Santa Fe River

Surface Water Improvement and Management Plan

Review Draft

June 1, 1995

Suwannee River
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I. Executive Summary

The Surface Water Improvement and Management (SWIM) program for the Santa Fe River began in 1988. Water quality and biological monitoring have been conducted on the river, tributary streams, and lakes since 1989. Geographic Information System (GIS) databases have been developed to further analyze and model the watershed. Geographic data developed through the SWIM program include land cover, soils, topography, property ownership in the 100-year floodplain, and water quality. This information is being used in analyses of the watershed for existing and potential pollution loading, and for land acquisition suitability.

The River System

The Santa Fe River watershed encompasses nearly 1,400 square miles in north central Florida. The Santa Fe is the only major tributary of the Suwannee entirely in Florida, and almost all the watershed is within the Suwannee River Water Management District (SRWMD). Most of the watershed is farmland and forested, but it is one of the fastest developing areas in the SRWMD, particularly for rural residential uses.

The river originates in Santa Fe Swamp, which in turn is fed by lakes Santa Fe and Little Santa Fe. The river flows west for about 80 miles to its confluence with the Suwannee River. The river goes underground at O'Leno State Park near High Springs, re-emerging three miles away. Springs located along the lower river add clear ground water from the Floridan Aquifer and buffer the more acidic waters of the upper watershed. Springs in the lower river also buffer the variability of river flow by providing a relatively constant base flow from ground water. The upper river is fed more by runoff and seepage from the surficial aquifer, and as a result varies in flow from season to season.

Water quality overall is good, but some point and nonpoint source pollution impacts have been identified. Water quality monitoring data indicate that New River, Lake Rowell, and Alligator Creek near Starke are areas impacted by point and nonpoint sources of pollution. Increasing nutrient levels in springs has been observed and is being monitored. Overall, the most significant threat to the river system's water quality is from nonpoint sources of pollution.

Priority Issues

Seven priority issues are identified for the 1995 Santa Fe SWIM Plan.

1. Resource Monitoring

Resource monitoring includes water quality, biological, and land cover monitoring. Monitoring provides baseline data to compare future conditions with, and it also provides an ongoing check on the overall health of the river system. The monitoring networks need to be maintained, and additional monitoring efforts conducted to support related management strategies. The Resource Monitoring program is designed to address this issue.

2. Identifying, Reducing, And Preventing The Impact of Pollution Sources
Although the health of the river system is good, there are existing and potential threats to water quality and ecological communities. Several regulated point sources of pollution exist in the watershed. Many land use activities pose nonpoint source pollution threats, and need to be identified and managed. A GIS-based modeling approach will be used to identify priority subwatersheds for more detailed assessment, including field surveys, intensive sampling, and contaminant transport modeling.

3. Minimum Flows and Levels
Establishing minimum flows and levels standards for surface and ground waters is a statutory requirement for water management districts that ensures consumptive uses of water (or water resource projects) do not disrupt important natural functions. Because the Santa Fe River system has a strong surfacewater-groundwater interaction component, this issue has a direct bearing on the health of the river system. A cooperative investigation project with the U. S. Geological Survey (USGS) is underway to address this issue.

4. Land Acquisition and Management
Public acquisition and management of lands within the watershed are effective resource management tools that, due to limited funding and District policy, have to focus on the most important areas. Current priority is given to lands within the 100-year floodplain. Several acquisition projects are underway in the watershed, primarily along the lower Santa Fe River.

5. Technical Assistance and Intergovernmental Coordination
Multiple jurisdictions and agency responsibilities, across all levels of government, require close coordination if management efforts are to succeed. A major management issue within the watershed is providing technical assistance to local governments and other agencies. Several ongoing coordination efforts provide an opportunity to improve coordination among the 33 governmental entities with jurisdiction in the watershed.

6. Public Involvement and Education
Just as other agencies and governments are important partners in the overall management strategy for the watershed, an informed and involved public is needed. Basic environmental education can help individuals and community groups become partners in protecting and managing the resources of the watershed. Involving the public in management efforts brings in valuable assistance to agencies, and it also

provides a perspective that assures a broader approach to managing activities within the watershed. Environmental educational programs for public schools in the District are supported by the SWIM program, and a landowner's guide for water front property owners is planned.

7. Recreational Use

Public use of the lakes, rivers, springs, and public lands of the system is increasing and must be managed to prevent overuse and abuse of sensitive natural resources. This includes use of public lands along the river as well as use of the river, streams, and lakes. Public use areas such as springs and boat ramps that are subject to erosion and sedimentation will be surveyed and a priority list of restoration needs developed.

Management Strategies and Schedule

Five programs define the overall management strategy for the Santa Fe River SWIM Program: Resource Monitoring, Resource Planning, Program Implementation, Restoration Implementation, and Waterbody Planning. Each program includes projects and tasks that are planned to address the priority issues listed above.

1. RESOURCE MONITORING	**1995**	**1996**	**1997**
1.1 Water Quality Monitoring			
1.1.1 Monthly Sampling	→	→	→
1.1.2 Lab Analysis	→	→	→
1.1.3 Data Management	→	→	→
1.1.4 Water Quality Reports	→	→	→
1.1.5 Special Event Monitoring	→	→	→
1.1.6 LAKEWATCH Program Asst.	→	→	→
1.2 Biological Monitoring			
1.2.1 Quarterly Monitoring	→	→	→
1.2.2 Biological Monitoring Report	→	→	→
1.3 Land Cover/Use Monitoring			
1.3.1 Land Cover/Use Mapping	→		
1.3.2 Aerial Photography		X	
2. RESOURCE PLANNING			
2.1 Geographic Info. System			
2.1.1 Database Maintenance	→	→	→
2.1.2 Future Land Use Maps	X	X	X
2.2 Pollution Source Identification			
2.2.1 Point Source Coordination	→	→	→
2.2.2 Watershed Assessment	→	→	
2.2.3 Field Surveys	→	→	→
2.2.4 Pollution Source Priority List			X
2.3 Minimum Flows and Levels			
2.3.1 Surface/Groundwater Statistics	→		
2.3.2 High/Low Flow	→	→	
2.3.3 Recharge Quantification	→	→	→
2.3.4 Surface/Groundwater Modeling	→	→	→

3. PROGRAM IMPLEMENTATION			
3.1 Technical Assistance			
3.1.1 Land/Water Tech. Assistance	→	→	→
3.1.2 Land/Water Coordination	→	→	→
3.1.3 Regional Plan Assistance	X		
3.2 Local Plan Review			
3.2.1 Plan Amendment Review	→	→	→
3.3 Interagency Coordination			
3.3.1 Technical Advisory Group	X	X	X
3.3.2 Enforcement Coordination	→	→	→
3.3.3 Cooperative Studies	→	→	→
3.4 Policy/Program Coordination			
3.4.1 Suwannee River Coord. Comm.	X	X	X
3.4.2 Issue-specific Coordination	→	→	→
3.4.3 Regulatory Technical Support	→	→	→
3.4.4 Nonreg. Program Support	→	→	→
3.5 Public Education			
3.5.1 Environmental Education	X	X	X
3.5.2 Waterfront Prop Owner's Guide	→	→	→
3.5.3 SWIM Informational Video	→	→	
3.5.4 Public Involvement	→	→	→
4. RESTORATION IMPLEMENTATION			
4.1 Stormwater Management			
4.1.1 Stormwater Problem Study		X	
4.1.2 Stormwater Mgmt Improvement	→	→	→
4.2 Erosion Evaluation/Control			
4.2.1 Erosion Problem Area Study	→		
4.2.2 Riverbank Erosion Control		→	→
4.2.3 Inventory control structures		→	
5. WATERBODY PLANNING			
5.1 Annual SWIM Plan Review			
5.1.1 SWIM Plan Review	X	X	X
5.1.2 SWIM Plan Revision			X
5.2 Annual Priority List Review			
5.2.1 Annual Priority List Review	X	X	X

II. Background Information

SWIM Act Background

The SWIM Act[1] was passed into law by the Florida Legislature effective July 1, 1987. The general purpose of the Act is to restore or protect the quality of surface waters in the State of Florida and to provide an on-going planning and coordination mechanism to maintain surfacewater quality. The Legislature delegated the responsibility of evaluating, prioritizing, and developing management plans for surface waters to the state's five water management districts, in cooperation with other state agencies and local governments.

Two principle factors are recognized within the Act as contributing to the decline in the surfacewater systems of the state: point and nonpoint sources of pollution[2], and the destruction of the natural systems that protect and purify surface waters and provide habitat for fish and wildlife. The values placed on the state's surface waters, including ecological, aesthetic, recreational, and economic values, are impacted or threatened by these two factors.

SWIM Principles and Concepts

The SRWMD advocates a regional approach to water management based on a simple fact: surfacewater bodies, groundwater aquifers, and their related natural systems are not confined to political jurisdictions. The lands that drain into a water body, defined as the watershed or basin, often include the jurisdiction of many levels of government--each of which has different interests, responsibilities, and capabilities for resource protection and management. The overall quality of a water body and natural resources cannot be assured unless there is effective coordination and cooperation. Therefore, the management of these systems must cross multiple political jurisdictions.

Two factors related to land use are important to consider when discussing surfacewater systems and water quality. First, land use is an important determinant of water quality. Substances either intentionally or inadvertently put on the surface of the land are rinsed into receiving water bodies following storm events and normal overland surfacewater flow. More intensive land uses usually introduce greater quantities of contaminants such as fertilizers, pesticides, oil and gasoline residues, and other toxic substances than less intensively developed land.

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[1] Sections 373.451-373.4595, Florida Statutes (F.S.)

[2] These and other terms are defined in Appendix D.

Second, the authority to regulate land uses in Florida, including land use allocation, density, and intensity controls through land use planning, lies principally with local units of government. Since land use is a key determinant in the quality of a basin's water bodies, much of the responsibility for surfacewater protection lies with local governments. Local governments often have a greater awareness of local conditions and are more able to respond to the particular needs of their jurisdictions. This awareness and response, however, rarely extend beyond the local government's boundaries. Since there may be a number of local jurisdictions within a watershed, regional and state agencies should consider the impact of local land use decisions that could affect regional natural resources. Further, local governments within the Santa Fe Watershed are mostly small and rural, and depend on regional and state agencies for technical planning assistance.

Another issue is the fact that state and regional agency programs are typically focused on particular areas of statutory responsibility. An agency's policies or programs may be interpreted or applied inconsistent with another agency's, or differently over time. This can lead not only to confusion but can be detrimental to the area's natural resources. Fortunately, most of these type problems are minor and easily resolved through communication and cooperation among agency staff. The SWIM program is set up to accomplish this essential task.

Interagency coordination, local government assistance, and public information are three parts of the SWIM process that help bring management agencies together. To develop and assist in the implementation of SWIM management plans, the SRWMD established a SWIM Technical Advisory Group (TAG) to identify regional management issues, exchange data and information, and review management proposals. The TAG is comprised of representatives from the review agencies listed in section 373.455, F.S., university staff, and appropriate federal agencies.

The combination of the above factors--the need for a regional approach to resource management, land use demands and impacts, and the overall planning needs of the region--emphasize the relevance and importance of the SWIM planning process.

SWIM Planning Process

Planning for SWIM waters is a three step process. First, conduct an evaluation of the District's surface waters to develop a priority list of those systems most in need of restoration or protection. Second, prepare management plans for priority waters to guide the restoration and/or protection of water quality. Third, implement and monitor the management plans, including annual evaluations and modifications as needed.

SWIM Priority List

The development of a priority waterbody list was first undertaken by the SRWMD in the fall of 1987. Using the criteria developed by the Florida DER (now DEP[3]), water bodies were prioritized by the SRWMD in cooperation with DEP, Florida Game and Fresh Water Fish Commission (FGFWFC), local units of government, and other interested parties. In order of priority, the first six SWIM priority waters were the upper Suwannee, lower Suwannee, Santa Fe, Steinhatchee, Alligator Lake, and Falling Creek. In 1990, the priority list was revised to include the upper and lower Suwannee and Falling Creek into an overall Suwannee River System, the expansion of the Steinhatchee plan to include the entire Coastal Rivers basin, and the addition of the Aucilla and Waccasassa rivers. All SWIM rivers include coastal waters to the limit of state waters in the Gulf of Mexico (nine nautical miles seaward of the shoreline) The current SWIM priority list is, in order, as follows:

1. ***Suwannee River System*** including the Alapaha and Withlacoochee rivers and Falling Creek

2. ***Santa Fe River System*** including the headwater lakes Santa Fe, Little Santa Fe, Sampson, Crosby, and Rowell, New River, Olustee Creek, and Ichetucknee River

3. ***Coastal Rivers Basin*** including the Econfina, Fenholloway, and Steinhatchee rivers, and Spring Warrior and Sanders creeks

4. ***Alligator Lake***

5. ***Aucilla River System*** including the Wacissa River

6. ***Waccasassa River*** including tributaries and Waccasassa Bay

SWIM Plans

A management plan was developed for the Santa Fe River by SRWMD staff and reviewed by other agencies and individuals, adopted by the SRWMD Governing Board, and approved by DEP in 1988. This plan outlined a two-year strategy for developing a comprehensive monitoring network for water quality, biology, and land cover throughout the priority basins, as well as the development of computerized data bases, including GIS coverages. Other programs included the establishment of special studies to better understand the river and the establishment of a technical assistance program to tie into the local government comprehensive planning process.

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[3]All further reference to past action by DER or DNR will be included under the new title of the agency--DEP

The initial SWIM plan for the Santa Fe was, in essence, a strategic plan to develop the SWIM program for the river. This revision is intended to provide guidance for continued watershed management. The linked components of the plan are:

1. Goal and policy statements that provide guidance for the overall implementation of the SWIM program,

2. A discussion and prioritization of issues affecting the river system and its SWIM program,

3. The revised work programs and tasks that comprise the management action strategies for the Santa Fe River SWIM program.

The initial plan also included the foundation for developing long-range management plans and strategies for the priority waters by including goal and objective statements for the SRWMD's SWIM program. The following section presents the goals, objectives, and policies of the Santa Fe SWIM program. The Management Strategies section describes how the goals will be achieved.

SWIM Program Goals

In recognition of the importance of natural systems in protecting surfacewater quality, the following goals have been established for all six priority waters in the SRWMD's SWIM program:

• To protect the ecological integrity of natural surfacewater systems;

• To enhance the environmental, aesthetic, scenic, and recreational value of surfacewater systems;

• To reduce the impact of point and nonpoint sources of pollution on water quality, fish and wildlife;

• To preserve habitat for native plants, fish, and wildlife, including threatened and endangered species; and

• To promote the public use of surface waters and the accrual of economic benefits consistent with protection and restoration objectives.

The goals of the Santa Fe River Watershed SWIM program are presented below. There are four inter-related components: an overall watershed management goal; water quality management goals; waterbody-specific management goals for lakes, wetlands, streams, and ground water; and watershed management policies for each program area.

Santa Fe River Watershed Management Goal

Based on the best available data and sound analytical procedures,

1. Maintain or improve current water quality conditions within the watershed;

2. Balance demands for water resources with the availability and quality of surface and ground waters; and

3. Maintain the functioning of natural systems such as springs, wetlands, and floodplains that protect water quality, provide floodwater storage and conveyance, and provide habitat for fish and wildlife.

Water Quality Management Goals

1. Annual mean water quality conditions for parameters identified in Section IV, Management Strategies, shall not exceed the 95 percent confidence interval of the mean for each variable for any year within the SWIM period of record. Sources of water quality impacts identified through the monitoring program will be identified and targeted for corrective action.

2. Stormwater management facilities shall treat all stormwater runoff to remove an average 80 percent of pollutants prior to discharge. Facilities discharging to Outstanding Florida Waters (OFWs) shall achieve an average 95 percent removal of pollutants prior to discharge.

3. Watersheds that experience or are projected to experience water quality problems from stormwater runoff will be identified by 1997. For water bodies that currently, or are projected to, approach or exceed state water quality standards, pollutant load reduction goals will be defined by 1998 to restore, or maintain, state water quality standards.

Waterbody Goals

1. Lakes

A. Prevent adverse impacts to lake ecosystems including natural hydroperiod fluctuations resulting from ground or surfacewater withdrawals.

B. Control the impact of nutrient inputs on lake water quality from nonpoint sources of pollution by providing assistance to develop central wastewater treatment systems wherever feasible, regulating development activity for stormwater impacts, and promoting the use of agricultural and silvicultural best management practices (BMPs).

C. Improve water quality, biological, and hydrologic monitoring of the watershed's lakes, including data analyses, to continually refine management issues and strategies.

2. Wetlands

A. Acquire for public conservation and water management purposes (including water quality and hydroperiod maintenance) significant wetlands communities associated with the river system, especially within the 100-year floodplain.

B. Manage public conservation and water management lands to protect natural ecological and hydrologic functions, including the restoration of native ecological communities.

C. Maintain the functioning of existing wetlands communities through the implementation of surface water management rules and regulations, providing technical assistance, and increasing public awareness of natural wetlands values.

D. Monitor long-term trends in land use and land cover throughout the watershed.

3. Tributary Streams

A. Establish and maintain water quality, biological, and hydrologic monitoring networks on tributary streams, prioritizing high growth areas and stream-to-sink watersheds.

B. Increase the use of urban, agricultural, and silvicultural BMPs within the Santa Fe River watershed by the year 2000.

C. Reduce or eliminate the discharge of inadequately treated storm water into tributary streams of the Santa Fe River system. Stormwater management levels of service established by local governments within the Santa Fe River system watershed should include both water quantity and water quality treatment, at a minimum consistent with criteria in District rules and state water quality standards.

D. Eliminate adverse environmental impacts from existing point source discharges to tributaries of the Santa Fe River by 2005.

E. Prohibit new or expanded point source discharges to the Santa Fe River System unless treated to ambient background conditions as determined from long-term monitoring data at the nearest station.

F. Evaluate the feasibility of additional floodplain mapping to identify the 10-year and 100-year floodplains of major tributaries to the Santa Fe River by 1998.

4. Santa Fe River

A. Assist the DEP in implementing anti-degradation and OFWs standards for the Santa Fe River system.

B. Define biological monitoring criteria which adequately characterize the ecological health of the Santa Fe River system by 2000.

C. Promote nonstructural floodplain management through land acquisition and the enforcement of District surfacewater management rules.

D. Identify existing and potential nonpoint source loadings to the Santa Fe River through the use of GIS modeling and analysis by 1997. Future Land Use Maps adopted by local governments in the watershed shall be the basis for such modeling and analysis.

