water owns and operates the largest municipal seawater desalination facility currently in operation in the western hemisphere. The plant, which is located on Tampa Bay in Hillsborough County, has a 25 million gallon per day treatment capacity and was built in response to a need for alternative water supplies to offset the heavy dependence on groundwater in the Tampa Bay region. Several municipalities in the St. John's River Water Management District are currently investigating the feasibility of a seawater desalination facility in Flagler County, which will potentially offset the need for additional quantities of groundwater in rapidly-growing areas. Table 4-8 contains conceptual costs for seawater desalination facilities. The availability of fresh groundwater and more cost effective alternative water supplies in the District makes it unlikely that desalinated seawater will be a viable alternative water source in the District during the planning period.

Table 4-8. Conceptual Seawater Desalination Costs[1].

Quantity Produced	Capital Cost	Cost/million gallons/day	Cost/1,000 Gallons	Annual Operation and Maintenance
5	$52,540,950	$10,508,190	$4.31	$3,469,620
10	$89,088,615	$8,908,862	$4.07	$6,407,580
20	$196,600,000	$9,830,000	$5.30	$23,515,000

[1]Costs based on Southwest Florida Water Management District 2010 Regional Water Supply Plan, Tampa Bay and Northern Planning Regions.

Part 2. Non-Agricultural Water Conservation

The following is an analysis to quantify the potential water savings that could be achieved through implementation of conservation options for all non-agricultural water-use categories including public supply, commercial/industrial/institutional, and recreational. The public supply category is divided into public/private utility, non-community water, and domestic self supply

subcategories and the industrial/commercial/institutional category is divided into mining, industrial, and bottled water subcategories. For some of the subcategories, the data necessary to develop accurate estimates of the potential for water savings for the planning period was not available. Therefore, methodologies were developed that employed a number of assumptions to overcome some of the data limitations.

Section 1. Public Supply Water Conservation

Water savings can be achieved through a combination of regulatory, economic, incentive-based, outreach measures, and technical assistance. Regulatory measures include water restrictions and codes and ordinances that require water efficiency standards for new development and existing areas. For example, the National Energy Policy Act of 1992 requires that all new construction built after 1994 be equipped with low-flow plumbing fixtures. In Florida, Senate Bill 494, which took effect in July 2009, requires all automatic irrigation systems to use an automatic shutoff device. Senate Bill 2080 prohibits contractual and/or local government ordinance restrictions on the implementation of Florida-Friendly™ landscaping.

Economic measures, such as inclining block rate structures, require customers of public water supply systems to pay more per gallon when they use water in excess of a standard base quantity. Incentive programs include rebates, utility bill credits or give-aways of devices and fixtures that will replace older, less water-efficient models. Recognition programs are also incentive programs that recognize home owners and businesses for their environmental stewardship.

Education is an important element of a successful conservation program. While the actual quantity of water saved as a result of customer education is not always measurable, the effort greatly increases the success of all other facets of the conservation program by raising customer awareness and changing attitudes regarding water use. Educating the public is a necessary facet of every water conservation program and education programs accompanied with other effective conservation measures can be an effective long-term water conservation strategy.

1.0 Public/Private Utilities

Water conservation planning for utilities is often achieved using the unit-based method whereby water savings are based on the unit savings rates of Best Management Practices. Best management practices for utilities include high efficiency clothes washer rebates, ultra-low flow and high efficiency toilet rebates, hot water on demand water heater rebates, waterless urinal rebates, water use evaluations, non-potable outdoor irrigation source replacements, and water efficient landscape and irrigation evaluations and rebates The unit-based method is appropriate when sufficient account-level utility data is available and can be used to identify the number of best management practice opportunities (for example, the number of non-conserving fixtures). However, detailed utility data was unavailable to the District for use in this Assessment. The District is currently working with Conserve Florida Water Clearinghouse to obtain pre-populated conservation models for public supply permittees that can be used for future conservation planning activities. The Conserve Florida Water Clearinghouse model includes a feature that optimizes the selection of conservation best management practices based on a program budget or based on meeting a per-capita water use goal. Utility-level data was not available in the

District during the development of this Assessment. Therefore, a reduction-based approach was used to estimate potential water savings. The analysis incorporates the use of the District's conservation initiative of 150 gallons per capita per day gross demand for public water supply. Results of the analysis are provided in Table 4-9. The Table shows that the potential for water savings for utilities in 2030 is 3.7 million gallons per day. This represents nearly a 20 percent reduction in demand.

2.0 Non-Community Public Supply

Non-community public supply primarily consists of state prisons located in the District. The potential for water savings at prisons is significant because in addition to installation of indoor fixtures such as high efficiency showerheads, toilets, faucets/faucet aerators, and waterless urinals, further savings can be gained by installing water control systems that alert staff to sabotage of fixtures that lead to leaks and running water. Other options include valve controls that allow staff to shut down water supply in sections of the facility. Potential water savings for prisons were based on conservation costs and savings achieved by the Alachua County Jail. Alachua County, in cooperation with Florida Power and Light Energy Services and the Alachua County Sheriff's Department, recently completed the installation of water savings devices at the Alachua County Jail. The jail typically used 100,000 gpd and the devices were projected to save an average of 46,000 gpd. Devices installed included waterless urinals, replacement of the existing 3.5 gallon-per-flush pneumatically controlled toilets with electronically controlled 1.6 gallons per flush toilets containing security lock-out controls, and replacement of controls and valves for lavatories and showers throughout the facility with tamper-resistant timer controls that automatically perform shut-off functions. The reported savings for the Alachua County Jail case study were used to develop metrics that could be used for conservation planning for other correctional facilities. Of these metrics, the demand reduction rate of 46 percent (of baseline use) was used to estimate water savings for others prisons in the District. Table 4-10 shows that the potential for water savings for the non-community water use subcategory in 2030 is 0.81 million gallons per day.

3.0 Domestic Self Supply

Due to the largely rural nature of the District, there are a relatively high number of domestic self supply users. Domestic self supply is defined as "the use of water for individual personal household purposes of drinking, bathing, cooking, or sanitation." Because indoor water use for domestic self supply is not regulated, the District takes a non-regulatory approach to encourage conservation for domestic self supply users. The District's Water Conservation webpage gives multiple examples of water conservation techniques which can be used in a residential situation. Although these best management practices are identified for public water suppliers, many of the best management practices are applicable to domestic self supply. To estimate the potential for domestic self supply conservation, it was assumed that the 2030 domestic self supply water demand in each county could be reduced by approximately 20 percent, which is the average percentage reduction that could potentially be achieved by the public/private utility subcategory as shown in Table 4-9. Based on a 20 percent reduction of the 2030 demand, Table 4-11 shows the potential domestic self supply conservation savings for each county. The total potential reduction by the year 2030 is 4.75 million gallons per day.

Table 4-9. Year 2030 Water Conservation Potential for the Public/Private Utilities Water-Use Subcategory[1].

County	Public Water Supply	2030 Population	2030 Base Demand		2030 Potential Savings[1]
			gpcd		
Alachua	CITY OF ALACHUA[2]	9623	188	1.810	0.367
	CITY OF ARCHER	2075	85	0.176	0.018
	CITY OF HIGH SPRINGS	4372	131	0.573	0.057
	CITY OF NEWBERRY	4549	178	0.812	0.130
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.096	0.010
	Total			**3.467**	**0.581**
Bradford	CITY OF LAWTEY	1003	250	0.251	0.101
	CITY OF STARKE	7261	136	0.984	0.098
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.094	0.009
	Total			**1.329**	**0.208**
Columbia	CITY OF LAKE CITY[3]	26065	176	4.588	0.678
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.273	0.027
	Total			**4.861**	**0.706**
Dixie	TOWN OF CROSS CITY	4002	227	1.514	0.914
	TOWN OF SUWANNEE	940	106	0.100	0.010
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.006	0.001
	Total			**1.620**	**0.924**
Gilchrist	TOWN OF TRENTON	1850	125	0.231	0.023
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.000	0.000
	Total			**0.231**	**0.023**
Hamilton	CITY OF JASPER	4000	168	0.673	0.067
	TOWN OF JENNINGS	966	133	0.128	0.013
	CITY OF WHITE SPRINGS	1400	93	0.130	0.013
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.000	0.000
	Total			**0.931**	**0.093**
Lafayette	TOWN OF MAYO	1264	169	0.213	0.023
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.000	0.000
	Total			**0.213**	**0.023**
Levy	CITY OF CHIEFLAND	3159	158	0.498	0.024
	TOWN OF BRONSON	1801	178	0.321	0.051
	TOWN OF CEDAR KEY	1240	169	0.210	0.024
	TOWN OF FANNING SPRINGS	1134	170	0.192	0.022
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.139	0.014
	Total			**1.360**	**0.135**
Madison	CITY OF MADISON	6049	213	1.287	0.380
	CITY OF GREENVILE	1159	111	0.128	0.013
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.075	0.008
	Total			**1.490**	**0.400**
Suwannee	CITY OF LIVE OAK	8873	154	1.370	0.039
	ADVENT VILLAGE	700	211	0.148	0.043
	TOWN OF BRANFORD	1717	95	0.162	0.016
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.059	0.006
	Total			**1.739**	**0.104**
Taylor	CITY OF PERRY	8229	207	1.700	0.466
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.075	0.008
	Total			**1.775**	**0.473**
UNION	CITY OF LAKE BUTLER	1925	135	0.259	0.026
	PWS with Demands < 0.1 mgd (PWS not listed above)			0.000	0.000
	Total for all PWS in Union County			**0.259**	**0.026**
District Total				**19.27**	**3.70**

[1]For service areas split by District boundaries, the quantities in the Table are what is projected to be used in the District's portion of the counties. Quantities are shown in million gallons per day.

[2] Water savings calculated accordingly: a) calculation for PWS with demands < 0.1 mgd, savings = 10% of 2030 base demand, b) for PWS with demands > 0.1 mgd and gpcd ≤ 150, savings = 10% of 2030 base demand, c) for PWS with demands > 0.1 mgd, and gpcd > 150, savings calculated accordingly: 2030 demand @ 150 gpcd = 2030 population x 150 gpcd Savings = 2030 base demand - 2030 demand @150 gpcd.

[3] Includes Turkey Creek Utilities.

[4] Lake City includes Brandon-Brent/Verndale and Seally Pine Ridge S/D Service Areas.

Table 4-10. Year 2030 Water Conservation Potential for the Non-Community Water-Use Subcategory (Prisons)[1].

County	2030 Demand	2030 Savings[2]	Capital Cost ($1,000)[3]
Baker	0.351	0.161	$1,381
Columbia	0.350	0.161	$2,864
Jefferson	0.131	0.060	$1,397
Lafayette	0.184	0.085	$1,945
Suwannee	0.406	0.187	$1,802
Union	0.336	0.154	$3,141
Total	**1.76**	**0.81**	**N/A**

[1]Quantities are shown in million gallons per day.
[2]2030 Savings = 0.46 x 2030 baseline demand
[3]Capital cost = $1,185/inmate x facility design max capacity.

Table 4-11. Year 2030 Water Conservation Potential for the Domestic Self-Supply Water-Use Subcategory[1].