E. Identify appropriate agricultural BMPs for all subwatersheds with existing or projected water quality problems resulting from agricultural land uses by 1998, including restricted livestock access to the river, erosion controls, and animal waste management.

F. Identify subwatersheds or urbanized areas with existing or projected stormwater pollutant loadings to the Santa Fe River system by 1998 that may benefit from the establishment of master stormwater management and treatment systems. Assist appropriate local governments to establish stormwater utilities to reduce nonpoint source pollution of the Santa Fe River system.

5. Groundwater Resources

A. Initial priority is given to the lower Santa Fe River watershed to characterize the interaction of surface and ground waters including aquifer recharge and discharge rates.

B. Define primary recharge areas for the first- and second-magnitude springs that feed the Santa Fe River and its tributaries by 1998. Priority shall be given to the Ichetucknee River springs group.

C. Identify alternative strategies for watershed-specific management plans to ensure the long-term, surface-groundwater hydrologic balance of the Santa Fe River system by 1998. Include recommended policies and strategies in the 1998-2001 SWIM Plan update.

<u>Watershed Management Policies</u>

1. Monitoring

A. Water quality monitoring shall be conducted in the most efficient and cost-effective manner to adequately gauge the health of the river system both seasonally and long-term

B. Water quality samples above the 90th percentile of SWIM period of record data collected at the same site will trigger additional monitoring efforts, field surveys, and possibly contaminant transport modeling, to locate the source of pollutants.

C. Water quality and biological monitoring reports shall be presented to the Governing Board on an annual (or as-needed) basis and will recommend action to the Governing Board to resolve identified problems.

D. Water quality and biological monitoring shall be closely coordinated with other agencies, institutions, and local governments to ensure efficient and effective monitoring.

E. Hydrologic monitoring shall be conducted on a frequency and at locations sufficient to support water quality monitoring and management strategies, hydrologic characterizations, water shortage declarations, and other water management purposes.

F. Stormwater management facilities directly or indirectly discharging to surface waters within the Santa Fe River watershed shall be periodically monitored to evaluate the effectiveness of water quality treatment.

2. Planning, Technical Assistance, and Coordination

A. The Santa Fe River Watershed Management Plan shall be reviewed annually and updated on a triennial basis.

B. Technical assistance shall be provided to local governments within the watershed for the evaluation and revision of Local Government Comprehensive Plans required by Chapter 163, F.S., prior to 1998.

C. Resource management plans and programs shall be coordinated with all local governments and resource management agencies with jurisdiction in the watershed.

D. Results of the watershed assessment project shall be provided to local governments and other agencies within the watershed. Specific recommendations for future watershed management activities or programs shall be provided to all responsible entities.

E. Coordinate with, and assist, the DEP in establishing water quality management criteria for point and nonpoint source regulations (e.g., Total Maximum Daily Loads {TMDL's}). Review and provide comments on new or revised point source discharge permits.

F. Provide technical assistance to the Department of Health and Rehabilitative Services (HRS) in administering Chapter 10D-6, Florida Administrative Code (F.A.C.), and the restriction of onsite sewage treatment and disposal systems in the 10-year floodplain of the Santa Fe River system.

3. Land Acquisition and Management

A. Acquisition priority within the Santa Fe River watershed shall be given to lands within the 100-year floodplain of the Santa Fe River system, including headwater lakes and tributary streams.

B. Land management activities for public lands within the Santa Fe River watershed shall prioritize the restoration of native ecological communities, protection of water management functions including floodwater storage and conveyance, and appropriate public use.

4. Regulations

A. Stormwater management facilities shall provide adequate treatment of stormwater runoff such that post-development conditions for water quality and quantity meet pre-development conditions and that offsite impacts, where permitted, are adequately mitigated.

B. District regulations shall, to the extent practicable, address watershed-specific issues such as increased water quality treatment in stream-to-sink watersheds or activities within identified spring recharge areas (spring basins or catchment areas).

C. Consumptive use applications which may affect the flow or levels of the Santa Fe River, its tributaries, lakes, or wetlands will be reviewed for potential impacts. Applications qualifying for an individual permit under section 40B-2.041, F.A.C., shall provide sufficient data to assure that adverse impacts will be avoided.

Watershed Description

The Santa Fe River system includes the Santa Fe River and its watershed, its principle tributaries New River, Olustee Creek, Ichetucknee River, its lesser tributaries, and Lakes Santa Fe, Little Santa Fe, Sampson, Rowell, Altho, Hampton, and Crosby. The Alligator Lake watershed is not included as it is addressed in the Alligator Lake SWIM Plan. The Santa Fe system was selected as a priority water body due to the threats from increasing urbanization and development within the watershed. The system was also selected due to its outstanding fish, wildlife, aesthetic, and recreational values.

The Santa Fe Watershed covers much of the eastern portion of the SRWMD with a total watershed area of 1,390 square miles (Map 1). The basin covers parts of Alachua, Baker, Bradford, Clay, Columbia, Gilchrist, Union, and Suwannee counties. This portion of the District is more developed than most of the District. The watershed is the fastest growing due to the proximity of Gainesville and several other incorporated areas.

Physiography and Topography

The Santa Fe River watershed is within the Northern Highlands and Gulf Coastal Lowlands physiographic regions, shown on Map 2. The River Valley Lowlands is an extension of the Gulf Coastal Lowlands. The divide between the Highlands and Lowlands is the Cody Scarp, described as the most persistent topographic break in Florida. The escarpment is less pronounced in the Santa Fe basin than further to the west, so placing an exact line on a map is difficult. It is along this transitional zone between the two physiographic regions that the river, as with virtually all other streams, goes underground.

The eastern two-thirds of the watershed, basically that portion within the Northern Highlands region, has surface drainage features including lakes, streams, and wetlands. The western third, in the Coastal Lowlands, lacks surface drainage with the exception of the Santa Fe and Ichetucknee rivers and Cow Creek. Watershed runoff characteristics correspond closely to the general hydrogeologic conditions of the Floridan Aquifer shown on Map 3. All precipitation not taken up by evapotranspiration, that would otherwise run off as stream flow, percolates down into the Floridan Aquifer and moves through the aquifer to points of discharge.

Elevations within the watershed of the Santa Fe River vary from over 200 feet above sea level along the Trail Ridge in the east, to about 10 feet above sea level at the confluence with the Suwannee River. The upper watershed is characterized by nearly level pine flatwoods with gently rolling hills. Tributary streams are fairly well-incised in the landscape, with occasionally broad forested floodplains. In the mid-watershed, moderate to gently rolling hills with areas of prominent karstic features such as sink depressions and captured streams provide areas of picturesque relief. The lower watershed is primarily a broad, slightly undulating karst plain with interspersed wetlands areas.

Climate

The climate of the Santa Fe basin is humid and subtropical in the summer with winters often more characteristic of southern temperate climate. The average annual temperature at Lake City is 69° F. The warmest temperatures are recorded during the months of June through August, with maximum average temperatures near 90° F. The coldest temperatures are associated with continental cold fronts moving through the area during December and January, with average annual minimum temperatures of about 45° F. Freezing temperatures are usually associated with frontal activity and occur only for short periods.

Area rainfall averages about 54 to 55 inches per year. Nearly half the basin's precipitation falls during the summer, most of this associated with highly localized convectional thunderstorms. Tropical storms and hurricanes can bring inclement weather and intense, heavy precipitation to the area. The driest months of the year are typically October and November, although an unusual storm in October 1992 with 11 to 13 inches of rainfall in the upper watershed caused an unusual flood. Rainfall during the winter months results from frontal activity, and is generally less intense and of longer duration. Winter rainfall is important for recharging groundwater aquifers, which provide base flow to the river and its tributaries, because evaporation and transpiration are much lower resulting in greater runoff as well as recharge to the aquifers.

Map 1. Location of the Santa Fe River Watershed

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Map 2. Physiographic Regions

Map 3. General hydrogeologic conditions

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The Santa Fe River watershed lies along the climatic river basin divide for Florida. North and west of the divide, high stage and discharge of rivers and streams is generally in March through April; low stage is usually October through November. From the Santa Fe east and south, high stage and discharge is generally September through October; low stage is usually May through June. Because the Santa Fe is along this climatic divide, the difference is less pronounced than that of extreme south Florida or further west in the panhandle.

Hydrogeology

The Santa Fe basin is underlain by over 1,000 feet of sedimentary rocks--300 to 800 feet of which contain potable fresh water. Aquifer systems that exist within the basin include the Floridan Aquifer throughout the basin and intermediate and surficial aquifers in limited areas of the basin. The Floridan Aquifer is the principle source for municipal and industrial water use and provides the greatest abundance and quality of potable water in the basin. The surficial aquifer and water from the confining bed are used to a limited extent for domestic and farm supplies, including irrigation in some places.

The surficial aquifer is formed of unconsolidated sand beds located above the confining bed formed by the upper Alachua Formation and overlying clays. The confining bed often contains zones of fresh water and becomes thin and discontinuous toward the west. This confining bed is referred to as the intermediate aquifer, and may provide water to some of the river's headwater lakes. Recharge to the surficial aquifer is provided by rainfall and locally by water that is discharged upward from water-bearing zones in the underlying confining bed. Streams receive most of their base flow when crossing the saturated zone of the surficial aquifer. Local irrigation and domestic wells which use the surficial aquifer as a water source are prone to contamination due to the unconfined nature of this aquifer.

The confining bed is located mostly in the Alachua and upper Hawthorne formations, varying somewhat across the basin. Water-bearing zones in the confining bed are usually limestone but can locally be shell beds and possibly sand. The number and thickness of these zones apparently increase toward the northeast as the confining bed becomes thicker. Recharge to these zones are from downward percolation from overlying beds as well as from stream seepage in some areas. The water-bearing zones of the confining bed are used mostly for domestic and agricultural supplies and in places for irrigation. In Bradford and eastern Union counties these zones have been the principle source of domestic water supplies (USGS, 1983).

The lower Santa Fe River intercepts the Floridan Aquifer--as evidenced by the abundant springs along this reach. The Floridan Aquifer consists of several hundred feet of limestone and dolomite, including (increasing in depth) limestones at the base of the Hawthorn Group and the Suwannee, Ocala, Avon Park, and Lake City Limestones. The Floridan Aquifer is confined in the eastern watershed and unconfined in much of the western part of the watershed (where recharge potential is greater). Very little is known about the confining bed below the Floridan Aquifer, but it is presumed to consist of gypsiferous limestone and dolomite, ranging from the lower part of the Lake City Limestone to the base of the Cedar Keys Limestone (USGS, 1983).

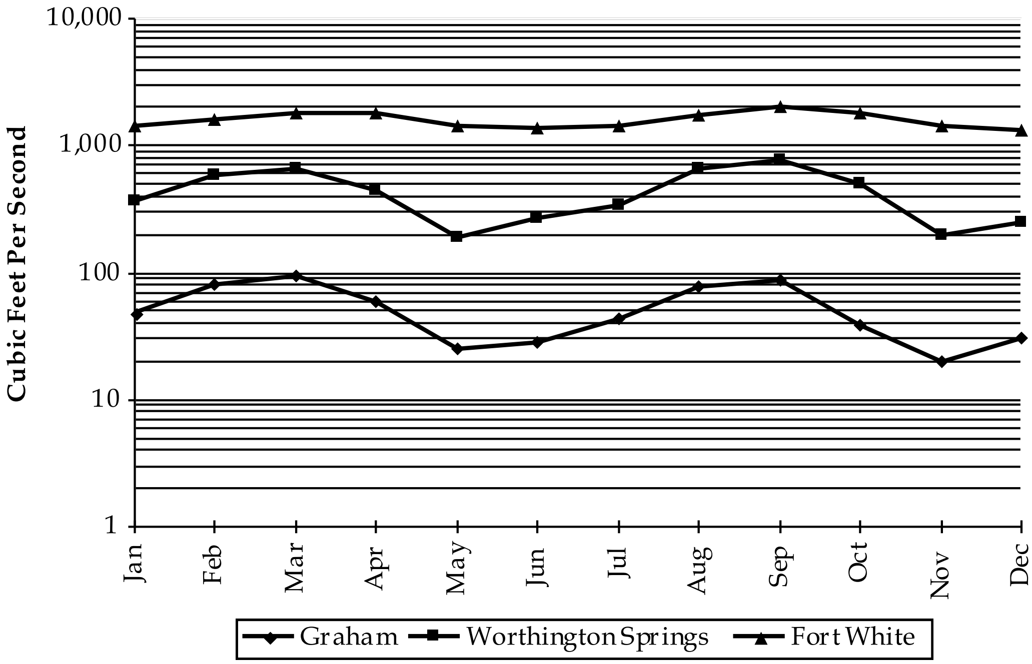
Hydrology

The Santa Fe River originates from Santa Fe Lake and Little Santa Fe Lake, flows through the Santa Fe Swamp, and moves westward to the Suwannee River. In addition to Santa Fe Lake and Little Santa Fe Lake, there are many lakes and ponds in the watershed, primarily lakes Sampson, Crosby, Rowell, Altho, and Butler. At times of high water, Palestine Lake in Union County partially drains to the Santa Fe system; likewise, Ocean Pond in Baker County is reported to occasionally drain into Olustee Creek. An easily discerned surface drainage system exists in the eastern two-thirds of the basin where the limestones of the Floridan Aquifer are overlain by deep sands and a confining layer. Surface drainage is lacking in the western third of the basin with the exception of the Santa Fe and Ichetucknee rivers and Cow Creek.

Flow in the upper river is more variable than the lower river, as shown on Figure 1. The consistent input of groundwater from the river's springs provides a more stable base flow for the lower river. Data for three stations monitored by the USGS are shown. The period of record for the stations varies--35 years at Graham, 60 years at Worthington Springs, and 64 years at Fort White. Graham, the most upstream station, shows the most variability in flow. Worthington Springs, about midway down the river, also shows noticeable fluctuation in seasonal flow. These two stations are in the upper, surface-drainage part of the watershed. Fort White shows a much less variable flow. This station is downstream of the river's sink and emergency in O'Leno State Park, and includes considerable groundwater input.

There are 34 named springs along the river, varying in discharge from 360 cubic feet per second (cfs) for the Ichetucknee Springs group, to less than 1 cfs for several of the lesser springs (USGS, 1983). There are likely many seeps and small springs in the river bed that have not been named or identified. The Santa Fe goes underground at O'Leno State Park at the toe of the Cody Scarp in the transition zone between the Northern Highlands and the Gulf Coastal Lowlands physiographic regions. The river surfaces after traveling about three miles underground where it receives an average additional 211 cfs of groundwater upon re-emergence at River Rise (USGS, 1983). The river flows over ground in O'Leno State Park only during periods of very high flow. One such instance was observed following a period of unusually heavy rainfall in the upper watershed in October 1992.

Figure 1. Average Discharge of the Santa Fe River



Source: USGS, 1992

Streams and Tributaries

The Santa Fe River has three main tributary streams: New River, Olustee Creek, and the Ichetucknee River (see Map 1). New River originates in southeastern Baker County and flows southwest, forming the border between Union and Bradford counties. The base flow of New River is sustained by discharge from the surficial aquifer. Its tributaries are sustained by base flow from water-yielding zones in the confining bed. These tributaries, during low flow, have much clearer water than the darker-colored water in streams supplied by the surficial aquifer (USGS, 1983). The subwatersheds of the Santa Fe River system are shown by type on Map 4.

Olustee Creek originates in southwest Baker County and joins the Santa Fe downstream from the New River. Its flow is derived mainly from the surficial aquifer, but it actually loses flow to the confining beds and the Floridan Aquifer (USGS, 1983).

Ichetucknee River is a clear, spring-fed river widely known for its outstanding clarity, wildlife, and recreational values. It rises from a series of springs in the Ichetucknee State Park and flows south for 5.5 miles to the Santa Fe. South of the U.S. 27 bridge, the river banks and floodplain are heavily subdivided and developed. Heavy public use causes noticeable impacts to the river. Apart from noise the most noticeable has been visibly reduced aquatic vegetation. Restricted use of the river in the state park has allowed much of the vegetation in the upper river to re-establish. The spottiness and relative lack of abundant vegetation in the lower river (where use is not restricted) indicates that the park's management approach has caused noticeable improvement in submerged aquatic vegetation.

Two smaller tributaries contribute flow to the Santa Fe--Sampson River and Cow Creek. Sampson River provides an outlet for lakes Sampson, Crosby, and Rowell, which are all hydrologically connected, although to what degree is currently unknown. Alligator Creek, which drains the Starke area, empties into Lake Rowell (including discharged effluent from Starke's wastewater treatment plant). Cow Creek, the river's last surface tributary, drains part of eastern Waccasassa Flats in Gilchrist County. It probably derives its base flow from the surficial aquifer and surface runoff from the Waccasassa Flats area.

An important surfacewater system in the Santa Fe Watershed is the sinking stream systems that occur along the transition zone. These streams are captured by sinkholes and provide a direct surfacewater connection to the Floridan Aquifer. The water quality of these streams is a major concern in this river system because although the streams do not have a direct surface connection to the Santa Fe, their flow contributes to the ground water discharged through the many springs of the lower river. They also pose a threat to local water supplies that use the Floridan Aquifer. These connections have been explored to a limited extent by cave divers and results indicate a need to better understand the hydrologic connection to the river system. Gas tracing studies conducted by Dan Hirth with the University of Florida have confirmed a connection between Rose Creek Sink and eight of the springs in the Ichetucknee Springs group. The travel time between Rose Creek Sink and the Ichetucknee springs, expressed as peak concentration velocity, is over 3 km/day, or about 2 miles per day. The sinking streams that need to be investigated further include Cannon, Clay Hole, and Rose creeks and Hammock Branch in central and southern Columbia County, and Parener's Branch in Alachua County. These areas are of concern because they are being converted from forests and farmlands to residential and other development.

Lakes

The Santa Fe River system includes the seven headwater lakes in Bradford and Alachua counties. The hydrologic connection of these lakes to the river is not always clear, however. Lakes Santa Fe and Little Santa Fe drain to Santa Fe Swamp, a heavily forested wetland over 5,000 acres in size (owned by the District). The river flows through the swamp as sheet drainage, without a clearly defined channel. Nor are all the hydrologic connections natural. The Santa Fe Canal was dug earlier in the century to connect lakes Altho and Little Santa Fe. The canal is inaccessible and vegetation appears to restrict water flow.

Map 4. Santa Fe River Watershed Type

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The lakes range in size, depth, water quality, and elevation. Most of the lakes are heavily used for recreation such as boating and fishing. Shoreline residential development is evident to varying degrees--Hampton, Santa Fe, and Little Santa Fe lakes are the most developed while Lake Rowell's swampy shoreline remains undeveloped (except for a cow pasture along the north shore). Table 1 shows some of the characteristics of the lakes.

Table 1. Characteristics of Lakes in the Santa Fe River Watershed

	Surface Elevation*	Surface Area (acres)	Avg. Max. Depth (feet)
Lake Altho	143 ft.	540	18
Lake Crosby	132 ft.	536	14
Hampton Lake	131 ft.	823	21
Lake Rowell	132 ft.	364	6
Lake Santa Fe	141 ft.	4,721	28
Little Santa Fe Lake	141 ft.	1,135	22
Lake Sampson	131 ft.	2,042	12

*Elevation is in feet above mean sea level (1927 geodetic vertical datum). Surveyed by SRWMD 1976-77.

Water Quality

The Santa Fe River system was designated an OFW in 1984. The river's water quality is rated as good in most reaches and fair in New River, Olustee Creek, and Alligator Creek (Starke) in the DEP’s 1994 Water Quality Assessment Technical Appendix. Much of the river is naturally low in pH and/or dissolved oxygen due to the swampland drainage. The basin water quality index table indicates that the reaches mentioned above have problems with nutrients, bacteria, and inorganic toxics (primarily mercury). The nutrient and bacteria problems are likely caused by natural sources, agricultural runoff, and sewage treatment plants that discharge effluent into the system (See the Priority Issues section for a listing of point sources). Lake Rowell, which receives treated effluent and stormwater runoff from the City of Starke has a eutrophication problem and considerable infestation of aquatic weeds. This lake should be studied to determine the feasibility of restoration once the discharge is removed.

The presence of mercury in the Santa Fe system may result from atmospheric deposition or natural causes such as peat in the Santa Fe Swamp, based on a study conducted by DEP in the 1980s. Mercury levels are at or below normal in Lake Santa Fe. Above normal levels are first encountered downstream from the swamp. The low pH of the river in the upper reaches appears to play a role in the presence of the elevated mercury levels. After the river resurfaces from the three mile underground section, the pH levels rise and the mercury content is decreased. However, the accumulation of mercury in the river's organisms has caused an advisory limiting consumption of some fish caught in the river.

Increasing nitrate levels in some of the springs along the lower Santa Fe indicate cause for concern. Trail Spring, on the lower Santa Fe, is currently monitored by DEP (since November 1992) in conjunction with the SWIM monitoring network and shows a mean concentration of 2.94 mg/l total nitrate-nitrite nitrogen. Values for the period of record range from 0.55 to 5.5 mg/l, illustrating the variability of the system. Lower values represent high river stage, when river water backs into the aquifer through the springs. During back flow, denitrification occurs--resulting in lower concentrations. Conversely, higher values represent low river stage when spring discharge is entirely ground water. Normal background conditions in the Floridan Aquifer in the area are around 0.4 mg/l. Similar trends in increasing nitrates are observed along the middle Suwannee River springs.

SWIM water quality monitoring was established in 1989 for the Santa Fe River. The network is designed to provide long-term, continual data from which trends can be discerned. The network is not designed to monitor compliance with discharge permits, or to pinpoint specific sources of pollution. Although monitoring stations have changed slightly since 1989, there are adequate data to characterize the river. The parameters sampled, station location, and monitoring frequency are described in Section IV. Based on the physical characteristics of the river, it is divided into two reaches for the purposes of reporting water quality. Reach 1 is the river above the river sink at O'Leno State Park and Reach 2 is from the river rise to the Suwannee.

Appendix B includes water quality monitoring data from 1989 to 1994 collected through the SWIM program. Graphs are provided for indicator parameters, including the mean values for the monitoring stations in each reach and the 25th and 75th percentiles[4]. Tabular data are also provided for each monitoring station. These tables include the number of samples, minimum and maximum values observed, the mean (average) values for the period of record, and the standard deviation from the mean.

Figures 2 and 3 are graphs of mean nitrogen and phosphorus values observed in Reaches 1 and 2 of the Santa Fe River. The monitoring stations in Reach 1 are at Brooker, Worthington Springs, and O'Leno State Park. Reach 2 stations are at US 441 near High Springs, SR 47 near Fort White, and US 129. The 25th and 75th

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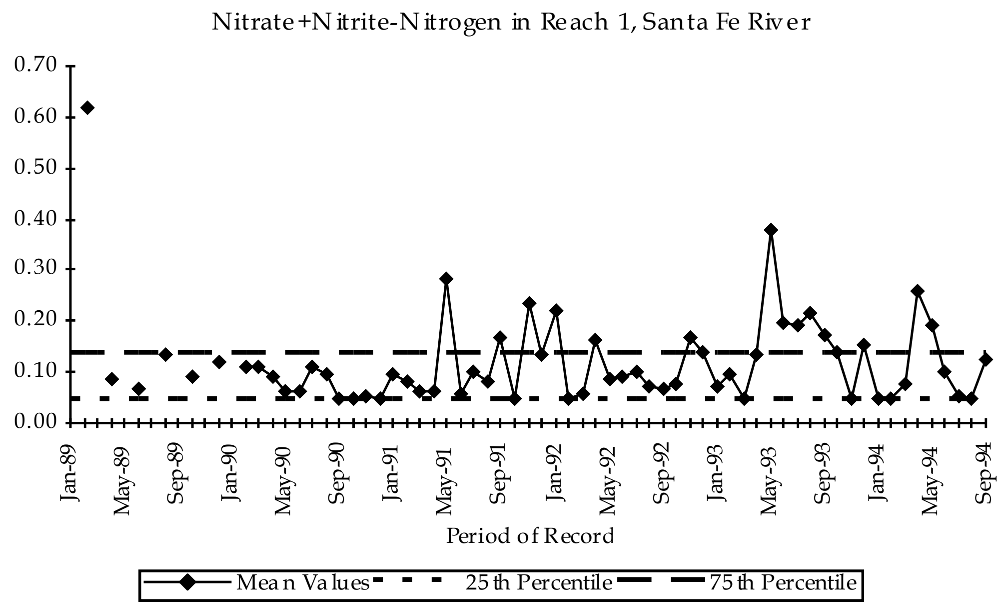
[4] A percentile is a statistical measure representing a level at which the percent of observed values fall--e.g., the 75th percentile is where 75 percent, or three-fourths, of the values are at or below.

Figure 2. Mean Nitrate+Nitrite Nitrogen Values, Santa Fe River



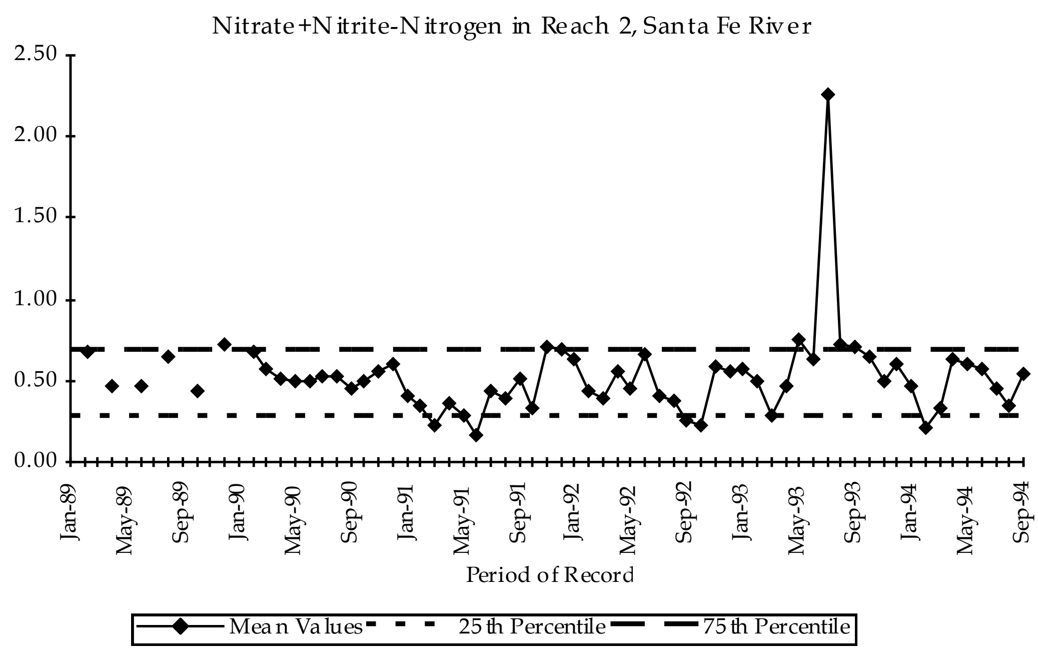
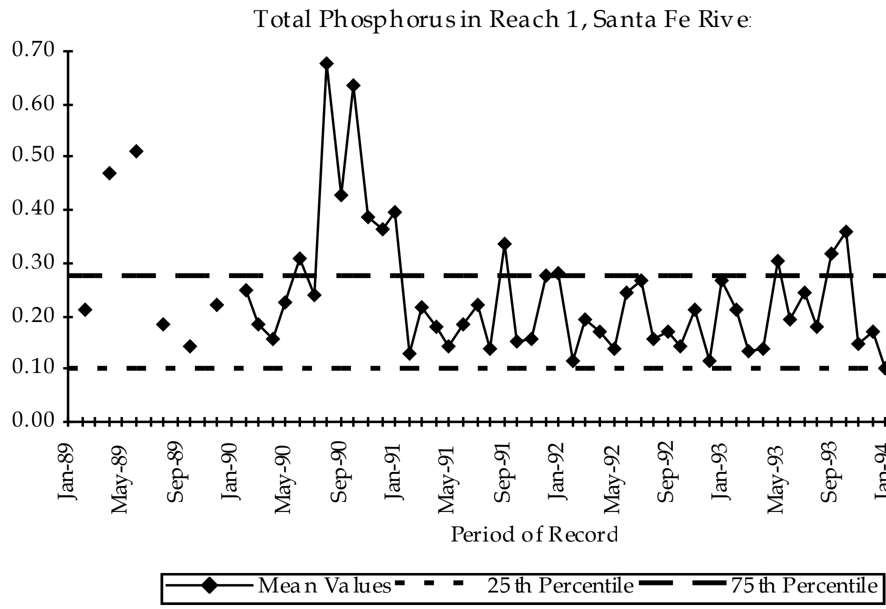
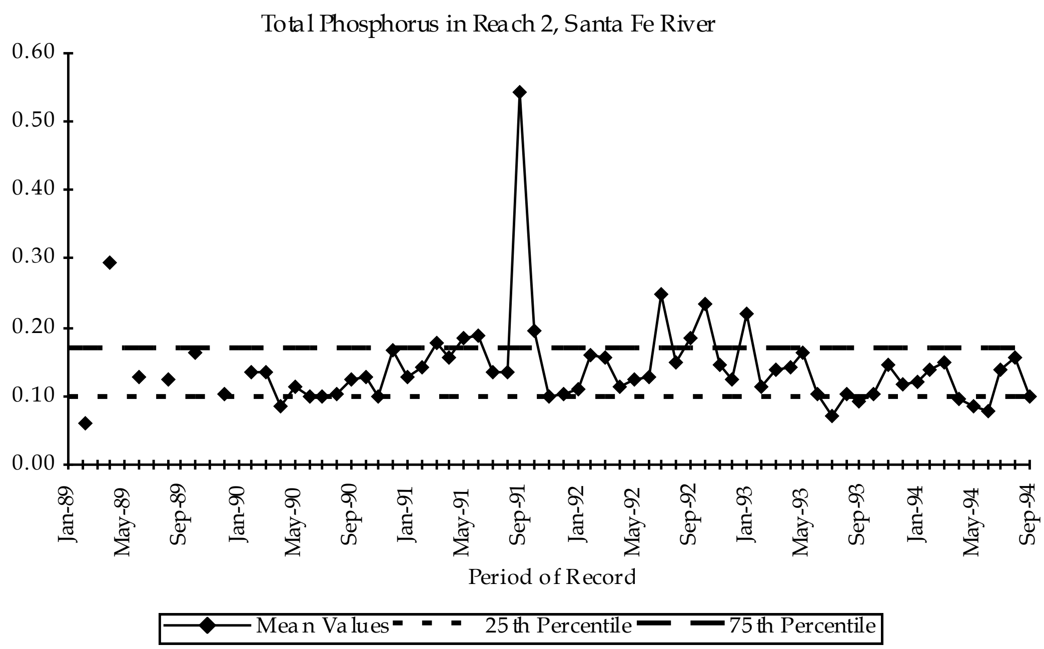


Figure 3. Mean Total Phosphorus Values, Santa Fe River





percentiles are depicted on the graphs as a frame of reference. Sampling was conducted every other month until February 1990 when monthly sampling was initiated. The higher nitrate values observed in Reach 2 during July 1993 were observed at the monitoring stations at US 441 and SR 47. No conclusive evidence as to the cause of these higher values has been discovered, but the sampling event was immediately following an increase in river discharge from heavy rainfall. It is possible that the sampling event caught a flush of nutrients or fertilizer from stormwater runoff. The higher values did not occur at the downstream station at US 129.

Slightly higher total phosphorus values were encountered in late 1990 and early 1991 in Reach 1, and in September 1991 in Reach 2. Higher discharge data for these time periods also indicate an association with a period of high rainfall and runoff.

Ecological Communities and Fish and Wildlife Resources

The Santa Fe basin encompasses six different ecoregions as defined by the U.S. Environmental Protection Agency (EPA) and the State of Florida. No other river drainage in the state covers this diverse a biogeographic area. This contributes to an overall high biotic diversity in the river system. Nearly every aquatic organism collected in the entire Suwannee drainage in Florida is also collected in the Santa Fe. The high biodiversity in the basin is a characteristic of this river system and is an important management consideration.

Aquatic Habitats

Flowing Water Ecosystems

Flowing water or lotic ecosystems constitute the major type of freshwater aquatic environment in the Santa Fe River basin. Major habitats associated with these systems which contribute to their ecological value include floodplain habitats, which mainly consist of various forested wetland communities, and those habitats associated with the stream channel.

The floodplain of the Santa Fe and its tributaries is dominated by forested systems, primarily various types of forested wetland communities. In the upper portions of the river, riparian areas are vegetated with cypress and swamp tupelo. Down river, various types of bottomland hardwood and floodplain swamp communities predominate. More frequently flooded swamps are dominated by bald and pond cypress, swamp tupelo, ash, and other tree species adapted to frequent flooding. Areas flooded less frequently exhibit a more mixed canopy which includes various oak species (live oak, laurel oak, swamp chestnut oak, black oak), water and mockernut hickory, sweet gum, black gum, american elm, blue beech, hop hornbeam, hackberry, and other species. The composition of the floodplain forest at a particular site is determined by a complex array of environmental factors, including topography, frequency depth and duration of flooding, soil types, etc.

These floodplain forests fulfill a variety of ecological roles. When flooded, they constitute important nursery habitat for riverine fishes. These areas serve as massive flood detention areas, storing flood waters and "buffering" river flood peaks downstream. The floodplain forests contribute leaf litter and plant detritus which forms a basic food source in riverine food webs, consumed primarily by various invertebrates.

River channel habitats include:

- Littoral (submerged bank) areas, which may provide important fisheries habitat, particularly if vegetated with species of emergent or submergent aquatic plants or covered with tree roots and trunks.

- Snag areas, submerged logs and brush, which have been shown to be important habitat areas for riverine invertebrates. Studies in other southeastern U.S. streams have shown that much of the invertebrate and fish production is associated with snags.

- Shoal areas, which are known to support abundant and diverse populations of benthic invertebrates. The FGFWFC showed that biomass and density of benthic invertebrates was considerably higher on limestone shoal areas in the Santa Fe, compared to sand-bottom areas of the river channel.

- Submerged aquatic vegetation beds. In the lower, spring fed portion of the Santa Fe, dense beds of eelgrass (*Vallisneria americana*), strapleaf sag (*Sagittaria kurziana*) and other submerged aquatics provide important fish and invertebrate habitat.

- Small tributary streams. It appears that these areas fulfill important roles as nursery areas for riverine fishes. The FGFWFC documented that most of the redbreast sunfish using Roaring Creek (in the upper Suwannee drainage) were juveniles, suggesting the nursery role of the creek.

Lake Ecosystems

In contrast to most other areas of the SRWMD, lakes are a major component of the surfacewater resources of this basin. A statewide study of lakes in the late 1970s by Dan Canfield at the University of Florida found that basic lake chemistry, and thus lake ecology, was closely related to regional geology in a particular physiographic region. In the northern highlands physiographic region (which includes most of the upper

Suwannee basin), three major groupings of lakes were identified based on water quality characteristics:

- Clear, acidic, softwater lakes of low mineral content and oligotrophic nutrient status. Generally, none of these are located within the basin, although lakes Santa Fe and Little Santa Fe tend toward this condition since they are located on a portion of the Trail Ridge physiographic area.

- Mesotrophic lakes which exhibit colored, acidic, soft-water characteristics. These include most of the large lakes such as Sampson, Crosby, Altho, and Hampton.

- Colored, acidic, soft-water lakes of low mineral content which exhibit a eutrophic nutrient status. Lake Rowell is the best example.

Lakes in the Coastal Lowlands physiographic region generally exhibited a similar trophic status, being oligotrophic to oligo-mesotrophic lakes, but the basic water chemistry was rather variable, depending mostly upon the water source of the lake and the proximity to limestone. Lake water chemistry ranged from acidic, soft-water lakes of low mineral content to alkaline, hard-water lakes of higher mineral content. Most of the lakes in the Lowlands portion of the Santa Fe basin are found along the rim of the Waccasassa Flats area.

Some aspects of the biology of lakes of the basin are known. The regional office of the FGFWFC has conducted fisheries assessments in selected lakes in the watershed to characterize fish populations. The DEP Bureau of Aquatic Plant Management conducts biennial aquatic plant surveys in publicly accessible lakes in the watershed. Some of the lakes are surrounded by forested swamp systems. Littoral marshes are present on some lakes, absent on others. Additional assessment of lake resources would be beneficial. SRWMD is conducting a more intensive, synoptic assessment of the Lake Crosby/Rowell/Sampson system (including Alligator Creek, draining to Lake Rowell) in 1994-95 to better define the status of this important subwatershed of the Santa Fe system and determine the impacts of point and non-point sources of pollution.

Important in-lake habitats include littoral zone marshes and submerged aquatic vegetation beds. Littoral marshes are important as habitat for fish communities. Data from the FGFWFC in several lakes in the basin show that higher fish species richness, biomass, and abundance occurs in littoral marshes compared to open water areas of lakes (Table 2). Reasons for this include more abundant food supply (small invertebrates) and protection from larger fish predators (e.g., bass).