County	Domestic Self Supply 2030 Demand	20% Percent Conservation Savings
Alachua	4.13	0.826
Baker	0.05	0.010
Bradford	1.98	0.396
Columbia	4.86	0.972
Dixie	1.21	0.242
Gilchrist	1.39	0.278
Hamilton	0.79	0.158
Jefferson	0.43	0.086
Lafayette	0.7	0.140
Levy	1.77	0.354
Madison	1.37	0.274
Suwannee	2.98	0.596
Taylor	1.28	0.256
Union	0.82	0.164
Total	**23.76**	**4.75**

[1]For service areas split by District boundaries, the quantities in the table are what is projected to be used only in the District's portion of the counties. Quantities are shown in million gallons per day.

Section 2. Industrial/Commercial/Institutional Water Conservation

The industrial/commercial/institutional water use category consists of industrial, dewatering, mining, power plants, bottled water production, and "other." The potential water savings resulting from conservation applied to power plants is not addressed because groundwater is not used by power plants in the District. The District's water conservation strategies for the industrial/commercial/institutional use category include requiring applicants for new water use permits and permit renewals to demonstrate how they will use the best available water saving technologies in their processes. The District's new Water Use Permitting Guide (adopted January, 2010) requires conservation plans for new permits and permit renewals. For industrial/institutional/commercial uses, the plan must include a water audit, leak detection and

repair, best available technologies to reduce water consumption, employee awareness and customer education. Water conservation measures and best management practices that are applicable to industrial/commercial/institutional permittees include source water metering, system audits, leak detection/repair, use of pressure-reducing valves, water budgeting, use of drought tolerant landscape, irrigation evaluations and retrofits, water use evaluations, performance contracting, retrofitting showers, faucets, washers, and toilets with high-efficiency models, retrofitting urinals with waterless urinals, cooling tower management, boiler water management, and employee awareness.

1.0 Mining

Table 4-12 shows the mining operations in the District that are permitted to use 0.1 million gallons per day or greater of groundwater. The table shows that the projected 2030 groundwater demand is 8.78 million gallons per day. Determining the water conservation potential for mining operations within the District is problematic for reasons that include the highly complex nature of how water is used, distinguishing between consumptive versus non-consumptive uses, and assignment of some mining water uses to the Industrial water use category. To accurately determine the quantity of water that could be conserved for mining operations, a detailed process evaluation would need to be conducted for each facility. It is recommended that each facility develop a comprehensive conservation plan that would identify conservation measures to reduce groundwater withdrawals, set targets for when these measures would be implemented, and develop cost estimates for implementing conservation measures that could be used to obtain grant funding to help offset costs. In lieu of such plans, for the purposes of this Assessment, it is assumed that it may be economically and technically feasible for these facilities to achieve at least a 5 percent reduction in water use.

Table 4-12. Year 2030 Water Conservation Potential for Mining Permittees[1].

County	Permittee	Mined/Processed Materials	2030 Demand Projections	2030 Savings Assuming 5% Conservation
Bradford	E I Dupont De Nemours	Titanium	1.04	0.052
Columbia	Lime Rock Industries	Limestone	0.52	0.026
Suwannee	Suwannee American Cement	Limestone, sand, or gravel	0.74	0.037
	Anderson Mining Corp.	Limestone, sand, or gravel	0.36	0.018
	Urban Mining	Unknown	0.48	0.024
Taylor	Martin Marietta Material	Limestone, sand, or gravel	1.86	0.093
	Cabbage Grove Mining Co.	Limestone, sand, or gravel	1.27	0.064
Hamilton	Angelo's Aggregate Materials	Limestone, sand, or gravel	2.52	0.126
Total			**8.78**	**0.44**

[1]Quantities are shown in million gallons per day. Since the baseline data set used in the Industrial / Commercial / Institutional projections is from the year 2000, the permittee names may now be different than those listed in the table.

Table 4-12 shows that the potential for water conservation for the planning period for mining operations if a five percent reduction of the 2030 demand was achieved through conservation is 0.44 million gallons per day.

2.0 Industrial

Table 4-13 lists the industrial permittees in the District with groundwater use of 0.1 million gallons per day or greater. The table shows that the 2010 groundwater demand is 73.88 million gallons per day. Ninety seven percent of this demand is attributed to the PCS phosphoric acid plant and phosphate mine in Hamilton County and Buckeye Technologies' Foley Plant in Taylor County. Both facilities have an estimated groundwater use of over 30 million gallons per day each. To accurately determine the potential for water conservation at these facilities, a detailed process evaluation would need to be conducted. It is recommended that both facilities develop a comprehensive conservation plan that would identify measures to reduce groundwater withdrawals, set targets for when these reductions would occur, and develop cost estimates that could be used to obtain grant funding to help offset costs of conservation measures. In lieu of such plans, for the purposes of this Water Supply Assessment, it is assumed that it may be economically and technically feasible for these facilities to achieve at least a five percent reduction in water use. Table 4-13 shows that a five percent reduction of the 2030 demand is 3.69 million gallons per day.

Table 4-13. Year 2030 Water Conservation Potential for Industrial Permittees[1].

County	Permittee	Process Description	Current and Projected Use[1]	2030 Savings Assuming 5% Conservation
Alachua	Florida Rock Industries (*Now Vulcan Materials*)	Concrete/cement manufacturing	1.32	0.066
Bradford	Enron Gas (*New owner unknown*)	Chemical processing, natural gas	0.13	0.007
Dixie	Unknown	Unknown	0.11	0.006
	Suwannee Lumber Co	Manufacturing of mulch, soil and rock/stone	0.11	0.006
Gilchrist	Unknown	Unknown	0.10	0.005
Hamilton	PCS	Chemical processing, Phosphate rock and phosphoric acid	32.61	1.63
	Moltech Power Systems (*Now Accutronics*)	Battery manufacturing	0.13	0.007
Levy	Corbitt Manufacturing	Mulch manufacturing	0.12	0.006
Suwannee	Gold Kist Poultry	Food processing – Poultry	0.42	0.021
Taylor	Buckeye Florida	Pulp processing	38.84	1.942
Total			**73.88**	**3.69**

[1]Estimated water use for these facilities is not anticipated to increase during the 2010-2030 planning period. Quantities are shown in million gallons per day. Since the baseline data set used in the Industrial / Commercial / Institutional projections is from the year 2000, the permittee names may now be different than those listed in the table.

Section 3. Recreational Water Conservation

1.0 Golf Courses

Golf courses can save water by implementing "smart" irrigation technologies, which are irrigation strategies that maximize water efficiency by monitoring and using information such as soil moisture, rain, wind, slope, soil, and plant type, and applying the right amount

of water to the landscape based on these factors. Smart irrigation technologies are typically weather-based or soil moisture-based. Both types of smart controllers use various technological configurations, all of which are capable of saving significant volumes of water. Potential savings for golf courses were based on results of research projects conducted by the University of Florida that provided data on how much water could be saved by smart irrigation systems. Adjusted water demands and savings at year 2030 are provided in Table 4-14. The Table shows a conservation savings of 0.31 million gallons per day.

Table 4-14. Year 2030 Water Conservation Potential for Golf Courses[1].

County	2030 Projected Demand	2030 Potential Conservation Savings[2]
Alachua	0.135	0.038
Bradford	0.153	0.043
Columbia	0.317	0.090
Jefferson	0.208	0.059
Levy	0.129	0.036
Madison	0.162	0.046
Total	**1.104**	**0.312**

[1]Quantities are shown in million gallons per day.
[2]2030 savings = 0.22 x 2030 baseline demand.

Another option for golf course water conservation is the use of subsurface irrigation technology in lieu of overhead irrigation. Subsurface irrigation reduces evaporative losses typically associated with overhead irrigation and is potentially a more efficient method depending on soil conditions, system design, and irrigation management techniques. The District should consider a pilot program to test subsurface irrigation on golf courses with different soil types.

Section 4. Summary of the Potential for Non-Agricultural Water Conservation Savings

Table 4-15 summarizes the estimates of the potential for water conservation for the year 2030 in the District for all non-agricultural water use categories. The total water conservation potential is at least 13.7 million gallons per day.

Table 4-15. Year 2030 Water Conservation Potential for Each Non-Agricultural Water Use Category[1].

Use Category		Potential 2030 Water Conservation Savings
Public Supply	Public/Private Utilities	3.70
	Non-Community Public Supply (Prisons)	0.81
	Domestic Self Supply	4.75
Industrial Commercial Institutional	Mining	0.44
	Industrial	3.69
Recreational	Golf Courses	0.31
Total		**13.70**

[1]Quantities are shown in million gallons per day.

Part 3. Agricultural Water Conservation

The following is a discussion of the potential water savings that could be achieved through implementation of conservation options for the agricultural water-use category. The District has extensively researched the water saving potential of increasing the water-use efficiency of irrigation systems in regions of the District with the greatest percentage of agricultural water users. A variety of irrigation systems and practices are employed at agricultural operations within the District. For the purposes of documenting agricultural water use types, they are included in the categories listed below.

- overhead irrigation (large sprinklers, center pivots, and traveling guns, etc.)
- low volume irrigation (drip, micro-jet, etc)
- nursery (sprinklers, misters, etc)
- livestock

The potential water savings that could be achieved through agricultural conservation was determined using the following methodology. The District's permitting database was used to determine the total agricultural irrigation use in each county and to determine the percentage of the total use that is applied through the various types of irrigation systems. The data showed that overhead irrigation represents approximately 80 percent of the systems used across the District. Because the percentage was so high, the methodology to determine the water conservation potential was focused on overhead systems.

Data from the US Department of Agriculture (Natural Resource Conservation Service) on best management practices for overhead irrigation systems was used to determine the degree to which implementation of these best management practices could reduce water use. The data were for typical agricultural operations within the District which include overhead irrigation of pasture, small grains, soybeans, hay, and corn. Suggested best management practices include the use of flow meters and efficient irrigation schedules and maintenance and routine upgrades to irrigation systems. The use of a combination of these best management practices could result in a theoretical reduction in agricultural water use of 19 percent in each county when compared to a system with no best management practices in place. However, a 19 percent reduction represents the maximum potential savings in agricultural water use assuming that all agricultural operations using overhead irrigation implement every best management practice. Since many operations may already be employing best management practices to some degree and some may not choose to implement best management practices, it is not realistic to assume that a reduction of this magnitude can be achieved. It was therefore decided that it may be possible to achieve a 10 percent conservation savings, which equates to a reduction of 11.12 million gallons per day Districtwide. Table 4-16 shows the total agricultural water use in each County, the percentage applied through overhead irrigation, the actual water use represented by that percentage, and the water savings based on a 10 percent reduction in the amount of water applied through overhead systems.

Table 4-16. Potential Agricultural Water Conservation Savings by County[1].

County	Agricultural Water Use	Percent Overhead Irrigation	Overhead Irrigation Usage	Ten Percent Reduction in Water Use
Alachua	19.69	83.0%	16.34	1.63
Baker	0.00	0.00%	0.00	0.00
Bradford	0.95	77.3%	0.73	0.07
Columbia	5.74	89.9%	5.16	0.52
Dixie	1.86	80.7%	1.50	0.15
Gilchrist	13.96	85.0%	11.86	1.19
Hamilton	19.33	96.0%	18.55	1.86
Jefferson	8.72	78.0%	6.80	0.68
Lafayette	7.01	81.0%	5.68	0.57
Levy	14.47	88.0%	12.73	1.27
Madison	11.35	93.0%	10.56	1.06
Suwannee	20.77	90.0%	18.69	1.87
Taylor	1.86	66.0%	1.23	0.12
Union	1.73	84.0%	1.45	0.14
Total	**127.44**		**111.28**	**11.12**

[1]Quantities are shown in million gallons per day.