In Table 2, richness refers to the number of species observed, biomass is the total mass of fish obtained from electroshock samples measured in kilograms per hectare, and abundance is the number of individuals per hectare. Littoral zones are shallower areas along the lake edges, limnetic zones are deeper areas in the lakes.

In some lakes, considerable areas of bottom are shallow enough to support submerged plant beds. In Lake Sampson, for example, extensive beds of eelgrass occur. Similar to the submerged beds in the river, these areas provide important habitat for invertebrates and fishes. A critical management issue for these plant beds is invasion by the exotic aquatic weed *Hydrilla verticillata* (Hydrilla). Vast areas of Lake Rowell are covered with Hydrilla, and this aggressive, invasive weed is now established in Lake Sampson as well. Studies conducted in Lake Rowell by the FGFWFC have shown that moderate levels of Hydrilla contribute to a more productive bass fishery, however, excessive levels reduce fish production and cause water quality and recreational use problems (nocturnal hypoxia, muck accumulations, impediments to navigation, etc.).

Table 2. Comparison of Lake Fish Species

	Species Richness		Fish Biomass		Fish Abundance	
	Littoral	Limnetic	Littoral	Limnetic	Littoral	Limnetic
Lake Crosby	29	8	136	16.4	19,348	6,560
Lake Rowell	25	10	256	35.6	47,564	1,018
Lake Sampson	22	9	165	18.8	50,428	640

Wetland Ecosystems

The two main types of wetland ecosystems present in the basin are marshes, vegetated with herbaceous aquatic vegetation, and swamps, vegetated with woody plants. Herbaceous marshes are found scattered throughout the basin as mostly small wetland systems (e.g., "grassy ponds"). Forested wetlands cover large areas of the river floodplain and adjacent areas. Isolated wetland systems (those present in the basin but not hydrologically connected with the river or its tributaries) are also an important wetland resources. The array of wetland types in the basin are:

- Forested wetlands dominated by needle-leaved deciduous trees; bald or pond cypress (*Taxodium distichum* or *T. ascendens*, respectively), and/or needle-leaved evergreen trees; slash pine, loblolly pine, pond pine or spruce pine

- Forested wetlands dominated by various types of broadleaf evergreen hardwoods (including sweet bay, *Magnolia virginiana* southern magnolia, *M. grandiflora*, and loblolly bay, *Gordonia lasianthus*)

- Forested wetlands dominated by various types of broad-leaved deciduous hardwoods (oaks, various gums, hickory, river birch, red maple)

- Herbaceous marshes ranging from sedgebogs, through wet prairies (vegetated with *Pontedaria*, *Sagittaria* spp., sawgrass, and other sedges) to permanently flooded marshes dominated by floating leaved aquatics such as *Nymphaea* and *Nuphar*.

Significant areas of wetlands in the basin include Santa Fe Swamp and Altho Swamp (both of which are under District ownership), Swift Creek Swamp, Mud Swamp, floodplains of the lower river (below the river rise), and the Waccasassa Flats region.

Aquatic Biological Communities

Monitoring data collected by the SWIM Program have been valuable in characterizing the status and condition of biological communities in the Santa Fe River and some of its tributaries. The two elements monitored by SWIM have been the algae present in the periphyton and the benthic invertebrate communities.

<u>Periphyton</u>. Periphytic algae are microscopic algae attached to surfaces in the river. They are important as basic food sources for many river invertebrates and are useful as water quality indicator organisms. The upper river (above the sink), with higher color and generally lower conductivity and acidic pH, is characterized by a periphyton community with more green and blue-green algae (Table 3). The lower river (below the rise) has lower color and is more alkaline and mineral-rich. The periphyton community here is more dominated by diatoms. Periphyton biomass is much higher in the lower river due to clearer water and a higher concentration of dissolved nutrients. The most species-rich periphyton community in the drainage is the site SFR020 in the upper drainage, with a total of 91 taxa of algae collected over the period of record of monitoring this site.

In lakes, the phytoplankton (microscopic floating algae) are useful water quality indicator organisms. This is seen in a comparison of phytoplankton communities in lakes Rowell and Sampson. Lake Rowell is enriched by nutrients from the City of Starke sewage plant discharge and urban and agricultural stormwater runoff. A more species rich algal community is present in this lake (total of 82 taxa) compared to Lake Sampson (total of 58 taxa), which has lower nutrient levels. Most of this increase is due to greater numbers of green and blue green algal species - these algae are generally indicative of a more nutrient-rich condition.

<u>Benthic Invertebrates</u>. A diverse benthic invertebrate community is present in the river, as shown on Table 4. Over 200 species have been collected from the system over a three

year period. Benthic invertebrates are small, bottom dwelling invertebrate animals such as snails, clams, crayfish, shrimp, aquatic worms, and

Table 3. Summary of periphytic algal community characteristics in the two reaches of the Santa Fe River.

	Upper Reach	Lower Reach
Mean Taxa Richness	20.0	23.7
Mean # Diatom Taxa	16.0	19.6
Mean # Blue-Green Taxa	1.6	1.4
Mean Diversity Index	2.44	2.78

Taxa Richness - the number of taxa (different species and genera) of algae collected.
 # Diatom Taxa - the number of taxa of algae in the diatom group. These are generally indicative of cleaner, unpolluted water.
 # Blue-Green Taxa - the number of taxa of algae in the blue-green group. These generally indicate nutrient enriched water quality.
Diversity Index - the Shannon-Weaver index of diversity. Calculated based on the number of taxa collected and their equitability (the degree to which one or a few taxa dominate). Higher value indicates a community composed of an even mix of a variety of taxa, generally regarded as a "healthier" biological community.

Table 4. Summary of benthic invertebrate community characteristics on Hester-Dendy samplers in the two reaches of the Santa Fe River.

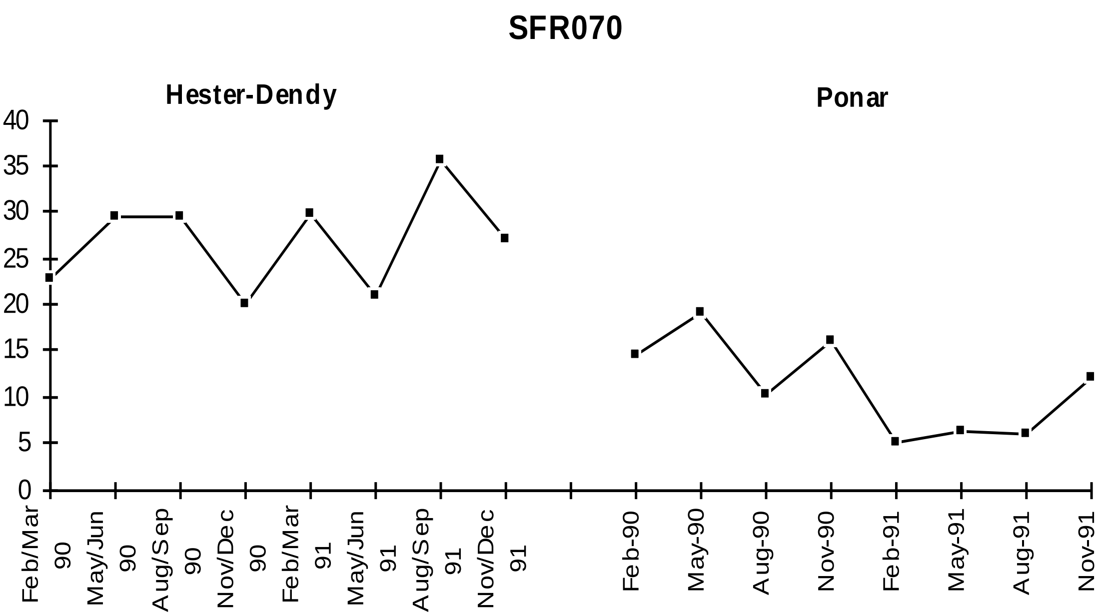
	<u>Upper Reach</u>	<u>Lower Reach</u>
Mean Taxa Richness	27.8	29.6
Mean EPT Index	9.04	8.00
Mean Diversity Index	3.56	3.80
Mean Equitability Index	0.66	0.72
# Crustacean & Mollusc taxa	2.0	2.6
Mean % Filter Feeders	0.34	0.26

EPT Index - the number of taxa of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) collected. These three groups of aquatic insects are generally indicative of clean, unpolluted water.
Equitability Index - the degree of dominance by only one or a few taxa. A lower number means greater dominance by fewer taxa. This type of situation generally indicates some type of stress or disturbance.
 # Crustacean and Mollusc Taxa - the numbers of taxa of crustaceans (amphipods, isopods, shrimp, and crayfish) and mollusks (snails and clams). Higher number generally indicates more mineralized, alkaline water quality.
% Filter Feeders - the percent of the community composed of filter-feeding organisms. Generally an indication of flow conditions. In small stream systems, many filter feeders drop out of the community at low flows.

aquatic insects. They are useful water quality indicator organisms since they have limited mobility and must contend with the water quality present at a site. They are also important food items in the diets of many fish in the river.

Habitat quality is an important characteristic which contributes to a diverse invertebrate community. Snag habitat in particular is a critical invertebrate habitat. Studies in other southeastern U.S. streams have shown that most of the diversity, biomass, and production of invertebrates is associated with snag habitat. This appears to be true for the Santa Fe as well. A more species rich invertebrate community is collected using Hester-Dendy samplers versus the community in the sandy river bottom environment (sampled using a ponar grab). This is seen in Figure 4. The HD samplers are made from hardboard and roughly imitate a piece of wood in the river. The HD data indicate the importance of snag habitat in the Santa Fe River system.

Figure 4. Comparison of benthic invertebrate taxa richness on Hester-Dendy samplers and petite ponar grab samples collected concurrently.



Fishes. Data from the FGFWFC and an older study of fishes of the Santa Fe River by T. R. Hellier show 63 species present in the system. The lower river is noted for "invasion" of marine species of both fishes and invertebrates. Marine fishes known to penetrate upriver include gulf pipefish, atlantic needlefish, striped mullet, Alabama shad, and hogchoker. Hellier divided the fish communities of the Santa Fe system into three major groupings of fish species:

Group 1. Those fish found throughout the drainage, both above and below the "natural bridge" (the underground portion of the river). These include the gar species (spotted and Florida gar), sucker, redbreast and spotted sunfish, bass, bowfin, and many shiners and killifish.

Group 2. Those fish more characteristic of the upper drainage, above the river sink. These were pickerel species, two shiners, and black crappie.

Group 3. Fish found primarily in the lower drainage, below the natural bridge. These were the various marine invaders, catfish, and the redeye chub, a small shiner described by Hellier as "one of the few vertebrates known from the subterranean waters of Florida."

Significant Natural Resources

The Florida Rivers Assessment, produced for the DEP by the Florida Resources and Environmental Analysis Center (FREAC) at Florida State University, lists three aquatic habitats in the basin designated as imperiled by the Florida Natural Areas Inventory (FNAI). These are:

- Aquatic Cave. Extensive areas of submerged caves occur in the lower Santa Fe drainage. Most of these are accessed through the springs or through sinkholes. These cave systems support several unusual troglodytic (cave-dwelling) forms of invertebrates, including several species of blind cave crayfish, blind cave shrimp, and subterranean amphipods. This community is designated "S-2" (imperiled in the state because of rarity or vulnerability) by FNAI.

- Blackwater Stream. These stream systems are characterized by high color and water chemistry characterized by an acidic pH and low mineral content. Biological communities in these streams are usually quite different from those found in most other Florida streams due to the acidic, soft water chemistry. The organisms found are not particularly unique or rare, but the community composition is very different from the more well-buffered, higher pH systems. Blackwater streams found in the drainage include many of the smaller tributaries in the upper part of the basin, above the river sink, and the upper reaches of the Santa Fe itself. This community is also designated S-2 by FNAI.

- Spring-run Stream. These streams originate entirely from the flow of artesian springs. The best example in the Santa Fe basin is the Ichetucknee River. These systems exhibit a clear, alkaline water chemistry. Beds of submerged aquatic plants are usually abundant and lush. These systems are usually subject to high levels of recreational use, which is one reason they have been designated as S-2 by FNAI.

The FREAC report provided listings of animals and plants with special status in the Santa Fe drainage (designated as federally or state endangered, threatened, or of special concern status or designated as rare by the Florida Committee on Rare and Endangered Plants and Animals). Brief accounts of particular species include:

Bartram's Ixia (*Sphenostigma coelestinum*). This small violet relative is found in the eastern part of the Santa Fe drainage. It is endemic to seven counties in north-eastern Florida, three of which are within the Santa Fe basin in the SRWMD (Baker, Bradford, and Union). A report by the Florida Committee on Rare and Endangered Plants and Animals (FCREPA) notes that "Perhaps the largest populations are in Bradford and Clay counties." This plant is designated as Threatened by FCREPA and Endangered by the Florida Department of Agriculture and Consumer Services in the Preservation of Native Florida Flora Act. The plant is found on hydric flatwoods/ wet prairie areas subject to periodic fire. Fire is an important environmental factor needed to maintain populations of this plant.

Sand grain snail (*Cincinnatia mica*). This hydrobiid snail is restricted to one site in the Santa Fe drainage. It is endemic to a small spring along the west bank of the Ichetucknee River. It is designated as a Species of Special Concern by the FCREPA because of this restricted distribution.

Suwannee Moccasinshell (*Medionidus walkeri*). This unionid clam ("freshwater mussel") is endemic to the Suwannee drainage and has been collected from the lower New River near its confluence with the Santa Fe. The mussel appears to prefer muddy sand substrata in areas of moderate current (which describes habitat conditions in much of the upper Santa Fe drainage).

Suwannee bass (*Micropterus notius*). This centrarchid is restricted in distribution to the Suwannee (including the Santa Fe) and Ochlockonee drainages. It is associated with areas of higher current (shoals, riffle habitats, etc.) in waters with alkaline pH. The lower Santa Fe contains the largest populations of this species in the Suwannee drainage. It has been declared as "rare" by FCREPA and is listed as a Species of Special Concern by the FGFWFC because of its restricted distribution. Interestingly, the species is a game fish commonly caught by anglers along the river. Fisheries biologist and managers believe that this does not represent a threat to the species as long as the existing good habitat conditions and water quality is preserved

Redeye chub (*Notropis harperi*). Hellier notes that "... the redeye chub is the most abundant vertebrate inhabitant of subterranean waters in Florida and occurs most frequently in springs and their surface runs." Hellier only collected this fish in association with springs and spring runs in the lower Santa Fe. Although its range includes north Florida south to Lake and Hillsborough counties and portions of southern Alabama and Georgia, its specific habitat requirements indicate that substantial alteration of spring habitats will affect populations of this fish in the Santa Fe drainage.

Spotted bullhead (*Ameiurus serracanthus*). This catfish is known only from a limited number of river drainages; primarily the Suwannee (including the lower Santa Fe), Ochlockonee, and Apalachicola basins. It prefers deeper holes in larger streams with rocky bottom. Its range has been described as similar to that of the Suwannee bass. The fish is classified as "rare" by FCREPA (primarily due to its restricted range of distribution). Just like the bass, this fish is caught by recreational anglers, but available evidence indicates that it is able to absorb this fishing pressure due to the existence of good water quality in these river systems and the availability of preferred habitat in abundance.

Alligator snapping turtle (*Macroclemys temmincki*). This snapping turtle, which can grow to be quite large (3-4' carapace length; J. T. Krummrich, FGFWFC, personal communication), appears to reach the southern limits of its distribution in the United States in the Suwannee drainage. It is the largest freshwater turtle in the U.S. and is an aggressive, raptorial predator, lying in wait on the bottom and using a lure-like tongue to attract fish within range of its trap-like jaws.

For most of these and other species with special status in the basin, protection of their habitat (including water quality, hydrology, and vegetation communities) is the most valuable management measure which can be taken to preserve their populations. Many of the species discussed in the above are particularly dependent upon the three habitat areas described in the beginning of this section: aquatic caves, and blackwater and spring-run streams.

Population Profile

The counties in the watershed experienced varying growth rates during the 1980s. Gilchrist County had the highest growth rate (68 percent), increasing by 3,900 people. Alachua County had the highest overall growth (30,227 additional people), but with a lower rate (20 percent). Columbia and Suwannee counties increased 20 percent as well. Bradford and Union counties experienced more modest growth rates (12 percent and 1 percent, respectively).

Overall, the watershed's population is projected to increase by about a third by the year 2010, if current generalized trends in population growth and distribution continue. Table 5 estimates the current and projected population residing within the watershed boundaries, based on the assumption that each census tract will maintain the same proportion of the overall population.

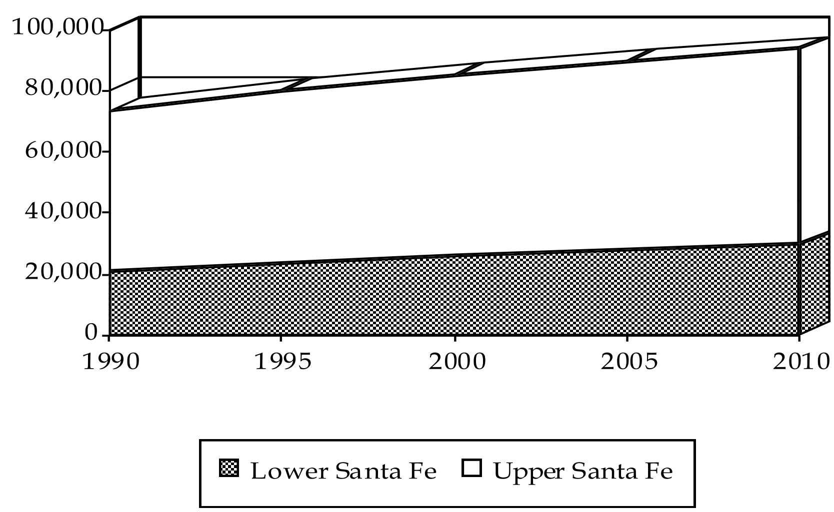
Table 5: Santa Fe River Watershed Population Projections

County	1990	1995	2000	2005	2010	Pop. Increase	Growth Rate
Alachua	20,482	21,926	23,291	24,588	25,806	5,324	25.99%
Bradford	21,389	22,230	23,370	23,845	24,415	3,026	14.15%
Columbia	17,120	19,164	20,731	22,177	23,543	6,423	37.52%
Gilchrist	2,900	3,360	3,840	4,290	4,680	1,780	61.37%
Suwannee	1,207	1,298	1,383	1,464	1,541	334	27.71%
Union	10,252	12,000	12,600	13,200	13,700	3,448	33.63%
TOTAL	73,350	79,978	85,215	89,564	93,685	20,335	27.72%

Source: SRWMD data, 1990 Census data, and State Data Center 1994

Figure 5 shows that the upper watershed (above the river sink, including Alachua, Bradford, and Union counties) will maintain a greater share of the total population. The lower watershed (below the river rise, including Columbia, Gilchrist, and Suwannee counties) is likely to experience a higher rate of growth, but will have a lower share of the watershed's total population.

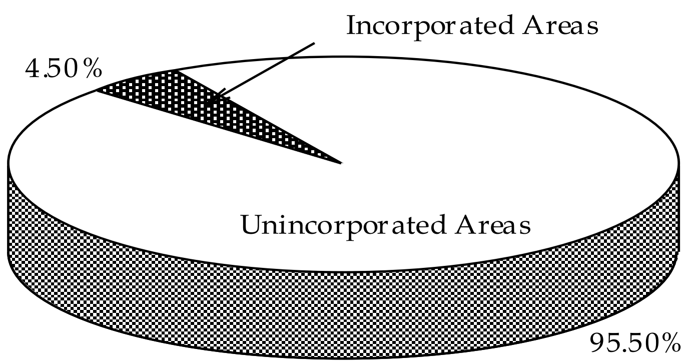
Figure 5. Santa Fe River Watershed Population Projections



The impact to surfacewater resources of an additional 20,000 persons living in the Santa Fe basin depends on several factors: where the people live in proximity to the river and lakes, the density of development, public facilities, and the construction and design standards of structures built. Many of these factors are in turn dependent upon the local government's development regulations, standards, and code requirements which govern the location, intensity, and type of development in any given area. Thus, local units of government have the authority and responsibility to most directly protect surfacewater quality and the related natural systems of the river and lakes through requiring the use of sound land use practices.

Figure 6 shows that the vast majority of population increase has occurred in unincorporated areas. The incorporated areas of the watershed accounted for only five percent of the population increase. Only Alachua, High Springs, Waldo, Lake City, and Lake Butler increased in population. The other cities showed a decrease in population between the 1980 and 1990 Census counts.

Figure 6. Distribution of Population Growth in the Santa Fe River Watershed, 1980 - 1990



Land Cover and Land Use

Land cover can indicate land use patterns on a regional scale, based on the type or lack of vegetation within an area. However, because satellite imagery-based land cover data are based on reflected light from vegetation and the land surface, it is not an accurate indicator of land use for smaller areas.

Land cover monitoring was one of the three monitoring programs established for the watershed in the 1988 SWIM Plan. Satellite imagery from 1988 was obtained and processed to provide a benchmark for the Santa Fe SWIM program. Generalized land cover is shown on Map 5, based on the 1988 satellite imagery. The intent of the land cover monitoring initiative is to update the satellite imagery for the watershed in five- to seven-year increments. GIS processing can detect changes in land cover, which in turn can indicate areas where development activities are occurring, and can help focus further studies on priority areas.

As shown on Map 5, most of the upper watershed is forested, in both managed pine plantations and natural forests. Cleared lands, mostly agricultural (range, pasture, and croplands), dominate the lower watershed. Urban areas show up around High Springs, Gainesville, Alachua, Lake City, Lake Butler, and Starke. The river and stream corridors show up as belts of vegetation, generally representing floodplains that have never been intensively farmed. What does not show up well on the land cover map is the proliferation of rural residences, however. The land cover information depicted on Map 5, derived from satellite imagery, is relatively accurate at a regional scale, but has limited utility for smaller land areas. It also is not accurate for detailed land use information.

The predominant form of land use in the Santa Fe River watershed is agriculture, including row crops, pasture, and silviculture. Urban areas are small and widely distributed in the watershed. Rural residential uses are the fastest growing land use in the watershed, with the typical development being a 50 to 100-acre subdivision with five to ten-acre lots. Subdivision activity has been most pronounced in southern Columbia, eastern Gilchrist, and northwestern Alachua counties. The proximity to Gainesville certainly influences this activity.

Water Resource Use

The principal uses of the surface waters of the Santa Fe system are recreational, with limited agricultural and irrigation uses. Groundwater, particularly from the Floridan Aquifer, is the principal source of potable water within the basin. Presently there is no commercial use of the river aside from recreational services such as marinas, bait/tackle shops, campgrounds, and canoe liveries.

Water withdrawals from the Floridan and surficial aquifers is a surfacewater concern because of the potential for reduced groundwater inflow to the river from springs (which provide most of the base flow of the river). Permitted water use, so far, does not indicate a threat to the river but significant additional withdrawals will have to be carefully evaluated for potential impacts. Permitted water use is depicted on Map 6, and permitted water well construction on Map 7. Surfacewater management permits, which are indicative of commercial developments and subdivisions, are shown on Map 8.

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Map 5. Land Cover in the Santa Fe Watershed, 1988

Note: This map is currently being revised and will be provided in the final draft.

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Map 6. Permitted Water Use in the Santa Fe River Watershed

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Map 7. Permitted Water Well Construction

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Map 8. Surfacewater Management Permits

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III. Priority Issues and Analyses

The priority issues for the Santa Fe River Watershed SWIM program are:

1. Resource Monitoring
    - Maintaining Ambient Networks
    - Additional Monitoring Needs
    - Biological Monitoring
    - Land Use and Land Cover Monitoring
2. Identifying, Reducing, And Preventing The Impact of Pollution Sources
    - Point Sources and Permitting
    - Nonpoint Sources
3. Minimum Flows and Levels
4. Land Acquisition and Management
5. Technical Assistance and Intergovernmental Coordination
6. Public Involvement and Education
7. Recreational Use

Resource Monitoring

Maintaining Ambient Networks

Resource monitoring began in 1989 as the cornerstone of the Santa Fe River SWIM program. Water quality and biological monitoring provide baseline information about the condition of the river system and indicate possible trends. Any significant worsening of water quality conditions will trigger action to identify and reduce the source and its impacts.

Hydrologic monitoring is related to water quality and biological monitoring. Water quality is directly influenced by water quantity. Currently, hydrologic monitoring including rainfall, river level and discharge, and lake level and groundwater levels are conducted outside the SWIM program but support SWIM program objectives.

Additional Monitoring Needs

Water quality and hydrologic monitoring is needed during and after storm events or within particular subwatersheds. Such data will be used to validate the results of the watershed assessment project (see below) and to provide data specific to stormwater pollutant loading from different land uses. These data are also essential to support nonpoint source investigations. Special event monitoring is supplemental to the ambient monitoring network.

Biological Monitoring

Biological monitoring provides a more comprehensive perspective of the health of SWIM priority waters. Biological monitoring includes quarterly sampling of periphyton, phytoplankton, and benthic invertebrates.

The Santa Fe basin encompasses six different ecoregions as defined by the U.S. EPA--consequently, overall biotic diversity in the river is very high. Nearly every organism collected in the entire Suwannee drainage in Florida is also collected in the Santa Fe. Biological monitoring provides continual information about the relative diversity of organisms in the Santa Fe system as well as their health, productivity, and distribution within the system.

Land Use and Land Cover Monitoring

Monitoring changes in land cover and land use are an important part of an overall resource monitoring strategy for the watershed. Land use activities and land cover characteristics are determinants of water quality, flow rates and water levels (hydrologic balance), and habitat quality.

Historic land use and land cover data for the watershed are limited. To help provide a benchmark for the SWIM program, satellite imagery was processed in 1988 to map regional land cover. This data provided a baseline land cover data set for the watershed, but has limitations for use in detailed assessments.

Detailed land cover and use information will be available in 1996 as a GIS coverage and database. Using aerial photography from January 1994, this information is being collected at Level III of the Florida Land Use, Cover, and Forms Classification System (FLUCFCS), the same classification system the satellite imagery was processed with. These data will provide a greater level of spatial and classification accuracy than the satellite data.

Periodic updating is needed to maintain current data on land use and land cover as the watershed develops. New land use and land cover mapping should be obtained on a regular basis (e.g., every five years) based on the rate of growth and development experienced. Since growth and development are not uniformly spread throughout the watershed, priority areas (defined through the watershed assessment process described later) should be the focus of this monitoring effort.

Pollution Sources

Threats to the health of the river system, especially water quality, stem from residential, commercial and industrial, or agricultural land uses, recreational uses of surface waters, water withdrawals, or other activities. The degree of threat or severity of impact resulting from our activities depends on several factors including the physical characteristics of the land, the type of activity, and measures taken to reduce adverse impacts.

Most development activities in the watershed are regulated to some degree by federal, state, regional, or local agencies. Pollution sources are the most obvious threats to the river system, and are classified as point and nonpoint sources. Point sources are direct discharges of pollutants, and are regulated by the DEP. Nonpoint sources are indirect discharges of pollution, are harder to identify, and are regulated in a less structured process. Most nonpoint source controls in the Santa Fe Watershed are addressed by voluntary means--the use and application of BMPs by agricultural and silvicultural operations. New intensive agricultural operations, particularly dairies and feedlots, are regulated by the DEP because of the higher degree of threat these activities pose to water resources. Other nonpoint sources are controlled by regulations, including the District's Surfacewater Management Rule, septic tank rules, and local land use planning and land development regulations.

Point Sources

There are five point sources of pollution identified along the Santa Fe system which are permitted through DEP[5] , described below and shown on Map 9. The approach to controlling point sources of pollution usually involves technical applications such as filtration, higher levels of waste treatment, or other mechanical means.

There are no known unpermitted point sources discharging to the river system. Detailed field studies, however, need to be conducted to verify this (see Implementation Strategies). None of the facilities identified below are operating under a temporary permit or consent order, and all are within permitted effluent standards.

1. The *Florida State Prison* in Starke operates a wastewater treatment plant that serves the state prison. The facility uses a trickling filter with additional treatment through land application. Effluent is discharged into the New River tributary near State Road 16. The design capacity of the system is 1.3 million gallons per day (MGD).

2. The *City of Lake Butler* operates a sewage treatment plant serving a population of about 4,000 with a design capacity of 0.5 MGD. The facility's treatment consists of rotating biological contactors and post aeration with effluent discharged to the New River.

3. The *City of Starke* operates a sewage treatment facility with a design capacity of 1.2 MGD, serving a population of about 7,000. Treatment consists of screening, grit removal, and biological treatment using contact stabilization, with effluent being discharged to Alligator Creek, which empties into Lake Rowell. A construction permit to convert to land application is currently being reviewed by DEP.

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[5] Limnology of the Suwannee River, 1985, and Surface Water Discharge Detail Report, 2/28/94

4. *Lawtey Correctional Institute* operates a 0.105 MGD wastewater treatment plant serving the prison facility. The system discharges treated effluent to Alligator Creek, a tributary to New River, itself a tributary to the Santa Fe River.

5. The *E. I. DuPont de Nemours Corporation* owns a dredge mining operation permitted to discharge 7.0 MGD into the Santa Fe River via Alligator Creek. Wastewater treatment consists of acidification, settling, neutralization, and final settling before disposal. The discharged effluent contains small amounts of aluminum, cadmium, calcium, chromium, copper, cyanide, iron, mercury, phosphorus, sulfate, ammonia, nitrate, and zinc.

Although technically not a point source, intensive agricultural operations such as dairies are regulated by the DEP under the Industrial Waste program. New regulations specific to the intensive agricultural operations are being developed by DEP.

<u>Nonpoint Sources</u>

Stormwater runoff from urban areas, roads, construction sites, agricultural and silvicultural areas, landfills, leaking underground storage tanks, and septic tank leachate are examples of potential nonpoint sources of pollution. Approaches to controlling pollution from nonpoint sources involves the application of BMPs such as sediment control during construction or roadside swales, as opposed to the more technological remedies that are used for point sources.

<u>Stormwater Management</u>

The District has administered Chapter 40B-4, F.A.C., Surfacewater Management, since 1986. This rule requires proper stormwater management for new development and redevelopment activities. Rule criteria require the management of water quantity to keep post-development runoff similar to pre-development conditions. Water quality treatment is required as well, and varies depending on the physical setting of the site and the type of water body discharged to. Sensitive areas such as interior-drained or stream-to-sink watersheds have more stringent water quality criteria. Facilities discharging to OFWs such as the Santa Fe River also have more stringent water quality treatment criteria.

All future developments subject to the District's rules, and those occurring since 1986, do not pose a threat to surfacewater quality--unless not maintained in compliance with permitting conditions. Existing (pre-1986) developed areas have greater potential to impact water quality, and need to be systematically evaluated and prioritized. The initial steps in this process are accomplished by the watershed assesment project described later. Previous SWIM work and contact with local officials has identified several current stormwater management problems as follows:

Lake City/Middle Columbia County
Several developing areas within the Rose Creek and Cannon-Clay Hole Creek basins experience stormwater management problems and flooding. This rapidly-developing area of Columbia County drains directly to the Floridan Aquifer at the creek sinks, and tracing studies have verified a link between Rose Creek and Ichetucknee Springs. Due to the growth in the area, the feasibility of a regional stormwater management system should be examined.

Waldo
The City of Waldo has several low-lying areas which flood and create stormwater management problems. Existing ditches and culverts provide no water quality treatment, but several flow into wetlands areas that may serve water quality benefits. Most of the city drains to Lake Altho via Altho Canal directly through these ditches; part of the city drains south. This are needs to be evaluated to determine the degree of impacts to Lake Altho, the feasibility of a master stormwater management system, and if possible the level of treatment offered by existing wetlands.

High Springs
Stormwater management for the City of High Springs is provided through numerous sinkholes which connect directly to the Floridan Aquifer and the nearby Santa Fe River. A stormwater management study conducted for the City in 1991 provides a basis for "an overall long-term stormwater management plan for the City of High Springs. The study inventoried existing stormwater management practices and facilities, and concluded with a priority list of tasks that fall into five prioritized areas:

A. Areas that need immediate attention due to erosion or erosion potential.
B. Sites that need to be investigated for potential groundwater pollution.
C. Existing facilities in need of repair or maintenance.
D. Priority areas in need of permanent drainage improvement.
E. Areas that need to be secured for drainage purposes.

<u>Silviculture BMPs</u>
Nonpoint sources of pollution associated with forestry activities are controlled through the application of BMPs detailed in <u>Silviculture Best Management Practices 1993</u>, Florida Department of Agriculture and Consumer Services, Division of Forestry. Outstanding Florida Waters, which in the Santa Fe River watershed include the Santa Fe River, Lake Santa Fe, Little Lake Santa Fe, Santa Fe Swamp, Olustee Creek, and the Ichetucknee River, are provided a 200-foot special management zone in which restrictions and limits on silviculture apply. A minimum 50-foot buffer, in which no cutting is allowed, must be maintained adjacent to all the water bodies listed above.

Map 9. Point Sources of Pollution

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Onsite Sewage Treatment and Disposal Systems

Areas that are not served by central sewage treatment plants rely on onsite sewage treatment and disposal systems (OSTDS). The traditional form is a septic tank and drain field. Chapter 10D-6, F.A.C., requires a minimum of two feet of unsaturated soil between the bottom of the drain field and the seasonally high water table to adequately treat domestic waste water.

Where OSTDS are not properly installed or maintained, or where drain fields are not adequately separated from the water table, waste water discharged from the tank is not adequately treated. Nutrients and bacteria can be carried to ground water or surface water, causing potential health problems and leading to eutrophication of surfacewater bodies.

Recent revisions to Chapter 10D-6, F.A.C., have restricted the placement of septic tanks within the 10-year floodplain or regulatory floodway of the Santa Fe River system. Within these areas advanced treatment systems which provide greater treatment of wastewater prior to discharge to a drain field are required. Not all of the 10-year floodplain of the river system has been mapped, however. Additional mapping, wherever feasible, would help implement the rule and address a potential nonpoint source of pollution.

Watershed Assessments

Land use is an important determinant of a watershed's water quality and ecological integrity. Land use decisions are made by local governments in accordance with comprehensive plans prepared under the guidelines in Chapter 9J-5, F.A.C. Minimum criteria in the rule require local governments to consider the suitability of land for use, including residential, commercial, industrial, agricultural, conservation, and public uses.

Most of the comprehensive plans applicable to the Santa Fe River watershed were not based on a thorough analysis of environmental conditions such as soils, topography, wetlands, and ground water because adequate information was not available. Also, future land use patterns designated in the plans generally conforms to historic land use patterns--e.g., agricultural and low-density residential.

Through the SWIM program data are now available to conduct such analyses and to provide recommendations to local governments for appropriate land use designations. Watershed models can be developed to help evaluate potential impacts to water quality from proposed future land uses.

Two basic steps define the watershed assessment process. An initial screening step using watershed-wide criteria is used to identify priority subwatersheds. Once these priority subwatersheds are identified, management plans are developed to address the land-use specific impacts identified. For some areas, particularly more-developed and faster-developing areas, more detailed analyses may have to be conducted. These second-level analyses may include basin-specific hydrologic and contaminant-transport modeling, determining actual pollutant loading rates for various land uses, and other more detailed assessments.

Products from the assessment project will be used to assist local government comprehensive planning efforts, and to develop a strategy to determine cumulative impacts with the watershed or subwatersheds.

Minimum Flows and Levels

Water management districts are responsible for establishing minimum flows and levels for surface and ground waters to prevent adverse impacts from consumptive uses of water and water resource projects. The legislative intent[6] is to provide for the water needs of natural systems while assuring the needs of reasonable-beneficial uses, as defined in State Water Policy.

Because the District has pursued a nonstructural water management strategy, the implementation of minimum flows and levels standards is accomplished by administering and enforcing water use regulations and the Water Shortage Plan. Within the Santa Fe River watershed, the emphasis should be placed on adequately characterizing the area's water resources, especially the interaction of surface and ground waters. Detailed water use data, coupled with accurate projections of future water use and water needs, are also required to quantify the degree of threat for over allocating water.

Ground water is the primary source of water for consumptive uses; surface water use is very limited. Regionally, there appears to be an adequate supply for reasonably foreseeable demands. Surfacewater use is primarily from lakes and small streams to irrigate crops, and can present more of a problem because of the variability of flow and surfacewater level from season to season. Typically, surfacewater demand is during dry periods, exactly when instream needs are most critical because of low flow conditions. Because of the availability of groundwater resources, an option that should be considered is reserving, by policy and District rules, surface waters for nonconsumptive uses[7].