The District is working to enhance the efficiency of agricultural water use. A water conservation plan is now required to be developed as part of the permitting process for each agricultural water use type. To meet this requirement an applicant must complete a "Water Conservation Worksheet" for each irrigation system associated with their operation. The worksheet is intended to document current and future improvements in efficiency, irrigation scheduling, and operation and maintenance. Permittees must demonstrate that the Florida Department of Agriculture and Consumer Services water conservation best management practices and University of Florida Institute of Food and Agricultural Science or US Department of Agriculture's Natural Resources Conservation Service irrigation scheduling are being implemented in their irrigation systems and practices. Water use permit durations are assigned based on the permittees' level of demonstrated water conservation implementation. This allows agricultural water users to obtain the water needed for irrigation while reducing water use in their operations to the greatest extent possible.

To provide the resources necessary for farmers to improve the efficiency of their water use and to improve water quality, the District has implemented the Suwannee River Partnership. The Partnership helps growers implement best management practices that effectively reduce surface water and groundwater contamination and use while still allowing productive use of resources. Best management practices developed by the Partnership use the best available technology, are practical and economically feasible for farmers to implement, and are voluntary and incentive-based.

Technical resources are also available from the Florida Department of Agriculture and Consumer Services, the Natural Resource Conservation Service, the Institute of Food and Agricultural Sciences and the county agricultural extension offices to assist the agricultural community in the implementation of best management practices. Additionally, funding for water conservation upgrades may be available to the agricultural community through Natural

Resource Conservation Service cost share programs such as the Environmental Quality Incentive Program.

Part 4. Summary of Alternative Water Source Availability

Table 4-17 is a summary of the quantity of water that will potentially be available in the District from alternative sources or saved through water conservation during the 2010-2030 planning period. Surface water availability could not be quantified because the District has yet to establish minimum flows on numerous rivers. The overall availability of brackish water also could not be determined because when brackish water is developed, it will be on a relatively small scale for specific industrial or power generation uses.

Table 4-17. Potential Availability of Water from Alternative Sources and Conservation During the Planning Period[1].

Alternative Source/Water Conservation	2030 Potential Water Availability
Brackish Groundwater	To be determined on a site and industry specific basis
Surface Water	To be determined based on future Minimum Flows and Levels establishment
Reclaimed Water	5.03
Non-Agricultural Water Conservation	13.70
Agricultural Water Conservation	11.12

[1]Quantities are shown in million gallons per day.

Part 1. Conclusions

Section 1. Demand Projections

Water Demand for the public supply, domestic self supply, agricultural, industrial/commercial/institutional, thermo-electric power generation, and recreational use categories is projected to increase by 11.82 million gallons per day during the planning period, based on the low-range projection methodology. The low range methodology involved a rigorous analysis of established growth and water use trends for each water use category within the District. Table 5-1 contains the low-range demand projections for each use category.

Table 5-1. Low-Range Demand Projections for All Use Categories for the Planning Period[1].

Water-Use Category	2010	2015	2020	2025	2030	Planning Period Increase
Public Supply	23.30	24.44	25.47	26.38	27.37	4.08
Agricultural	127.46	127.46	127.46	127.46	127.46	0.00
Domestic Self Supply	18.87	20.19	21.45	22.63	23.76	4.89
Industrial, Commercial, & Institutional	84.72	85.00	85.24	85.47	85.70	0.98
Thermo-Electric Power Generation	2.59	2.95	3.32	3.69	4.06	1.48
Recreational	1.81	1.92	2.02	2.11	2.20	0.40
Total	**258.73**	**261.96**	**264.95**	**267.74**	**270.55**	**11.82**

[1]Quantities are shown in million gallons per day.

Demand for groundwater based on the high-range demand projections, which were developed to reflect a potential peak water use scenario in excess of established growth trends, is projected to increase by 64.19 million gallons per day during the planning period. Table 5-2 contains the high-range demand projections.

Table 5-2. High-Range Demand Projections for All Use Categories for the Planning Period[1].

Water-Use Category	2010	2015	2020	2025	2030	Planning Period Increase
Public Supply	23.30	26.39	28.69	31.26	33.79	10.49
Agricultural	134.54	146.11	155.39	159.51	163.85	29.31
Domestic Self Supply	18.87	20.19	21.45	22.63	23.76	4.89
Industrial, Commercial, & Institutional	84.80	86.17	87.31	88.17	89.13	4.34
Thermo-Electric Power Generation	2.59	9.55	15.62	16.99	17.36	14.77
Recreational	1.81	1.92	2.02	2.11	2.20	0.40
Total	**265.89**	**290.32**	**310.47**	**320.68**	**330.08**	**64.19**

[1]Quantities are shown in million gallons per day.

Groundwater demand in the area of the District's North Florida Model, which encompasses all ofthe District, portions of three adjacent water management districts, and southern Georgia, is projected to increase by up to 24 percent during the planning period. The magnitude of groundwater withdrawals that are projected to occur by 2030 in the St. John's River Water Management District northernmost nine counties will be significantly larger than the withdrawals in the entire Suwannee River Water Management District.

Section 2. Water Resource Impact Assessment

The groundwater basin divide in the northeastern District has migrated southwestward more than 35 miles in 70 years as a result of the potentiometric decline that occurred from pre-development through 2005. As a consequence of this migration, the size of the groundwater contributing area to the eastern District has decreased by more than 20 percent or 1,900 square miles. The decrease is apparently a result of groundwater withdrawals originating in the District, the St. John's River Water Management District, and the State of Georgia. The decline in the potentiometric surface in the northeastern District is suspected to have impacted a number of rivers, lakes, and springs to the degree that they are not currently meeting their established minimum flows and levels or interim flow constraints or they will not meet them at some point during the planning period.

The North Florida Model was updated with both the low-range and high-range demand projections for each five-year increment during the planning period. Groundwater withdrawal simulations were conducted for each increment and potentiometric surfaces were generated for the Upper Floridan aquifer. The difference between each potentiometric surface and the baseline simulation (2005) was calculated to establish the potential cumulative drawdown for each increment. The results of the analysis showed very little difference between the predicted low-range and high-range drawdowns. This is because the high-range 2030 projected demand is only 52.5 mgd higher than the low range projection. This quantity is dispersed across the entire area of the District and is only 5 percent of the total 2030 groundwater withdrawal quantity in the model area (approximately 1.1 billion gallons per day). Both simulations showed identical areas of significant drawdown in the St. John's River Water Management District related to the projected groundwater withdrawals in Clay, Duval, and St. John's Counties. The only significant difference between the simulations is that the high-range withdrawal scenario exhibits small-scale localized areas of drawdown that result from proposed industrial and residential developments that are not part of the low-range scenario.

The North Florida Model was also used to predict cumulative declines from the year 2005 surficial aquifer water table, which is the baseline aquifer condition in the model. In both the low and high-range simulations, no appreciable drawdowns were observed in the water table through the year 2030.

The North Florida Model simulated the change in flow at various river gaging stations and springs within the model area for each five-year increment within the planning period. Based on this analysis, rivers that are predicted to exceed their established minimum flows during the planning period are listed below.

- The Upper Santa Fe River at Worthington Springs - predicted to exceed during the 2010–2015 interval. Even though flow declines are not predicted for the Upper Santa Fe at Graham during the planning period, the allowable flow decline is 0.0 percent; therefore, no additional surface water will be available during low-flow periods and additional groundwater development in the surrounding region may cause the established minimum flow for this gage to be exceeded.
- The Waccasassa River at Gulf Hammock - predicted to exceed during the 2010–2015 interval. However, District staff believes that problems with the model in the vicinity of the river raise questions about the validity of the prediction. The District is currently revising the North Florida Model and is evaluating the issue as part of this process.

Interim flow constraints have been developed for rivers that do not yet have established minimum flows. Rivers that are predicted to exceed interim flow constraints during the planning period are listed below.

- The Upper Suwannee River at White Springs - predicted to exceed during the 2010–2015 interval.
- The Lower Santa Fe River at Ft. White - predicted to exceed during the 2025–2030 interval.
- The Alapaha River at Jennings - predicted to exceed during the 2010–2015 interval.
- The Aucilla River at Lamont - predicted to exceed during the 2010-2015 increment. However, the exceedance is at the extreme low-flow end of the flow duration curve. In addition, the river is located in the far western portion of the District where impacts from groundwater withdrawals are minimal. The District will conduct additional investigations in the area prior to making a determination as to the seriousness of the impacts.

Numerous springs in the District with established minimum flows and interim flow constraints were assessed using the North Florida Model. Based on the results of the analysis, interim flow constraints for Hornsby Spring and the Santa Fe River Rise, located along the Lower Santa Fe River, are predicted to be exceeded during the 2015-2020 and 2025-2030 intervals respectively. As a result of the data presented above, it is recommended that the District designate specific regions in the northeastern portion of the District as Water Supply Planning Regions. Figure 5-1 shows the location and extent of the proposed Water Supply Planning Regions.

Section 3. Assessment of Alternative Water Source Availability

Alternative water sources that are potentially available to meet demands through 2030 were evaluated. Alternative water sources are defined as all sources of water other than fresh groundwater from the Upper Floridan aquifer. Alternative sources that were evaluated include surface water, reclaimed water, and brackish groundwater. Water conservation was also evaluated even though it is a demand management strategy rather than an alternative water source. Table 5-3 is a summary of the availability of water from alternative sources and the potential quantity that could be saved through conservation.

Table 5-3. Potential Availability of Water from Alternative Sources and Conservation During the Planning Period[1].

Alternative Source/Water Conservation	2030 Potential Water Availability
Brackish Groundwater	To be determined on a site and industry specific basis
Surface Water	To be determined based on future Minimum Flows and Levels establishment
Reclaimed Water	5.03
Non-Agricultural Water Conservation	13.70
Agricultural Water Conservation	11.12

[1]Quantities are shown in million gallons per day.