Land Acquisition and Management

One of the more direct resource management and protection tools available is land acquisition and management. Using funds from the Water Management Lands and the

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[6] Found in Section 373.042, Florida Statutes

[7] As allowed for in Section 373.223(3), Florida Statutes

Preservation 2000 Trust Funds, the District can acquire fee simple interest in lands important to water management. Lands are purchased strictly on a voluntary sale basis.

Through 1994 the District has acquired over 7,137 acres in the Santa Fe Watershed, including Santa Fe and Altho swamps. A small tract adjacent to Poe Springs Park has also been acquired and leased to Alachua County, who operates the park.

Using geographic data developed through the Santa Fe SWIM program, a GIS-based model has been developed to evaluate the suitability of lands within the watershed for public acquisition by the District. Data layers used include property ownership (within the floodplain), soils, land cover, hydrogeology, and permitting information. The District's 1995 Land Acquisition and Management Plan (LAMP) describes the process in more detail and shows existing and projected District acquisition activities and other public lands in the Santa Fe Watershed.

Land management activities are important to restore and/or protect the natural resource values of acquired lands. Public use of these properties must be managed. Many of the lands acquired by the District are restored to native ecological communities, necessitated by past alterations. Ecological inventories provide a baseline data set from which land management plans are developed and implemented.

Technical Assistance and Intergovernmental Coordination

Local Planning

Comprehensive land use plans have been adopted by all local governments within the watershed under the 1985 Growth Management Act. These plans have a direct impact on the water-related resources of the Santa Fe River watershed by designating or allocating land uses within the area, and establishing policies to appropriately use and manage lands.

Because many of the local governments in the watershed have limited staff and resources to develop and implement the plans, technical assistance is needed to help ensure the quality and natural functions of the river system. Further, revisions to Chapter 373, F.S.[8], made by the 1989 legislature require the District to provide technical assistance to local planning programs. This assistance provides a linkage between watershed- or resource-based plans and programs with land use plans administered by local government.

Regional Planning

The third Environmental Lands Management Study Commission recommended changes to the state's land and resource planning framework in 1993, including

[8] Section 373.0391, Florida Statutes

substantial revisions to the regional planning requirements of the Growth Management Act. Regional policy plans are required to be revised, focusing on five key areas, including regionally significant natural resources. Natural resources of regional significance are one of the new required elements, including accurate mapping and policies and strategies aimed at protecting the function of regionally important systems.

The District's SWIM program has an opportunity to integrate SWIM projects with regional planning efforts by providing technical assistance in the form of GIS coverages as well as policy development. In addition to local technical assistance, this strengthens the connection between the District's SWIM planning efforts and the land use-based planning efforts of local governments and regional planning councils. Although the District has formal plan review requirements for both the local and regional plans, there is no formal linkage between water resource planning such as SWIM and land use planning. Coordinating the development of regional plans, and policies and strategies that deal with water and related resources, assures increased consistency between the efforts.

Ecosystem Management

The Environmental Reorganization Act of 1993 merged the former departments of Environmental Regulation and Natural Resources into the new Department of Environmental Protection. One of the components of the merger was the creation of the state's Ecosystem Management program, intended to provide a more comprehensive evaluation of agency programs affecting the environment--a more holistic approach that relies more on coordination and cooperation and less on regulations.

Six pilot areas were selected as candidates for Ecosystem Management Area Implementation Plan development, including the Suwannee River system (including the Santa Fe). This plan was developed around the many existing programs dealing with various aspects of the river system, especially the District's SWIM programs.

Coordinating with the DEP's Ecosystem Management program helps assure the visibility and viability of SWIM projects for the Santa Fe River system. Continued coordination provides opportunity to give and receive technical assistance from DEP and the other agencies involved in the program.

Program Coordination

An important management concern for the SWIM program involves coordination with the District's other planning and implementation programs. SWIM is not in itself a regulatory program, yet many of the resource protection tools needed to implement SWIM goals are in the regulatory arena. Similarly, the District's land acquisition and management responsibilities accomplish key SWIM goals by protecting important lands. Outreach activities, including technical assistance described above, environmental education, and public information can also help accomplish SWIM goals.

With the advent of the District Water Management Plan (DWMP), increased coordination among District programs has improved significantly. The District's limited staff resources necessitates close interaction among staff and programs to achieve multiple objectives whenever possible.

For example, GIS data developed through the SWIM program are used by the District's land acquisition staff to evaluate, on a watershed basis, appropriate areas for acquisition based on several criteria (including water quality and habitat protection). Environmental education efforts are also closely coordinated with SWIM staff.

Public Involvement and Education

Public Involvement in River Protection

There are many ways individuals and groups can help protect the Santa Fe River system, including volunteer observers and monitoring efforts and river cleanup programs. These activities not only provide an educational opportunity for the public, but a way to keep watch over conditions in the water bodies that government agencies often cannot.

Florida LAKEWATCH is a program administered through the University of Florida in which lakeside residents routinely monitor water quality conditions. Basic data are collected, analyzed by University staff, and made available to the public and resource management agencies. Often these data represent the only monitoring efforts for some lakes. The LAKEWATCH program currently includes lakes Santa Fe and Little Santa Fe. Expanding the LAKEWATCH program to the other lakes in the watershed, wherever feasible, should be pursued.

Littering and trash dumping continues to be a problem, especially in remote areas. Remote bridges and river access points are particularly troublesome areas where people dump old appliances, vehicles, and household trash. Citizen groups have organized river cleanup days, where interested people pick up trash and litter from the river and its banks. Providing financial assistance, logistic support, and other assistance to these groups is an important public involvement and education that public agencies need to consider.

Lakefront and riverfront property owners have a vested interest in the condition of the watershed's surface waters. Waterfront residents also have a direct impact on surface waters from their activities--including lawn fertilizer application, septic system maintenance, vegetation clearing, wetlands impacts, and hydrologic alterations. Often, landowners see little direct impact from their individual activities and do not consider the cumulative impact of theirs and their neighbor's activities on the river system. Providing a basic guide to help reduce impacts from seemingly innocuous activities, as well as information about the water body, how the different ecological communities interact, agency responsibilities and contacts, etc. to waterfront property owners can help accomplish watershed protection goals.

WaterWays/Environmental Education

Environmental education is an important part of natural resource management and protection programs. Including basic environmental education curricula in grade schools helps students understand how river systems work, and the important functions they serve. With an adequate understanding of natural systems, students are instilled with a set of values that recognize the importance of protecting water quality, water levels, floodplains, and fish and wildlife habitat.

SWIM environmental education activities are aimed at providing grade school teachers with the tools and knowledge needed to help make students aware of natural resources. Included are teacher workshops, newsletters, reference and source materials, in-classroom presentations and speakers, serving on local and state advisory boards, conducting field trips, participating in the EnviroThon program, and responding to specific requests for information or assistance.

Recreational Use of the River System

Public Lands Use

Recreational use of public lands is a watershed management issue for heavy-use areas--especially state parks and publicly-owned springs. Adequate facilities, including boardwalks and trails, parking and restroom facilities, improved boat ramps, and other amenities can help protect sensitive resources while allowing for public access and use. Lands acquired by the District for water management purposes are made available for appropriate public use.

Surfacewater Use

Recreational use of the river system is heaviest during the summer months, and is focused on the headwater lakes (boating, fishing, and water-skiing) and the lower river and the springs (swimming, boating, and fishing). Impacts from recreational use include water quality degradation from a lack of sanitary facilities and outboard motors, shoreline erosion from uncontrolled access and boat wakes, and use conflicts from incompatible activities.

An example of recreational management on the river is boating restrictions during flood events. During high-flow conditions[9] a no-wake rule is in effect to help protect the river's banks and private property from the damage caused by boat wakes.

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[9] When the Suwannee River at Branford reaches 26'MSL, a no-wake rule is in effect on the Santa Fe River from US27 at High Springs to the confluence with the Suwannee. Motorized craft must operate at no greater speed than that necessary to maintain steerage.

IV. Management Strategies for the Santa Fe River Watershed

The management strategies for the Santa Fe River watershed reflect a continuation and modification of those identified in the original SWIM plan for the system (SRWMD, 1988). The five program areas are Resource Monitoring, Resource Planning, Program Implementation, Restoration Implementation, and Waterbody Planning. Each of these are in turn comprised of a number of projects intended to address the priority issues identified earlier.

Projects are further broken down into the tasks--specific actions--which the SRWMD intends to undertake to implement the management strategies. Completing the programs, projects, and tasks is dependent upon the availability of adequate funding and the direction of the SRWMD Governing Board.

1. Resource Monitoring

Program Definition: Resource Monitoring involves those activities related to the collection and analysis of data. Examples include water quality sampling, biological sampling, land cover and land use mapping, and trends analyses. The Resource Monitoring program also encompasses the analyses conducted on or with the data collected to determine changes or trends.

Resource monitoring is the cornerstone of the SRWMD's SWIM program. An ongoing monitoring program of the state of the natural systems is important to the health of the river system. The Resource Monitoring program is comprised of three elements: water quality monitoring, biological monitoring, and land cover/land use monitoring.

The SWIM long-term water quality and aquatic biological monitoring program began in 1989. Water quality samples were collected and analyzed at 25 stations throughout the watershed at bimonthly and monthly intervals (the original bimonthly sampling schedule was switched to monthly beginning February 1990, and the number of stations reduced to 10 in 1992). Biological sampling of benthic macroinvertebrates, phytoplankton, or periphyton has been conducted at 6 stations along the Santa Fe on a quarterly basis. Sediment samples are taken annually at O'Leno State Park, above the river sink, and twice annually at US 129 near Hildreth.

Land cover and land use directly influence the quality of natural systems, including riverine or other aquatic systems. Habitat and land cover alterations from development activities, conversion of natural ecosystems to agricultural production, disruptions to natural surface- and groundwater flows, and the introduction of pollutants into rainfall runoff all constitute threats to the natural systems of the Santa Fe River. Regional land cover data were obtained from satellite imagery in 1988 and converted to a GIS coverage. This coverage, although useful for considering large areas, is not detailed enough for land use determinations or for smaller areas. A land use and land cover GIS coverage is currently being developed from 1994-1995 aerial photography. This coverage, described later, will provide additional detail for this monitoring effort.

Project 1.1: Water Quality Monitoring

Project Goal: Maintain a monitoring network capable of providing continuous data related to water quality in the river system, particularly to identify changes and trends in water quality.

The first need in monitoring water quality is to develop and document a water quality monitoring network design which provides sampling specifications and methods, sample handling and analyses, data management and analyses, and information reporting mechanisms. A water monitoring network was initiated in 1989 for the Santa Fe River and the tributaries thought to provide water quality information needed to adequately characterize conditions in the Santa Fe River watershed. Tables 3 and 4 list the sample collection locations, the variables tested, and the frequency each variable is tested. These tables list the network as of April 1994. Modifications were made to the network in 1990 and 1992.

Task 1.1.1: Conduct monthly water quality sampling 1995-1998

Mid-channel, mid-depth water samples will be obtained and measurements made *in situ* for basic physical descriptors twelve times yearly (once monthly) at 10 stations (Table 6 and Map 11).

Task 1.1.2: Laboratory Analyses 1995-1998

Analyses for the parameters and variables listed in Table 7 will be conducted twelve times yearly (once monthly) for each of the 10 sampling stations by the contracted laboratory.

Task 1.1.3: Data management and analysis 1995-1998

Maintain a data management system that provides easy access to statistical tools, and to STORET transfer. The system must include a documented protocol for data quality control procedures that will be followed. Document and perform statistical analyses of monitoring data to identify trends and provide a basis for identifying and resolving water quality problems.

One of the principle goals of water quality monitoring is the dissemination of data collected and analyses conducted. Compiling and reporting results of data analyses, with target audiences of both the Governing Board and the public, is the second aspect of the monitoring program. Significant changes in water quality will trigger additional monitoring and field studies to identify causes and alternative management approaches.

Table 6. Water Quality Sampling Stations

Station No.	Station Name and Location	Sampling Regime
SMR010C1	Sampson River, above Santa Fe River	Chemistry
SFR020C1	Santa Fe River at Brooker	Chemistry, Biological
NEW010C1	New River at SR 18	Chemistry, Biological, Bacteria
SFR030C1	Santa Fe River at Worthington Springs	Chemistry, Biological
OLS010C1	Olustee Creek at SR 18	Chemistry
SFR040C1	Santa Fe River at O'Leno State Park	Chemistry, Biological, Bacteria, Sediment*
SFR050C1	Santa Fe River at US 441	Chemistry, Biological, Bacteria
SFR060C1	Santa Fe River at SR47/Fort White	Chemistry, Bacteria
ICH010C1	Ichetucknee River above US 27	Chemistry
SFR070C1	Santa Fe River at US 129	Chemistry, Biological, Bacteria, Sediment**

* - Sediment sampling in May
** - Sediment sampling in May and November

Lake water quality monitoring stations were discontinued in 1991 due to SWIM funding shortfalls. Lakes Santa Fe, Little Santa Fe, Altho, Rowell, Sampson, Crosby, and Hampton were monitored bimonthly as part of the SWIM program in 1989 and 1990.

Table 7. Water Quality Variable List and Frequencies

Parameter	Variable	STORET Code
Water Column (Field)	Sample and Total depth	
	Water temperature (°C)	10
	pH	400
	Dissolved oxygen	299
	Salinity	480
	Conductivity (field)	94
	Conductivity at 25°C	95
	Secchi depth	78
	Stage	65
Physical/Biological	Color	81
	Turbidity	82079
	Residue, total nonfilterable	530
	Residue, fixed nonfilterable	540
	Total Dissolved Solids	515
	Alkalinity as CaCO3	410
	Total organic carbon	680
	Dissolved organic carbon	681
Major Ions, total	Potassium	937
	Sodium	929
	Magnesium	927
	Calcium	916
	Chloride	940
	Fluoride	951
	Sulfate	945
Nutrients	Nitrite plus Nitrate	630
	Total Kjeldahl N	625
	Ammonia N	610
	Orthophosphate	671
	Total Phosphorus	665
Sediments	Composition	multiple
	Total Phosphorus	668
	Trace Metals	multiple

Map 10. Monitoring Station Location, Santa Fe River Watershed

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Task 1.1.4: Water quality reports 1995-1998

Reports which document water quality conditions and trends will be made to the Governing Board and the public. Trends involving basic parameters characterizing portions of the river and tributaries will be presented, with discussion of possible causal relationships. Annual reports will be published summarizing water quality conditions. This report will be provided to agencies, local governments, and interested citizens.

Task 1.1.5: Special event monitoring 1995-1998

Water quality sampling and analysis for special events such as individual, site-specific storm or rainfall events provides data supplemental to the main monitoring network, and provides data to be used in watershed assessments. Additional monitoring to identify the causes of degraded water quality detected through the ambient monitoring network will be undertaken when needed. Stormwater management facilities discharging to surface waters may also be monitored. Areas with existing or suspected stormwater pollutant loading, including those listed in the Priority Issues section, will be targetes. This task will aid implementation of water quality management goals by documenting pollutant loading to specific water bodies or stream reaches, which will support restoration or preventive implementation actions.

Task 1.1.6: LAKEWATCH Program assistance 1996 - 1998

Provide technical and financial assistance to the Florida LAKEWATCH program to develop and maintain a network of volunteers to monitor the lakes of the Santa Fe Watershed. Lakes Santa Fe and Little Santa Fe are currently monitored through this program. This helps accomplish resource monitoring objectives of the SWIM program, as well as involving and educating the public about water quality issues in the watershed.

Project 1.2: Biological Monitoring

Project Goal: Define conditions of aquatic biota in the Santa Fe River on an ongoing basis, determine relationships between water quality, hydrology, and aquatic communities, and report these data and conclusions to the District Governing Board and other resource management agencies.

Biological monitoring of the Santa Fe River has been conducted quarterly at six stations along the river since 1989 (Map 11). The biological monitoring component of the overall resource monitoring program is continued from the initial management plans through the time frame of this management plan.

Task 1.2.1: Implement quarterly aquatic biology monitoring network, 1995-1998

Monitoring of aquatic biota was initiated in 1989 on the Santa Fe and New rivers. Benthic macroinvertebrates were sampled in 1989. Invertebrates, periphyton, and phytoplankton were sampled in 1990. Table 3 lists the stations and biological elements which will be sampled in the aquatic biology network. Monitoring schedule at all sites will be quarterly (February, May, August, and November).

Task 1.2.2: Biological monitoring report 1995-1998

Results of the biological monitoring program will be analyzed and reported in conjunction with the water quality reports described under Task 1.1.4.

Project 1.3: Land Cover and Land Use Monitoring

Project Goal: Monitor changes in land cover and land use throughout the Santa Fe River Watershed to define and analyze long-term regional trends in land conversion and development activity.

Task 1.3.1: Land Use and Land Cover Mapping 1994-1995

Interpret 1994-1995 aerial photography for the watershed and create a GIS coverage and database using Level III classifications in the FLUCFCS.

Task 1.3.2: Aerial photography/digital orthophotography 1996

Obtain recent (1994 or 1995) digital orthophotography of the Santa Fe River watershed for use in detailed studies or analyses of priority areas within the watershed.

2. Resource Planning

Program Definition: The Resource Planning program encompasses those activities related to the development of plans and strategies for watershed management, and includes activities such as watershed assessments and GIS development. Included are digital data base development, special studies aimed at specific geographic areas (e.g., subwatersheds), conducting specific analyses for the provision of technical assistance to other agencies, and the further identification of management needs and issues.

Project 2.1: GIS Database Development and Maintenance

Project Goal: Develop and maintain computerized, geographically referenced data bases of the physical, hydrologic, and cultural features that comprise the Santa Fe River watershed.

Task 2.1.1: Database Documentation and Maintenance 1995-1998

This is an ongoing task to keep the GIS databases operational and to provide user information related to GIS coverages.

Task 2.1.2: Future Land Use Map Automation 1995-1998

Future Land Use Maps adopted by local governments within the watershed were digitized and a coverage created in 1993, with the exception of Alachua County. Since the maps can be amended up to twice a year by local governments, this task will maintain the coverage up-to-date and complete the coverage by including digital information obtained for Alachua County in 1994. This task will be closely coordinated with the North Central Florida Regional Planning Council (NCFRPC), which provides technical planning assistance to many of the local governments in the watershed.

Project 2.2: Identifying and Evaluating Point and Nonpoint Sources of Pollution

Project Goal: Develop a comprehensive inventory and priority list of existing and projected point and nonpoint sources of pollution to the Santa Fe River system, including alternatives for eliminating or reducing pollution loadings.