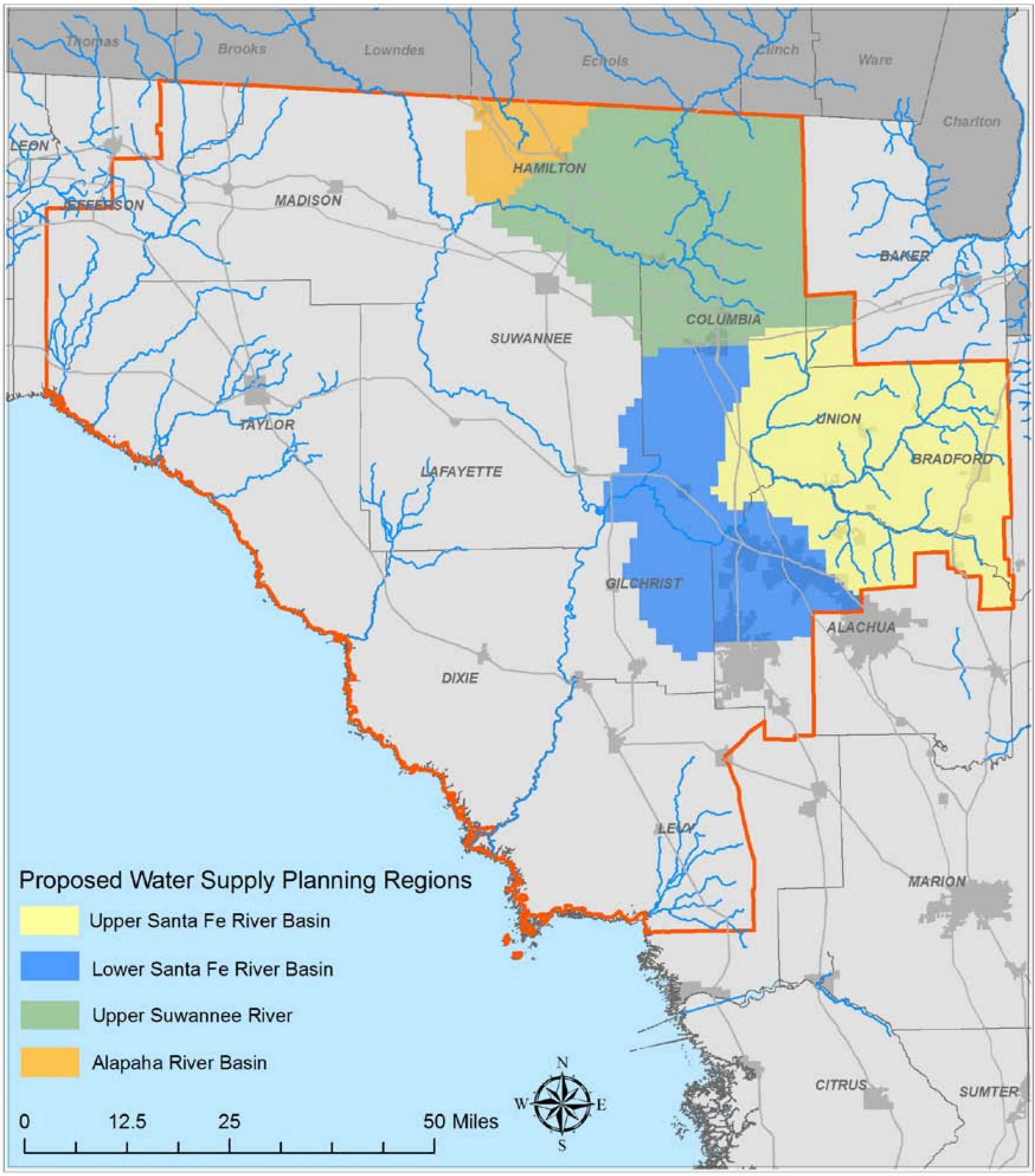

Figure 5-1. Proposed Water Supply Planning Regions.

Part 2. Recommendations

Section 1. Proposed Water Supply Planning Regions

- Designate the Upper Santa Fe River Basin, Lower Santa Fe River Basin, Upper Suwannee River Region, and Alapaha River Basin as Water Supply Planning Regions due to significant regional declines in the Upper Floridan aquifer potentiometric surface and predicted exceedances of established minimum flows and interim flow constraints in these areas.
- Limit the duration of water use permits in the proposed Water Supply Planning Regions to no more than five years until recovery and prevention strategies are developed and implemented unless the applicant implements measures to provide reasonable assurance that their proposed use will result in a net benefit to the resource.
- Develop a plan to require all new applicants for water use permits and those renewing permits in excess of 100,000 gallons per day in the proposed Water Supply Planning Regions to monitor and report their use. Continue efforts to develop a more accurate assessment of the actual water use of the major water users in the District, especially in the proposed Water Supply Planning Regions.
- Encourage all new applicants for water use permits in excess of 500,000 gallons per day in the proposed Water Supply Planning Regions to use alternative sources of water if the sources are technically, economically, and environmentally feasible.
- Develop recovery and prevention strategies in conjunction with the St. John's River Water Management District for the proposed Water Supply Planning Regions that will implement enhanced levels of conservation, aquifer recharge projects, use of alternative sources, and reductions in groundwater withdrawals.
- Pursue funding sources and legislative backing for the implementation of recovery and prevention strategies and for the development and study of alternative supply and water conservation options.

Section 2. Minimum Flows and Levels

- The importance of establishing minimum flows and levels for all the District priority water resources as expeditiously as possible cannot be over emphasized. The District should investigate every avenue to secure the necessary funding to complete the required data collection, analysis, peer review, and establishment.
- Develop and refine tools and methodologies to implement minimum flow and levels. This will make them easier to establish, peer review, and defend.

Section 3. Data Collection

- Staff should recommend changes to the monitoring network following a comprehensive audit of the District's existing monitoring networks. Use various statistical methods to optimize the locations of data collection sites and frequency of collection for rivers, groundwater, springs, lakes, wetlands, and rainfall throughout the District to gain a better understanding of hydrologic trends and to gauge whether minimum flows and levels and interim flow constraints are being met.
- Develop a monitoring partnership with the State of Georgia for ground- and surface water data collection and sharing.

Section 4. Modeling

- Continue to use the North Florida Model, Mega Model and Northeast Florida Model to refine the understanding of the magnitude of existing and projected impacts to water resources in the Upper and Lower Santa Fe River and springs, White Springs, Ichetucknee Springs, and the Upper Suwannee, Alapaha, and Withlacoochee Rivers. In addition, use the models to apportion the degree of impact to water resources from groundwater withdrawals in the District, the St. John's River Water Management District, and the State of Georgia.
- Update the calibration of the North Florida Model to reflect average hydrologic conditions. The model is currently calibrated to a drought condition. Continue to pursue other modifications that will allow the model to mesh more seamlessly with the St. John's River Water Management District's North East Florida model.
- Investigate any existing or planned modeling efforts in the southern third of Georgia.
- Coordinate with the St. John's River Water Management District, the State of Georgia, the US Geological Survey and other agencies to begin a process to develop a groundwater flow model with an area that would encompass the entire north Florida/South Georgia Region that may contribute to water resource impacts in the District.

Section 5. Coordination and Outreach

- Work with State of Georgia, the St. John's River Water Management District, the US Geological Survey, and other agencies to develop a strategy for data collection, data analysis and groundwater modeling to better define current and future regional water resource impacts. Coordinate with the State of Georgia and the St. John's River Water Management District to produce periodic, regional potentiometric maps to develop a more complete understanding of long-term aquifer trends in North Florida.
- Coordinate the review of water use permits in the boundary regions of adjacent water management districts and the State of Georgia to ensure consistency in requirements, restrictions, and special conditions.
- Enhance outreach programs to educate stakeholders, elected officials, and individuals on water supply issues.
- Continue to seek input on all aspects of the water supply assessment and planning process from affected parties throughout the District.

Section 6. Water Supply Planning and Development and Water Conservation

- Continue to work with the major users in each water use category to identify, improve, and modify water use data collection and reporting methods that will refine and enhance demand projection methodologies.
- Provide incentives to encourage local governments and water suppliers to coordinate water supply projects to facilitate a regional approach to water supply development.
- Encourage the exploration and use of the Lower Floridan aquifer for large industrial water users and thermo-electric power generation.
- Encourage the beneficial and efficient use of all reclaimed water resources in the District.
- Work through the Suwannee River and Ichetucknee Partnerships to enhance agricultural water conservation incentive and outreach efforts, such as the mobile irrigation lab program, to help farmers increase the efficiency of their water use.

- Designate a water conservation coordinator to enhance the District's efforts to develop and implement water conservation programs for all use categories.
- Require the major industrial, mining, and agricultural users in the proposed Water Supply Planning Regions to develop and implement comprehensive water conservation plans to maximize reductions in water use.
- Develop a method to assess freeze protection quantities prior to the 2015 Water Supply Assessment. Develop a set of Best Management Practices for the frost/freeze protection of various crops.

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Adams, Bruce (2010). Discussions with Bruce Adams on 4/8/10. Bruce Adams served as the Water Conservation Officer at SFWMD for 30 years. He is currently serves the Florida Golf Superintendents Association as a professional consultant.

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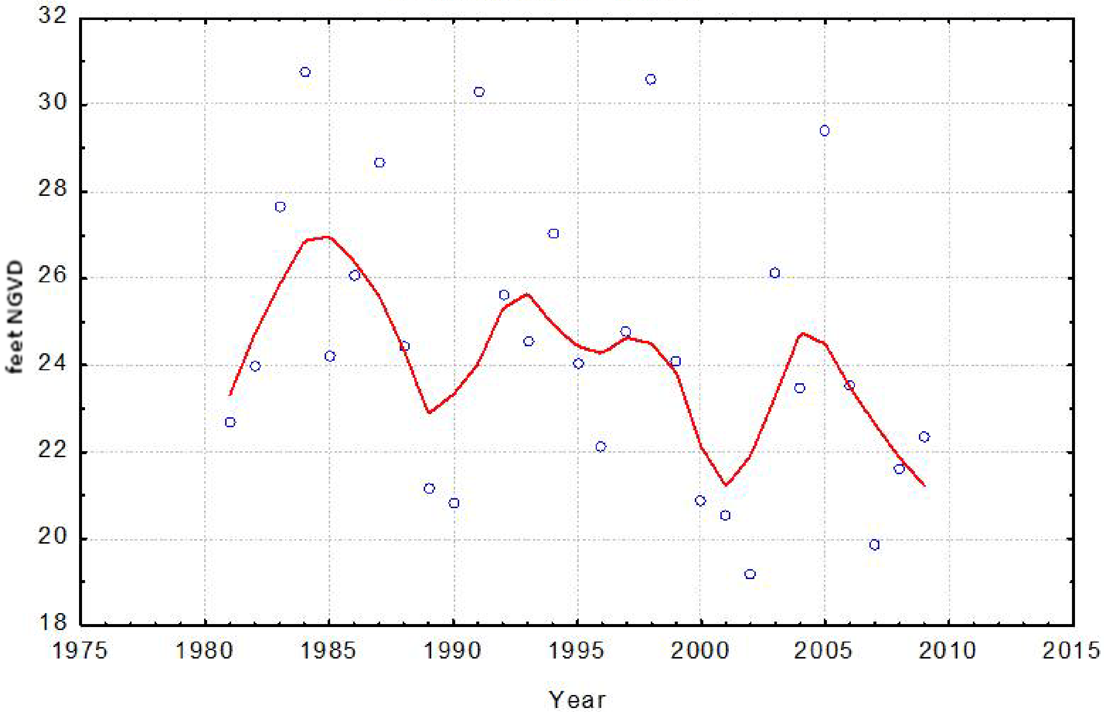

Figure 1. LOWESS-smoothed trendline of groundwater levels for well 041923001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