As previously discussed, some impacts to the river system have already been detected through the ongoing water quality monitoring project. The causes are not fully understood at present. A means to reliably quantify the impact these nonpoint sources have on the river system is needed. Mapping these areas and constructing a database containing known, discrete data is a necessary first step. The end result of this project is to identify nonpoint sources, their impact to the system, and ultimately to enable regulatory or voluntary controls to be enacted to stop the degradation of the river.

Task 2.2.1: Point Source Coordination 1995-1998

The SWIM program for the Santa Fe River is not a regulatory program, yet the decisions, processes, and results of the permitting process profoundly affect the management of the river system. The intent of this task is to involve the Santa Fe River SWIM program in the review of point source discharge permit renewals and new permits. The Northeast District office of DEP has agreed to provide data to SWIM staff.

Task 2.2.2: Watershed Assessment 1995-1997

Using GIS coverages and databases, watershed assessments will be conducted to help identify areas that are potential nonpoint source problems. This task is a screening process to identify priority subwatersheds and/or river or stream reaches for further analysis, including possible Pollutant Load Reduction Goals.

GIS coverages applicable to this task that have been developed through the Santa Fe River SWIM program, and other District programs, include:

- soils
- topography
- watershed boundary and type
- existing land use and land cover
- future land use
- hydrogeologic conditions

The assessment process will be applied and fine-tuned using a pilot area in the Starke/New River area. The assessment will use two approaches to evaluate the relative impact of water quality degradation and wetlands impacts. An index approach, which assigns a relative weight to predetermined factors such as soil/land use combinations and resulting pollutant load estimates, will be used for appropriate parameters. A more detailed modeling approach will be used for nutrients. This process is illustrated in Figure 7.

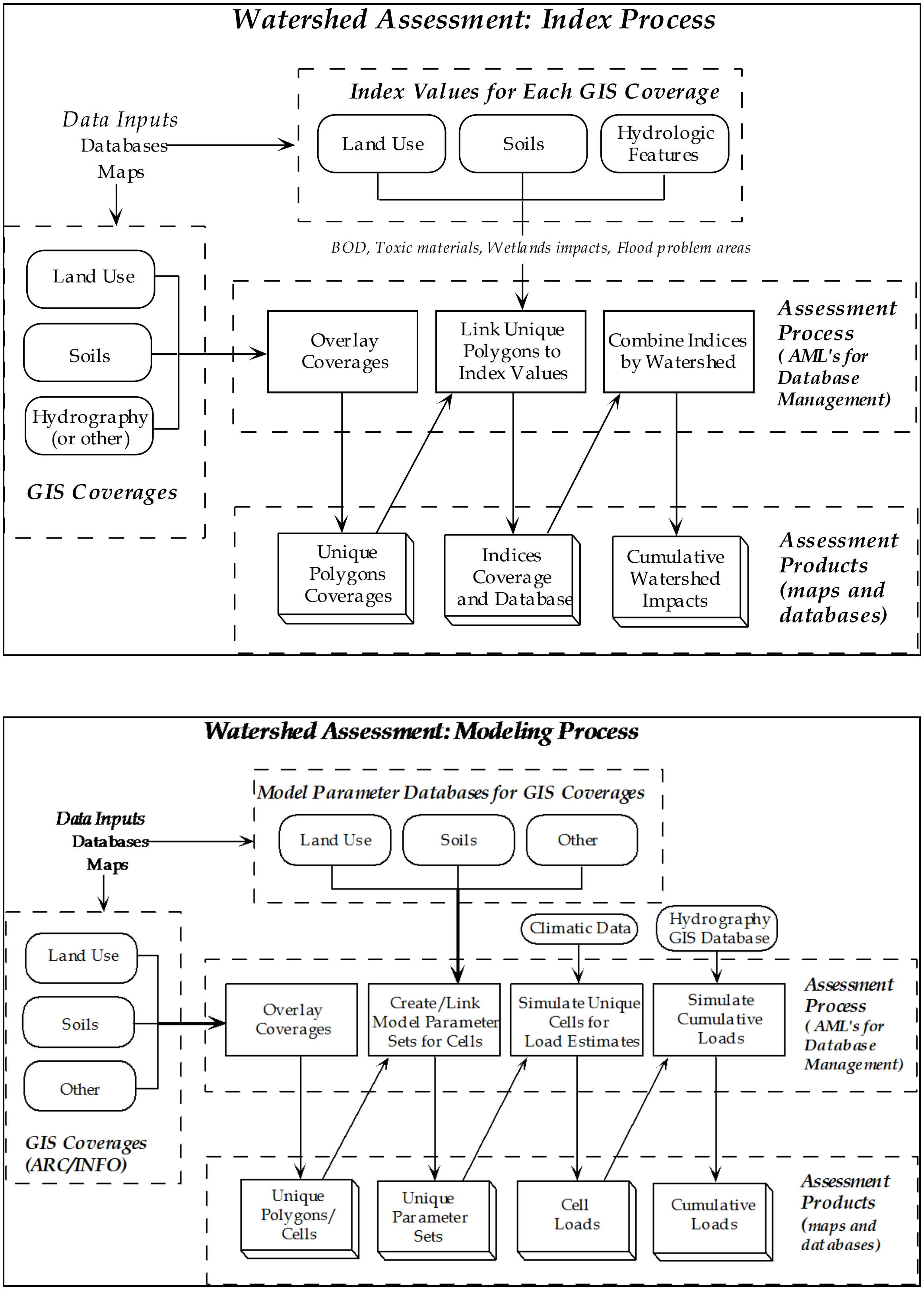
The assessment results will be used to develop a list of priority subwatersheds for more detailed analysis. This detailed analysis will provide the basis for future management decisions, including quantified pollutant load reduction goals specific to each watershed and/or water body. Additional monitoring and research needs will be identified where appropriate to support District and other agency action to protect water quality, habitat, and related resources.

Task 2.2.3: Field Surveys 1995-1998

Further field studies are proposed for site specific source checks, mapped area confirmation, compliance checks, and to complement and support special event monitoring. After particular reaches of the river or specific geographic areas are targeted for further investigation (e.g., stormwater problem areas), field surveys are conducted to obtain more detailed information, verify potential pollution sources, and to further refine modeling or other analyses.

Field surveys will be used to finalize computer mapping and aerial photography work efforts. They are a final refinement of watershed mapping (and subsequent analyses) as well as a means for visual, first-hand checking of suspected pollution sources.

Figure 7. Watershed Assessment Process



Task 2.2.4: Subwatershed Priority List and Management Plans 1997

Based on the preceding tasks, a priority list of subwatersheds (e.g., Rose Creek, Ichetucknee Trace) will be developed. Management plans/guides will be developed for those land uses within the watershed that were identified as problems during watershed assessment runs. These plans or guides will provide specific information for those identified land uses to mitigate the off-site impacts of these activities. Both agricultural and urban management guides or BMPs will include practices to manage runoff; fertilizer, pesticide, and cultural practices; chemical storage; fuel storage; animal waste; and water use for meeting environmental resource objectives.

This project, summarized, will provide: the water resource problem areas, ranking of the problem areas, the causes of the problems, and management solutions and preliminary cost estimates by land use.

Project 2.3: Minimum Flows and Levels for Surface and Ground Waters in the Santa Fe River Watershed

Project Goal: Determine and recommend minimum flow and level standards for surfacewater flows and levels and groundwater levels, based on a thorough understanding of the hydrologic relationship between ground water and surface water in the Santa Fe River Watershed (including water quality and water quantity).

This project is based on the SRWMD's minimum flows and levels program described in the 1995 DWMP. The lower Suwannee River, including all or part of the Santa Fe River watershed, is the first priority for establishing minimum flows and levels. Tasks identified below focus on surface- and directly related groundwater data.

Minimum flows and levels for surface and ground waters are required by Chapter 373.042, F.S. These standards are intended to protect the water needs of natural systems and are implemented three ways: constructing and operating water resource projects, water use regulations (Chapter 40B-2, F.A.C., Permitting of Water Use), and water shortage declarations.

The Santa Fe River watershed is widely known for its unique karst features, foremost among which are the numerous first- and second-magnitude springs throughout the river system. The lower watershed's rolling-hill landscape, formed by limestone solution and riddled with sinkholes of varying ages, reveals a geographic area with a complex, intricate ground-surfacewater hydrology. The influx of ground water into the surface waters of the system results in the single greatest change in the chemistry, appearance, and life-structure of the river. During periods of low flow, the vast percentage of water flowing out of the Santa Fe is of groundwater origin, with only enough surface water to slightly color the river water with tannins.

With the exception of spring gaging by the USGS and the SRWMD and some limited spring water testing, little data exists for a comprehensive analysis of the relationship between ground and surface waters. Of particular concern to the SWIM program are areas which provide base-flow ground water to the river that are susceptible to water quantity or quality alterations. These areas must be located, mapped, analyzed, and quantified as to their effect on the river system. This project will be coordinated with the SRWMD's groundwater monitoring (quantity and quality) and with the water use permitting program.

Task 2.3.1: Surface and Groundwater Statistical Summaries 1995

Existing data on surfacewater flows and groundwater levels for all gaging stations in the watershed with five or more years of record will be statistically analyzed. Surfacewater statistics were compiled during 1994-95, and groundwater statistics will be compiled in 1995.

Task 2.3.2: Magnitude and Frequency of High and Low Flows for Streams in the Santa Fe Watershed 1995 - 1996

High and low flow frequency statistics for streams in the watershed are needed for quantifying surface waters. This task will develop a log-Pearson frequency analysis for low and high flows for existing and discontinued stations with at least ten years' data. Monthly and annual analysis will be conducted on low flows, annual analysis will be conducted for high flows.

Task 2.3.3: Recharge Quantification 1995 - 1997

The Floridan Aquifer provides base flow to the lower Santa Fe River; this groundwater input is critical to quality and quantity considerations. Areas with high recharge potential have been identified and include much of the lower Santa Fe Watershed. This task is aimed at quantifying recharge rates, which provides data necessary for groundwater flow modeling.

Task 2.3.4: Modeling Groundwater and Surfacewater Interaction in the Lower Santa Fe River 1995 - 1998

Data collection tasks identified above will culminate in the development of watershed model(s) for the Santa Fe Watershed. MODFLOW and MOD-BRANCH are models that will be considered for groundwater flow and groundwater-surfacewater interaction, respectively. The tasks applicable for

1995 - 1998 will involve literature research, data sufficiency analysis, and data development.

3. Program Implementation

Program Definition: Program Implementation is the action component of the Santa Fe River system SWIM program, encompassing activities related to carrying out the policies and tasks identified in the plan. Included are analyses, presenting results of analyses and special studies, providing products of the monitoring or planning programs such as maps and data reports, recommending or instituting rule changes based on special studies or analyses, undertaking specific enforcement activities, intergovernmental and interagency coordination, and providing ongoing technical assistance to other agencies or local government. Related implementation activities undertaken by the District include administering regulatory programs and land acquisition and management activities. These are not SWIM programs *per se*, but, through SWIM program assistance and coordination, fulfill SWIM program goals and objectives.

Project 3.1: Technical Assistance

Project Goal: Provide technical assistance and information to support local and regional land use planning and regulation in the Santa Fe River watershed. Coordinate planning activities with local governments and regional planning councils to better integrate land and water planning.

The rural counties within the Santa Fe Watershed generally have limited capability to interpret, administer, and enforce the complex requirements of the new planning and land development regulation processes. For the water resources of the Santa Fe River system, it is essential that the technical information and technical expertise of the SRWMD's SWIM program be made available to and be utilized by local governments within the watershed. This effort, in order to be successful, must initiate with the planning process and be continued on an ongoing basis, including revising the SWIM program to adapt to changes in the region.

Local government comprehensive plans within the watershed were developed and adopted from 1989 to 1991. Much of the water resources information to support proper land use planning--such as resource availability, identification of sensitive areas, and development suitability--was not available. Local plans are required to be evaluated in 1998 and 1999, followed by plan revisions. The Santa Fe River SWIM program will work toward providing adequate water resources information prior to the plan revision schedule to better integrate land and water planning in the watershed.

Regional planning councils are required to prepare and adopt Strategic Regional Policy Plans by 1997, including a section on land use and natural resource protection. Part of the effort is to identify natural resources of regional significance and to adopt policies which will protect these resources, while allowing for appropriate use. The Santa Fe River SWIM program will provide recommended maps and policies for significant natural resources to the NCFRPC.

Task 3.1.1: Land and Water Planning Technical Assistance 1995 - 1996

Develop a water resources map series with resource descriptions for each local government within the Santa Fe Watershed. Included will be information on watershed hydrology, identification of subwatersheds, water quality information, land acquisition and management plans, watersheds with special criteria, land cover, and significant natural resources. The water resources atlas will be part of the County Water Management Plans developed in conjunction with the DWMP. This document provides a basis for coordinated land and water planning at the county level.

Task 3.1.2: Land and Water Planning Coordination 1995-1998

Provide location-specific technical assistance to local units of government relating to land use planning, impact analyses, development review, facility development or siting, water quality problems or issues, ecological analyses, or other issues or problems as requested by the local government.

Task 3.1.3: Strategic Regional Policy Plan Assistance 1995

Assist the NCFRPC in the development and implementation of the Strategic Regional Policy Plan required by Chapter 27E-5, F.A.C. as it relates to the Santa Fe River watershed.

<u>Project 3.2: Local Government Comprehensive Plan and Plan Amendment Review</u>

Project Goal: Ensure that local comprehensive plans within the Santa Fe River Watershed provide protection for the various elements of the Santa Fe River system including water quality, water quantity, fish and wildlife habitat, and consistent economic and recreational values.

As previously discussed, there is a critical link between land use/land development and surfacewater quality and the quality of natural systems associated with the river. Within the current framework of regulatory and management programs affecting the river, that link is land use planning.

Local units of government within the Santa Fe River Watershed in Florida are required to submit new or revised comprehensive plans pursuant to Chapter 9J-5, F.A.C., and Chapter 163, Part II, F.S. The SRWMD is a designated review agency pursuant to Chapter 163.3184, F.S., and reviews local plans and amendments for water resources issues. Local governments within the Santa Fe River Watershed have submitted and adopted plans by July 1991. All local plans are currently being revised for compliance with Rule 9J-5, F.A.C. and can be amended up to twice yearly.

Task 3.2.1: Local Government Comprehensive Plan Amendment Review 1995-1998

Review local comprehensive plan amendments for issues relating to the surface waters of the Santa Fe River system. Provide review comments, objections, and recommendations to affected local governments, Department of Community Affairs (DCA), and other state agencies. All counties and municipalities within the watershed are included for the duration of the planning period.

Project 3.3: Interagency Coordination (Technical Coordination)

Project Goal: To provide for increased interagency coordination for matters involving the Santa Fe River system, including research and special studies, resource monitoring, rule and regulation enforcement, and resource planning and management.

Many agencies share responsibilities related to the watershed. Resource management efforts can be enhanced through regular coordination, including water quality and biological monitoring, hydrologic monitoring, research efforts, mapping, and related studies. Regulatory coordination has been facilitated by the District's new Environmental Resources Permitting program, which combines surfacewater management, wetlands dredge and fill, and dock construction activities (among others) into a single permitting process. Larger projects, such as point source discharges, pipelines, and landfills, are regulated by the DEP with input from District staff.

Task 3.3.1: Santa Fe River Technical Advisory Group 1995-1998

Conduct meetings as needed with a technical advisory group to provide status reports, program updates, and to obtain technical assistance from cooperating agencies in SWIM programs and projects.

Task 3.3.2: Enforcement Coordination 1995-1998

Coordination in enforcement actions will be increased and facilitated where possible through interagency meetings, workshops, and projects between regulatory agencies with jurisdiction on the Santa Fe River system.

Task 3.3.3: Cooperative Studies 1995-1998

Interagency technical coordination for studies on or within the Santa Fe River system will be increased through cooperative studies. Included may be joint study efforts, shared data and/or resources, or coordinated review of procedures and results.

Project 3.4: Policy and Program Coordination

Project Goal: Provide for increased coordination among governmental entities and programs within the Santa Fe River Watershed to help assure that such programs are consistent with SWIM goals and programs, and to broaden the base of support for SWIM Plan implementation.

Task 3.4.1: Policy Coordination 1995-1998

Provide technical, logistic, and staff support to the Suwannee River Coordination Committee, or its successor as a policy advisory group. SWIM policy issues, intergovernmental cooperation and coordination requests, watershed management issues, and the review of planning and management programs affecting the river system are examples of issues the committee could address.

Task 3.4.2: Land Acquisition and Management Technical Support and Coordination 1995 - 1998

Provide technical support to the Land Acquisition and Management Department and DEP in land acquisition planning, the evaluation of individual tracts proposed for acquisition, and land management practices to enhance surfacewater quality and the restoration and/or maintenance of native habitat and vegetative cover.

Provide technical support and assistance to the Land Acquisition Department, the CARL Committee, and other entities involved in public lands acquisition.

Task 3.4.3: Regulatory Technical Support and Coordination 1995 - 1998

Provide technical support to District regulatory programs in the protection of surfacewater quality and fish and wildlife habitat. Provide assistance as requested by DEP and other state agencies in the implementation of water quality and habitat-related regulations.

Task 3.4.4: Nonregulatory program support and coordination 1995 - 1998

Provide support and assistance to nonregulatory programs such as the District's Forestry and Agricultural Resources Management program, which will develop comprehensive, site-specific management plans in cooperation with private landowners to reduce water quality and habitat impacts from farming and forestry operations.

Project 3.5: Public Involvement and Education

Project Goal: To increase public involvement and educational efforts about the natural resources, functioning, and values of the Santa Fe River system in order to allow residents and visitors to better manage their personal activities and impacts to the river system.

Task 3.5.1: Environmental Education 1995-1998

SWIM brochures and documents, and especially the WaterWays curriculum developed for elementary and secondary students, provide information about the basic functioning of the Santa Fe River system and outline activities that can bring about a more complete understanding of the river. Field trips to SRWMD Save-Our-River lands, science projects, and classroom projects and presentations are examples of components of an environmental education program.

Task 3.5.2: Waterfront Property Owner's Guide 1996-1997

People that live along the rivers, streams, and lakes in the watershed have a direct impact on many aspects of the river system. Providing a comprehensive guide of how their impacts can be reduced or eliminated, descriptions of how the Santa Fe system functions, listings of agency responsibilities and contacts, and other considerations can help achieve significant watershed protection goals. Further, because many similar publications have been prepared across the country, there are resources available to efficiently produce such a document.

Task 3.5.3: SWIM Informational Video 1995 - 1996

Develop an informational video about the need for protecting water quality and habitat for fish and wildlife resources, and how the SWIM program addresses protection issues. This video will be used in public meetings and workshops and will be made available for groups and schools to educate the public and help promote the SWIM program.