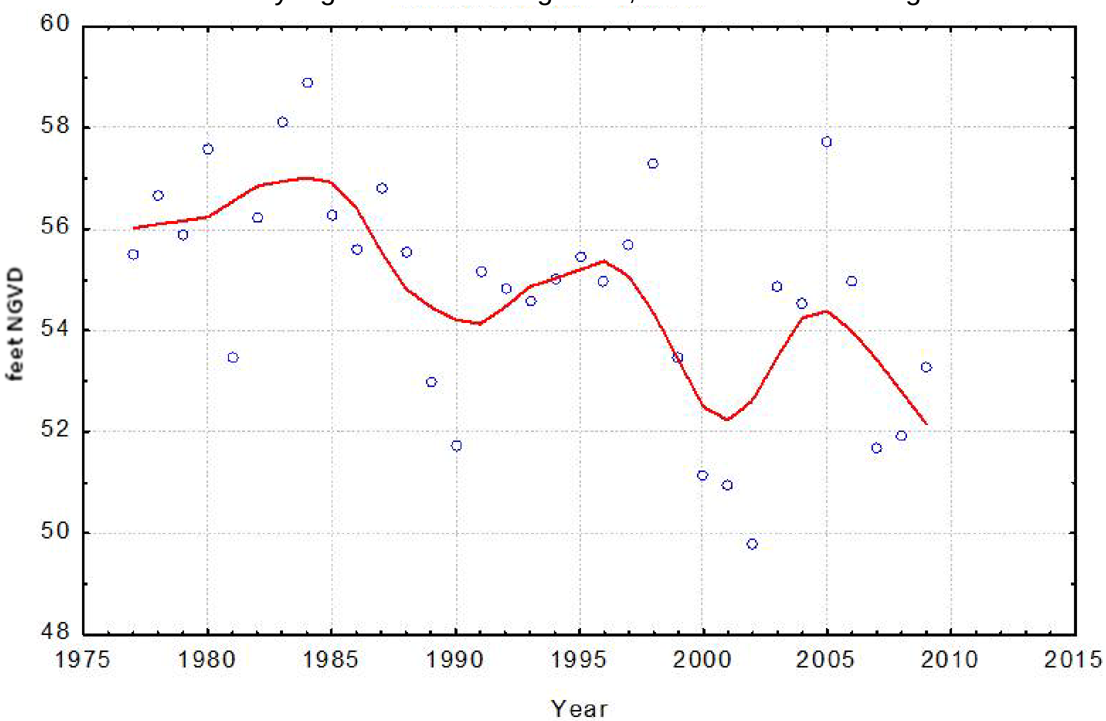

Figure 2. LOWESS-smoothed trendline of groundwater levels for well 051933001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

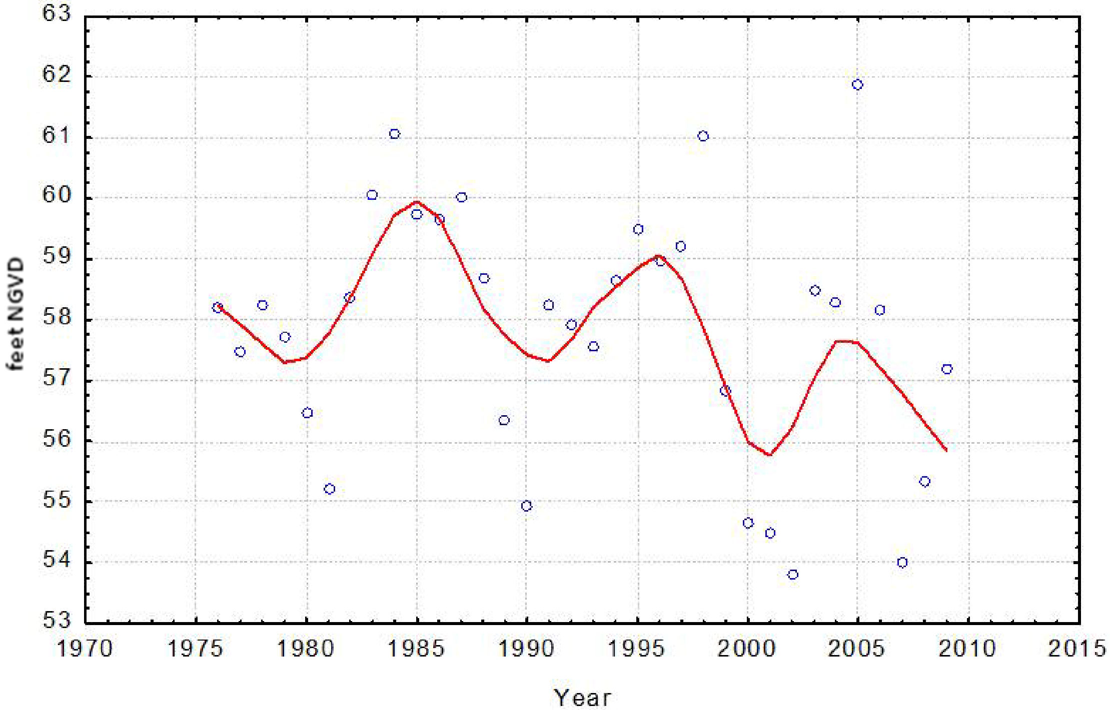

Figure 3. LOWESS-smoothed trendline of groundwater levels for well 062102001. This well does not exhibit a statistically-significant declining trend, as determined through Kendall-Tau analysis.

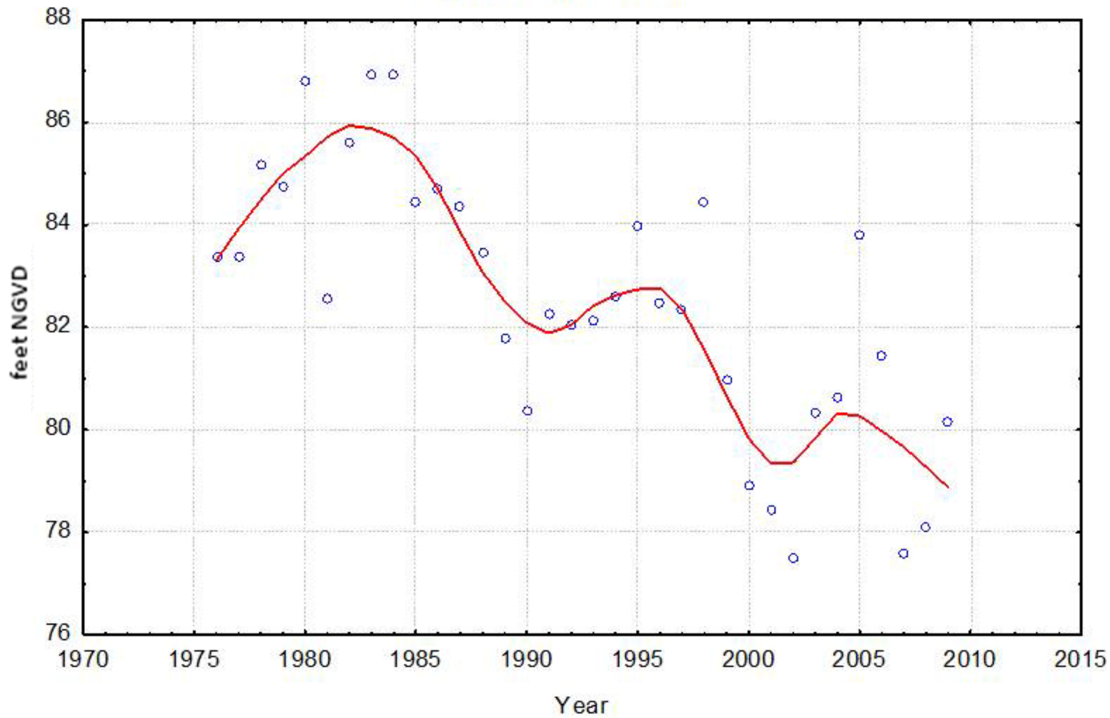

Figure 4. LOWESS-smoothed trendline of groundwater levels for well 072215001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

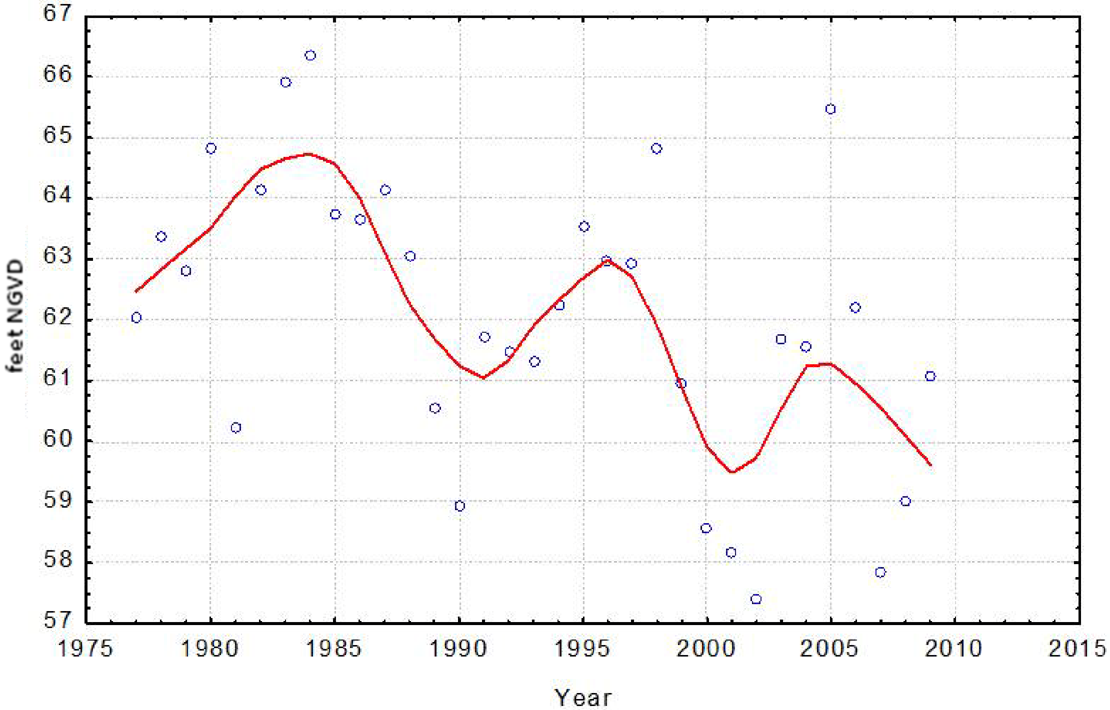

Figure 5. LOWESS-smoothed trendline of groundwater levels for well 072132001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

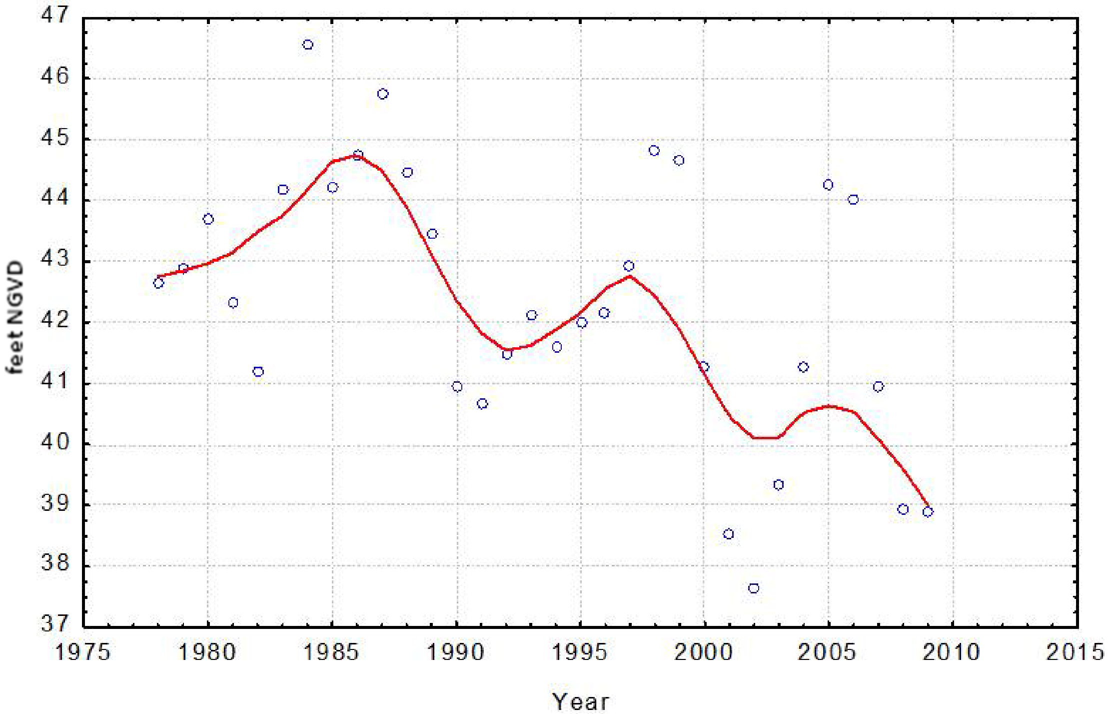

Figure 6. LOWESS-smoothed trendline of groundwater levels for well 081926001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

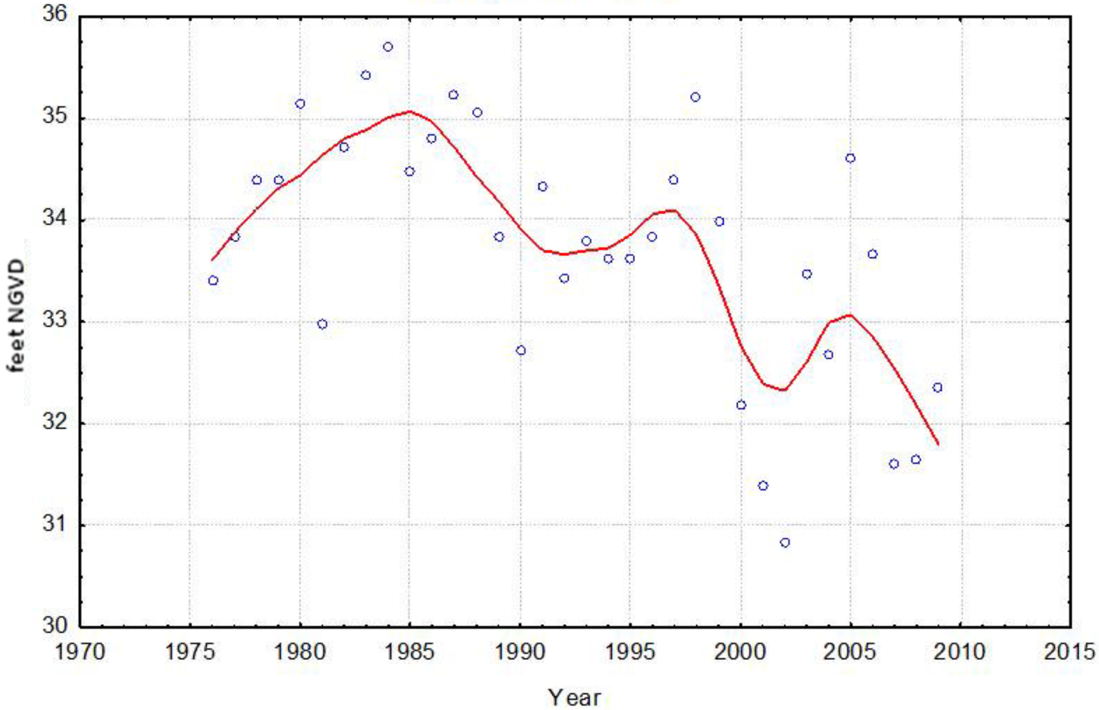

Figure 7. LOWESS-smoothed trendline of groundwater levels for well 081703001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

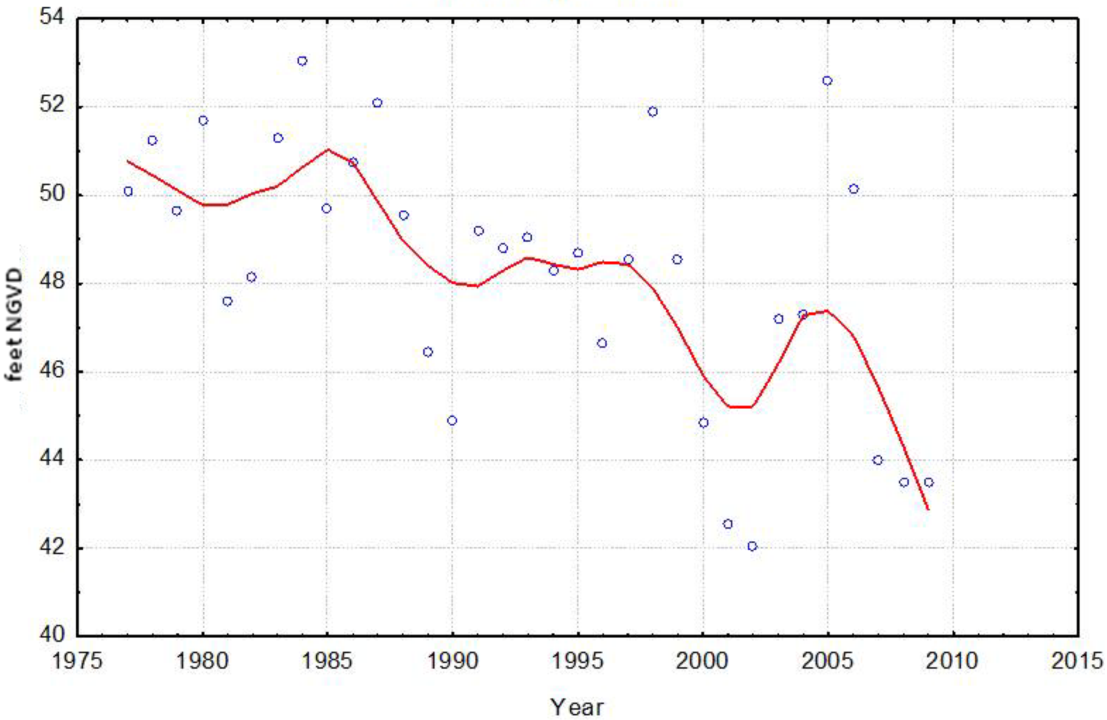

Figure 8. LOWESS-smoothed trendline of groundwater levels for well 041705001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

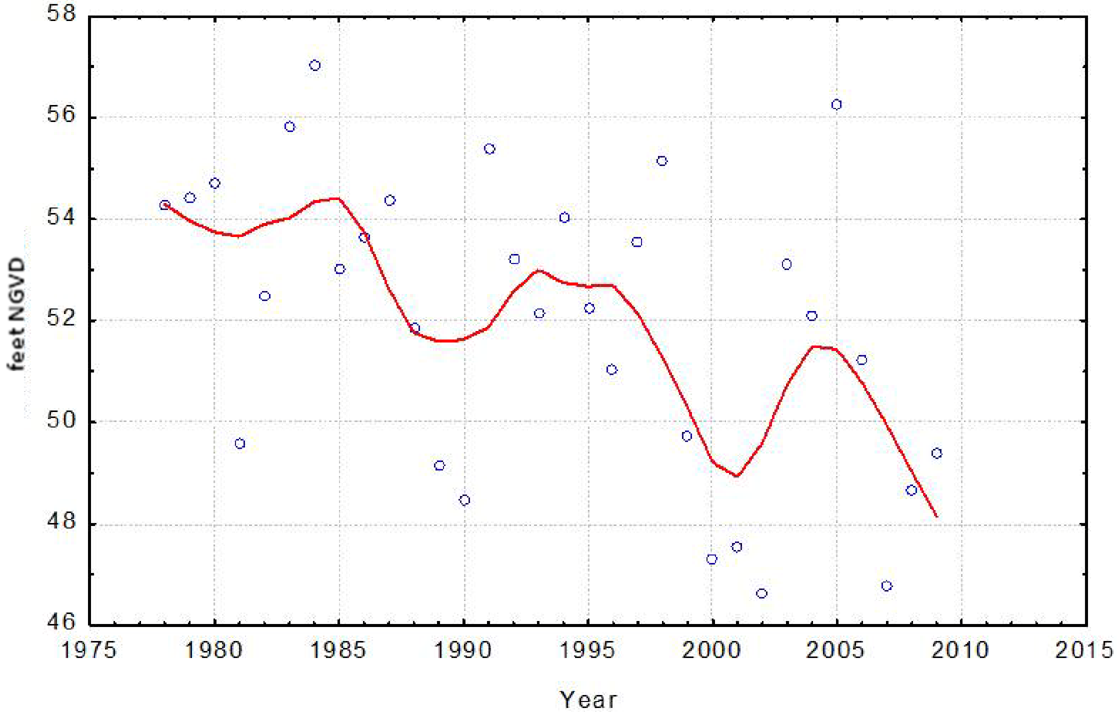

Figure 9. LOWESS-smoothed trendline of groundwater levels for well 011727001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

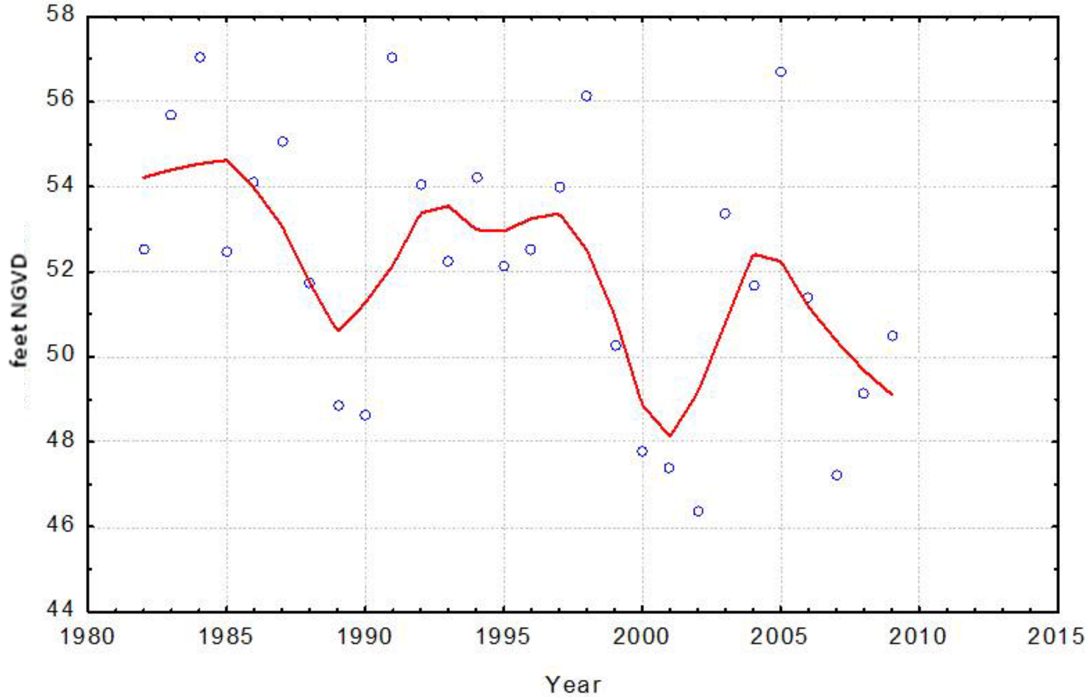

Figure 10. LOWESS-smoothed trendline of groundwater levels for well 011534001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

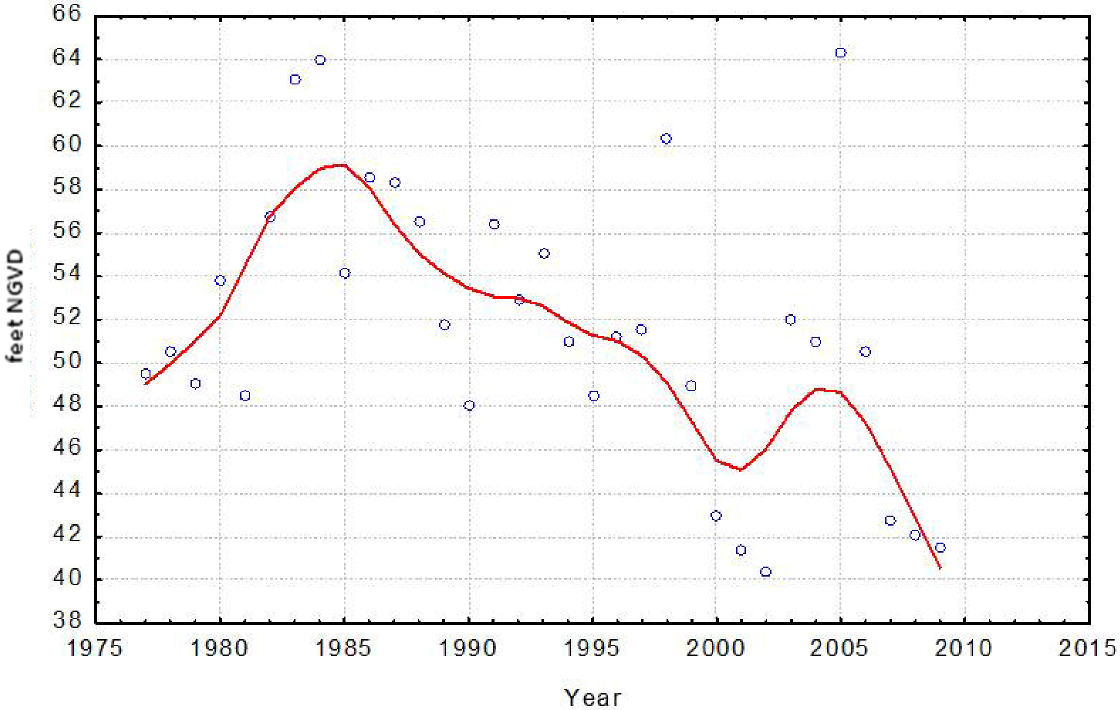

Figure 11. LOWESS-smoothed trendline of groundwater levels for well 091607001. This well does not exhibit a statistically-significant declining trend, as determined through Kendall-Tau analysis.

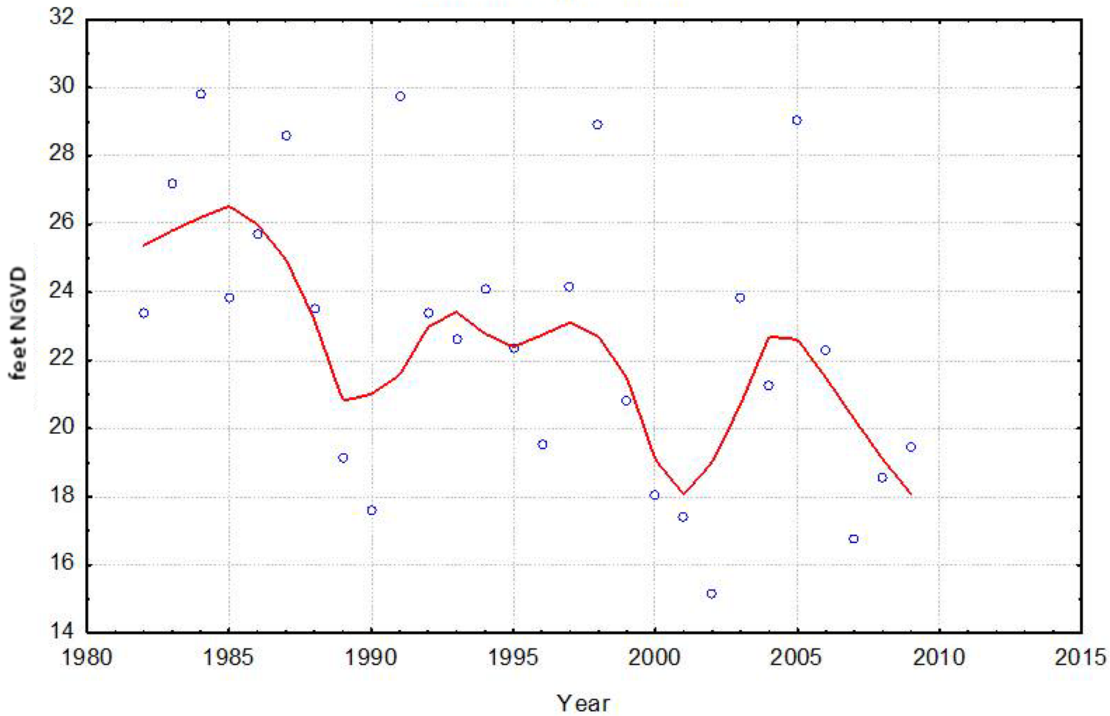

Figure 12. LOWESS-smoothed trendline of groundwater levels for well 051428004. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

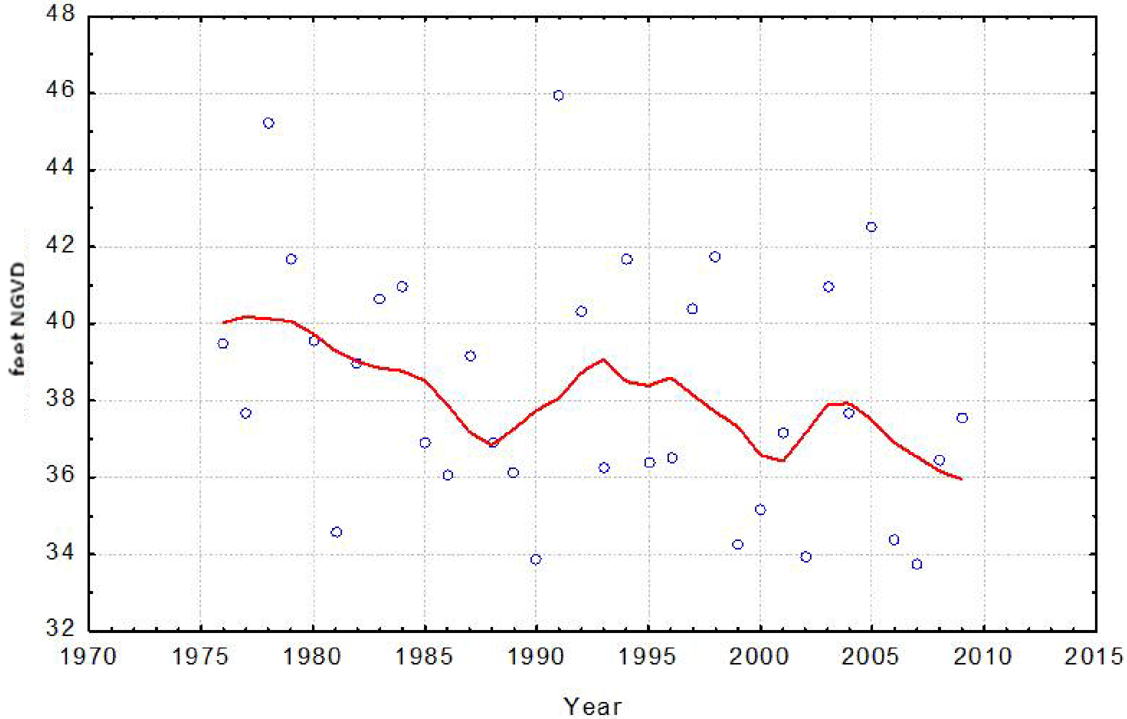

Figure 13. LOWESS-smoothed trendline of groundwater levels for well 011316001. This well exhibits a statistically-significant declining trend, as determined through Kendall-Tau analysis.

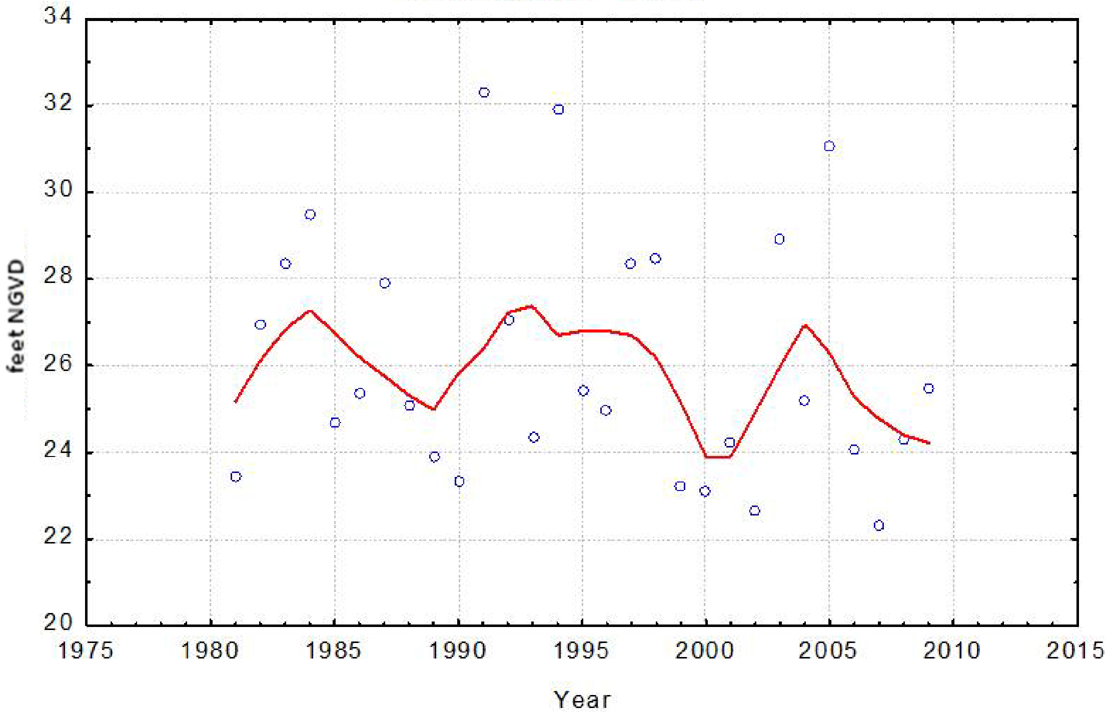

Figure 14. LOWESS-smoothed trendline of groundwater levels for well 031105006. This well does not exhibit a statistically-significant declining trend, as determined through Kendall-Tau analysis.

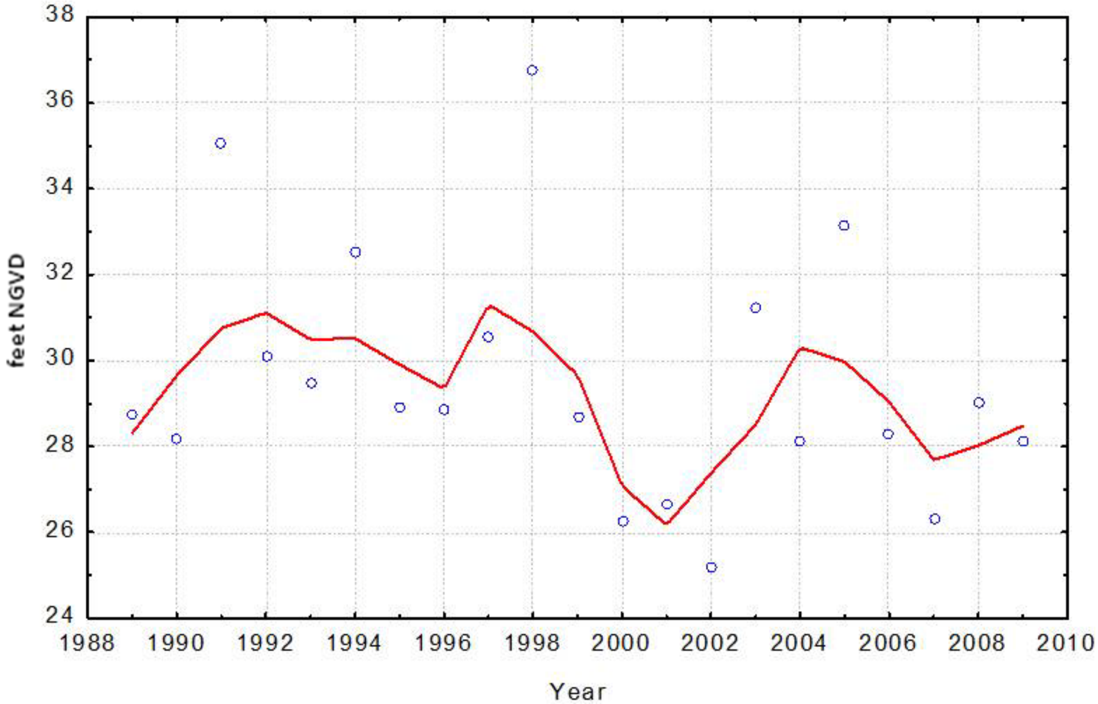

Figure 15. LOWESS-smoothed trendline of groundwater levels for well 051208001. This well does not exhibit a statistically-significant declining trend, as determined through Kendall-Tau analysis.

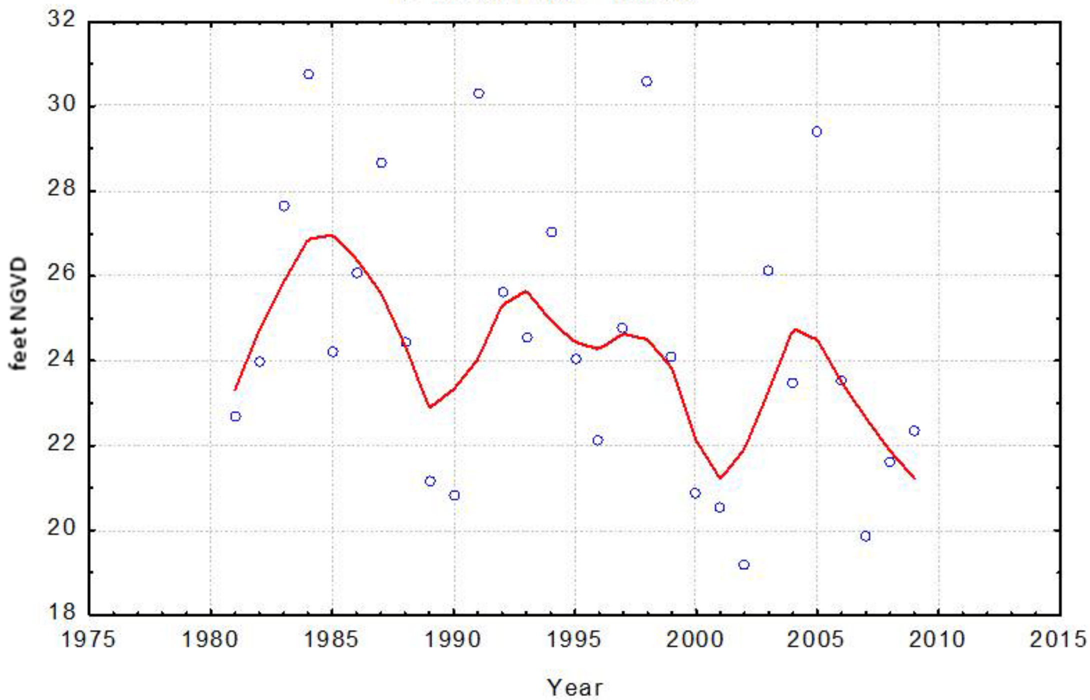

Figure 16. LOWESS-smoothed trendline of groundwater levels for well 041329001. This well does not exhibit a statistically-significant declining trend, as determined through Kendall-Tau analysis.

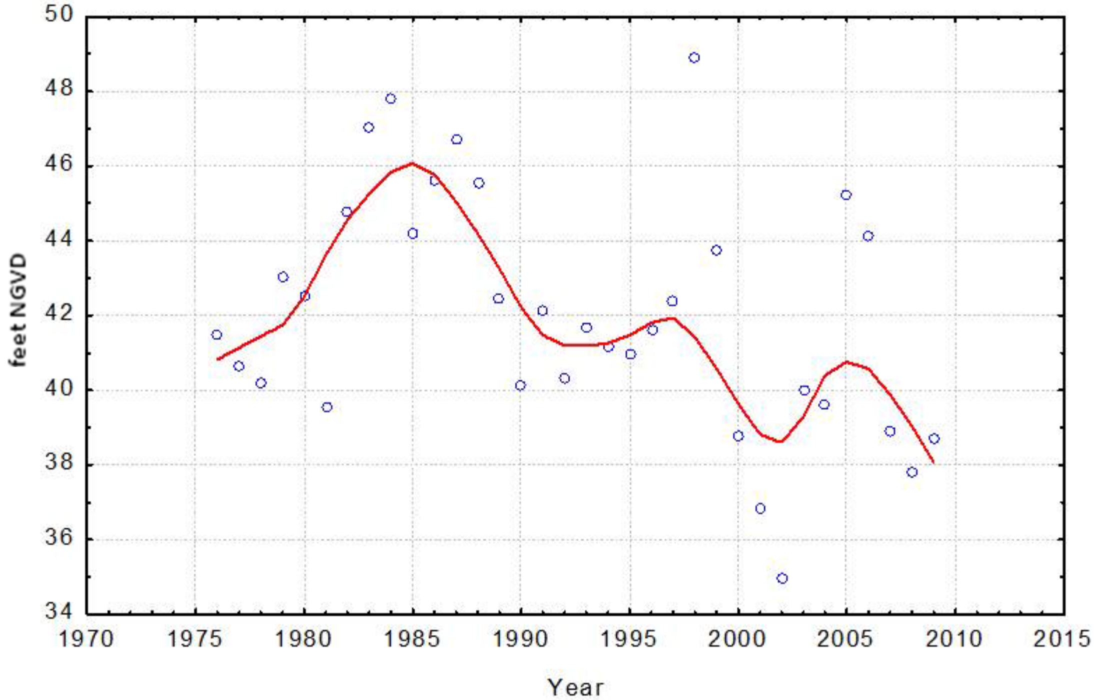

Figure 17. LOWESS-smoothed trendline of groundwater levels for well 101722001. This well does not exhibit a statistically-significant declining trend, as determined through Kendall-Tau analysis.

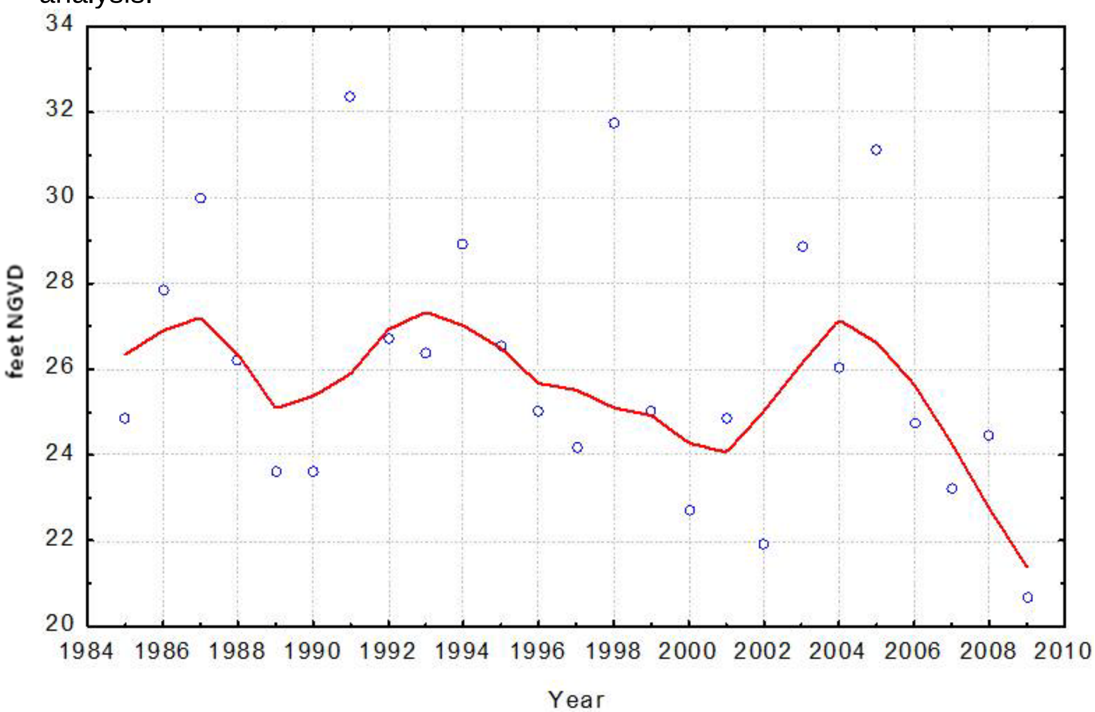

Figure 18. LOWESS-smoothed trendline of groundwater levels for well 041112005. This well does not exhibit a statistically-significant declining trend, as determined through Kendall-Tau analysis.

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