Task 3.5.4: Public Involvement and Assistance 1995 - 1998

Provide financial and technical assistance to groups involving the public in water quality and habitat protection. As described in Task 1.1.6, the Florida LAKEWATCH program uses volunteers to monitor lake water quality. Assistance should be provided to other groups involved with river clean-up activities, educational and awareness efforts, and general public participation in waterbody protection.

4. Restoration Implementation

Program Definition: This program includes activities aimed at restoring water bodies with degraded water quality and impacted areas such as springs, wetlands, and areas subject to erosion and sedimentation. The process for identifying nonpoint source loadings, either existing or projected, has been identified earlier and includes water quality monitoring, field surveys, and GIS-based watershed assessments. Those problem areas that are identified as in need of restoration, apart from regulatory compliance efforts, are addressed in this program.

Nonpoint sources of pollution identified through the SWIM program will be evaluated for restoration potential, and prioritized by the severity of impacts on the surface waters of the Santa Fe River system as described in Project 2.2.

Restoration activities undertaken through this program may include assisting local governments in planning and designing stormwater utilities and retrofitting stormwater management facilities to improve water quality treatment. Other restoration activities are aimed at reducing and managing the impacts from heavily used areas like publicly-owned springs and boat ramps.

Project 4.1: Stormwater Management Improvements

Project Goal: Improve the quality of stormwater discharges to the Santa Fe River system by increasing the level of stormwater treatment within the watershed.

Since 1986 most development activities are required through District (and DEP) rules to provide surfacewater and stormwater management to prevent flooding and water quality problems. Existing development, however, is not subject to these requirements and since most of the developed areas in the watershed predate the rules, this project is aimed at activities and land uses that predate stormwater rules.

Task 4.1.1: Stormwater Problem Area Survey 1996

In conjunction with Tasks 1.1.5 (special event monitoring), 2.2.2 (GIS watershed assessment), and 2.2.4 (field surveys), survey local officials to identify stormwater problems areas and local stormwater management needs. This task complements Task 2.2.4 by specifically identifying stormwater problem areas known to local officials. This task is intended to develop a comprehensive listing of known stormwater problem areas to supplement the listing in the Priority Issues section.

Task 4.1.2: Stormwater Management Improvements 1995 - 1998

Coordinate the application of District land acquisition, permitting, and assistance programs to resolve identified stormwater management needs in accordance with the priority list developed in Task 2.2.4. Other governmental programs that can help resolve identified problems (e.g., Pollution Recovery trust Fund) will be included wherever practicable. Initial priority is given to those problem areas identified in the Priority Issues section, and will be updated as Task 4.1.1 is completed.

Project 4.2: Erosion Evaluation and Control

Project Goal: Identify areas along the Santa Fe River and its tributaries and lakes that are experiencing accelerated shoreline erosion caused by human activities, and remediate the nonpoint source impacts to the river system caused by these activities.

Task 4.2.1: Erosion Problem Area Survey 1995

Conduct a survey of the public parks and boat ramps along the Santa Fe River, tributaries, and lakes to identify potential restoration projects. Coordinate with local officials to identify city and county owned facilities and possible remedial activities.

Task 4.2.2: Riverbank Erosion Control 1996-1998

Using a combination of funding sources, including SWIM and the Pollution Recovery Trust Fund, restore high-use, publicly-owned areas such as springs and county-owned parks along the Santa Fe River. Emphasize coordination among local governments and state and regional agencies.

Task 4.2.3: Inventory and assess water control structures 1996

Conduct an inventory and assessment of water control structures within the watershed that affect surface waters. Priority is given to the structures at Lake Sampson and Lake Butler. Subsequent effort is directed at a field survey of other structures or facilities (in conjunction with Task 2.2.3). This task will also provide recommendations for management actions (e.g., restoration, facility upgrading, regulatory compliance, etc.)

5. Waterbody Planning

Program Definition: Waterbody planning encompasses those activities involved with the ongoing SWIM planning process as it affects the Santa Fe River system. Specifically, such plan administration tasks as annual plan review and evaluation of implementation progress, minor revisions, and ongoing planning fall within this category.

Recognizing that the SWIM planning and management process for the Santa Fe River is an ongoing process, this program provides for the periodic review and analysis of the overall program, the projects conducted to accomplish management objectives, and the individual tasks that comprise the projects. As tasks and projects are implemented and the SWIM program progresses, it becomes necessary to redefine aspects of the SWIM program in order to further refine the program to meet the management needs of the river system and the agencies involved.

Project 5.1: Annual SWIM Plan Review and Evaluation 1995 - 1998

Project Goal: To annually review and evaluate the Santa Fe River SWIM plan and the implementation of programs, projects, and tasks for the purposes of project and task refinement, problem identification, and resolution of identified problems.

The Santa Fe River SWIM program is an ongoing program--the Santa Fe River SWIM plan and the overall program cannot be static and respond adequately to the changing needs of the river system and the management issues associated with it. In order for the SWIM program to be effective, the SWIM plans must be periodically reviewed, appraised, and modified as needed. The periodic, systematic evaluation of the plan and the overall program by SRWMD SWIM staff will help ensure that the program can respond to changing conditions and needs.

Task 5.1.1: Santa Fe River SWIM Plan Review and Evaluation 1995 - 1998

An annual review and evaluation of the Santa Fe River SWIM plan and the implementation of programs, projects, and tasks will be conducted. Annual evaluation reports will be prepared for the SRWMD Governing Board, DEP, and involved agencies and local governments.

Task 5.1.2: Santa Fe River SWIM Plan Revision 1998

Update or revise the Santa Fe River SWIM Plan according to the degree of successful implementation of the projects and tasks identified in this plan. This task may result in a substantially revised plan or a minor update of SWIM management strategies.

Project 5.2: Annual Priority List Review

Project Goal: To keep the SRWMD's SWIM Priority List updated to reflect the need for restoration and protection measures for the area's surface waters.

The SWIM priority list should be reviewed and evaluated each year to ascertain the priority ranking of the Santa Fe River system or the need for additional priority waters within the system.

Task 5.2.1: Annual Priority List Review 1995-1998

The SRWMD's SWIM Priority List will be reviewed annually and evaluated for the need for revisions to the Santa Fe River priority ranking.

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V. Appendices

Appendix A. Water Quality Data

The following tables summarize water quality data collected through the SWIM program in the Santa Fe Watershed from 1989 to 1994. The parameters sampled are described below, and the tables include the total number of samples; the mean, minimum, and maximum values, and the standard deviation about the mean.

Parmeter	Description
SECCHI	Secchi depth in meters
TEMP	Water temperature
CONDF	Field measured conductivity
CONDL	Conductivity at 25° C
PHF	Field measured pH
PHL	Laboratory measured pH
DO	Dissolved oxygen concentration
SAL	Salinity
COLORAP	Apparent color
TURB	Turbidity
BOD	Biochemical oxygen demand
RESFIXED	Total fixed residue
RESFIXNF	Fixed suspended residue
RESNFLT	Total suspended residue
RESDISS	Total dissolved residue
RESVOLDS	Volatile fixed residue
RESVOLNF	Volatile suspended residue
RESVOL	Total volatile residue
RESTOT	Total residue
ALKTOT	Total alkalinity as $CaCO_3$
CHLA	Chlorophyll a
TOC	Total organic carbon
DOC	Dissolved organic carbon
KTOT	Total potassium
NATOT	Total sodium
MGTOT	Total magnesium
CATOT	Total calcium
CLTOT	Total chloride
FTOT	Total fluoride
SO4TOT	Total sulfate
TKN	Total kjeldahl nitrogen
NOXNTOT	Nitrate plus nitrite nitgogen
NO3NTOT	Total nitrate nitrogen
NO2NTOT	Total nitrite nitrogem
NH3NTOT	Total ammonia nitrogen
PTOT	Total phosphorus
OPO4DISS	Dissolved orthophosphate
COLITOT	Total coliform bacteria
COLIFEC	Fecal coliform bacteria
STREPFEC	Fecal streptococci

STATID=SFR020C1   Santa Fe River at Brooker

Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	61	0.550	1.450	0.886	0.206
TEMP	62	8.900	26.800	19.568	5.097
CONDF	62	48.000	272.000	140.806	45.090
CONDL	62	54.000	273.000	156.484	45.929
PHF	61	5.020	7.610	6.448	0.670
PHL	0	.	.	.	.
DO	62	3.300	10.200	6.339	1.546
SAL	35	0.000	0.000	0.000	0.000
COLORAP	62	40.000	450.000	204.919	119.423
TURB	62	0.400	6.400	1.490	1.195
BOD	26	1.000	7.300	1.869	1.264
RESFIXNF	18	4.000	11.000	5.167	1.886
RESDISS	50	54.000	210.000	129.380	26.119
RESVOLDS	24	10.000	104.000	57.875	25.144
RESVOLNF	42	4.000	8.000	4.310	0.811
RESVOL	6	25.000	73.000	46.333	17.996
RESTOT	18	91.000	150.000	126.722	15.582
ALKTOT	62	5.800	136.000	26.127	23.805
CHLA	26	0.100	2.000	0.620	0.486
TOC	62	2.900	48.000	25.003	9.976
DOC	12	6.600	35.000	24.958	9.364
KTOT	54	0.500	2.500	0.889	0.429
NATOT	54	6.100	16.000	9.233	2.163
MGTOT	54	1.700	9.000	3.791	1.782
CATOT	54	7.100	22.000	13.128	3.822
CLTOT	54	10.000	40.000	23.743	7.296
FTOT	54	0.100	0.260	0.137	0.049
SO4TOT	54	3.000	34.000	11.735	7.504
TKN	61	0.170	1.400	0.761	0.282
NOXNTOT	62	0.050	0.350	0.074	0.053
NO3NTOT	26	0.050	0.350	0.069	0.059
NO2NTOT	26	0.050	0.050	0.050	0.000
NH3NTOT	61	0.010	0.095	0.028	0.018
PTOT	62	0.037	0.370	0.114	0.061
OPO4DISS	62	0.027	0.220	0.070	0.036
COLITOT	15	50.000	640.000	221.867	162.625
COLIFEC	18	1.000	1500.000	144.333	341.818
STREPFEC	0	.	.	.	.

STATID=SFR030C1 Santa Fe River at Worthington Springs

Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	61	0.300	1.500	0.862	0.289
TEMP	61	8.700	26.000	19.646	5.034
CONDF	61	59.000	319.000	135.607	58.480
CONDL	61	67.000	315.000	150.918	62.103
PHF	61	5.510	7.900	6.622	0.634
PHL	0	.	.	.	.
DO	61	4.900	10.500	6.805	1.338
SAL	34	0.000	0.000	0.000	0.000
COLORAP	61	45.000	750.000	246.148	157.389
TURB	61	0.340	5.500	2.171	1.038
BOD	26	1.000	8.000	1.973	1.585
RESFIXNF	18	4.000	10.000	4.889	1.605
RESDISS	49	46.000	186.000	128.061	27.115
RESVOLDS	23	10.000	118.000	60.043	26.817
RESVOLNF	41	4.000	8.000	4.293	0.716
RESVOL	6	15.000	92.000	49.333	31.296
RESTOT	18	47.000	190.000	129.944	32.731
ALKTOT	61	7.300	140.000	33.482	26.723
CHLA	26	0.100	3.500	0.713	0.761
TOC	61	5.800	45.600	27.785	11.984
DOC	0	.	.	.	.
KTOT	53	0.500	4.700	1.177	0.660
NATOT	53	4.200	22.000	8.551	3.290
MGTOT	53	1.600	11.000	4.200	2.103
CATOT	53	5.600	25.000	11.762	4.488
CLTOT	53	12.000	30.000	19.028	3.960
FTOT	53	0.100	1.300	0.185	0.177
SO4TOT	53	3.000	31.000	9.268	5.923
TKN	60	0.230	2.720	0.930	0.445
NOXNTOT	61	0.050	1.500	0.171	0.208
NO3NTOT	26	0.050	1.500	0.168	0.279
NO2NTOT	26	0.050	0.050	0.050	0.000
NH3NTOT	60	0.010	0.220	0.038	0.037
PTOT	61	0.122	2.100	0.431	0.374
OPO4DISS	61	0.050	1.500	0.334	0.294
COLITOT	17	6.000	860.000	210.471	251.127
COLIFEC	18	1.000	150.000	53.722	44.167
STREPFEC	0	.	.	.	.

STATID=SFR040C1 Santa Fe River at O'Leno State Park (above river sink)

Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	61	0.300	3.150	1.358	0.722
TEMP	62	9.900	27.500	20.850	4.470
CONDF	62	61.000	400.000	198.016	101.138
CONDL	62	64.000	394.000	213.758	104.947
PHF	60	5.470	7.940	6.977	0.630
PHL	0	.	.	.	.
DO	62	3.200	9.600	5.411	1.288
SAL	35	0.000	0.000	0.000	0.000
COLORAP	62	15.000	880.000	215.371	190.111
TURB	62	0.350	7.600	1.590	1.380
BOD	26	1.000	3.500	1.588	0.652
RESFIXNF	18	4.000	7.000	4.500	0.786
RESDISS	50	82.000	240.000	157.000	42.889
RESVOLDS	24	10.000	124.000	58.125	30.394
RESVOLNF	42	4.000	22.000	4.571	2.777
RESVOL	6	15.000	70.000	50.833	20.952
RESTOT	18	99.000	230.000	176.056	38.025
ALKTOT	62	7.800	150.000	65.803	46.839
CHLA	26	0.060	17.000	1.290	3.234
TOC	62	1.600	50.000	22.573	13.822
DOC	0	.	.	.	.
KTOT	54	0.500	2.700	0.989	0.471
NATOT	54	4.100	10.000	6.520	1.461
MGTOT	54	1.600	15.000	6.133	3.688
CATOT	54	5.200	53.000	23.159	14.370
CLTOT	54	7.300	21.000	14.296	2.779
FTOT	54	0.100	0.400	0.180	0.068
SO4TOT	54	3.000	46.000	16.335	10.638
TKN	61	0.100	2.600	0.708	0.467
NOXNTOT	62	0.050	0.520	0.145	0.110
NO3NTOT	26	0.050	0.360	0.122	0.091
NO2NTOT	26	0.050	0.050	0.050	0.000
NH3NTOT	61	0.010	0.156	0.032	0.027
PTOT	62	0.110	0.690	0.241	0.098
OPO4DISS	62	0.050	0.800	0.185	0.105
COLITOT	41	1.000	920.000	186.024	181.679
COLIFEC	41	1.000	410.000	57.902	74.511
STREPFEC	12	1.000	99.000	49.000	26.017

STATID=SFR050C1 Santa Fe River at US441 (downstream of river rise)

Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	62	0.300	1.400	0.904	0.280
TEMP	62	11.900	26.000	21.523	3.167
CONDF	62	60.000	481.000	310.468	129.194
CONDL	62	22.000	511.000	322.161	136.182
PHF	62	5.940	7.750	7.110	0.397
PHL	0	.	.	.	.
DO	62	0.500	8.200	3.905	1.404
SAL	35	0.000	0.100	0.006	0.024
COLORAP	62	5.000	750.000	168.468	164.824
TURB	62	0.180	5.000	1.068	0.915
BOD	26	1.000	5.000	1.642	0.908
RESFIXNF	18	4.000	105.000	10.278	23.681
RESDISS	50	96.000	340.000	225.320	65.343
RESVOLDS	24	10.000	102.000	62.708	22.911
RESVOLNF	42	4.000	6.000	4.214	0.470
RESVOL	6	15.000	79.000	48.333	23.424
RESTOT	18	140.000	340.000	269.444	54.284
ALKTOT	62	14.000	160.000	91.700	46.423
CHLA	26	0.100	7.010	1.158	1.724
TOC	62	1.500	48.000	17.539	13.354
DOC	0	.	.	.	.
KTOT	54	0.500	35.800	1.728	4.776
NATOT	54	2.700	13.000	7.863	1.945
MGTOT	54	1.800	14.000	7.669	3.429
CATOT	54	7.300	71.000	40.694	18.916
CLTOT	54	5.600	22.300	15.870	2.837
FTOT	54	0.100	0.360	0.185	0.058
SO4TOT	54	6.700	85.000	38.633	22.800
TKN	61	0.100	1.800	0.519	0.407
NOXNTOT	62	0.050	3.020	0.290	0.381
NO3NTOT	26	0.050	0.430	0.198	0.096
NO2NTOT	26	0.050	0.050	0.050	0.000
NH3NTOT	61	0.010	0.100	0.029	0.020
PTOT	62	0.053	0.327	0.172	0.059
OPO4DISS	62	0.050	0.264	0.129	0.045
COLITOT	54	1.000	610.000	106.296	105.793
COLIFEC	54	1.000	154.000	26.481	32.006
STREPFEC	24	1.000	230.000	35.917	45.869

STATID=SFR060C1   Santa Fe River at SR47

Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	61	0.300	6.000	1.339	0.958
TEMP	62	17.400	28.700	21.852	2.137
CONDF	62	125.000	400.000	310.774	65.326
CONDL	62	130.000	441.000	331.226	68.080
PHF	62	6.500	8.070	7.434	0.296
PHL	0	.	.	.	.
DO	62	3.500	8.600	5.308	1.068
SAL	35	0.000	0.100	0.003	0.017
COLORAP	62	1.000	500.000	94.984	120.135
TURB	62	0.160	6.500	1.014	1.190
BOD	26	1.000	6.600	1.658	1.135
RESFIXNF	18	4.000	28.000	6.500	6.051
RESDISS	50	80.000	810.000	213.340	92.035
RESVOLDS	24	10.000	87.000	46.250	22.682
RESVOLNF	42	4.000	8.000	4.357	0.906
RESVOL	6	14.000	45.000	31.333	12.941
RESTOT	18	190.000	240.000	216.667	12.367
ALKTOT	62	54.000	175.000	127.684	30.259
CHLA	26	0.100	4.100	0.627	0.800
TOC	62	1.000	47.000	10.518	9.739
DOC	0	.	.	.	.
KTOT	54	0.500	35.300	1.454	4.713
NATOT	54	2.400	8.400	5.478	0.895
MGTOT	54	2.400	8.300	5.965	1.362
CATOT	54	19.500	69.000	49.515	11.761
CLTOT	54	5.600	14.200	10.974	1.843
FTOT	54	0.100	0.220	0.155	0.040
SO4TOT	54	3.000	31.200	22.431	6.347
TKN	61	0.100	2.550	0.399	0.415
NOXNTOT	62	0.250	2.990	0.730	0.345
NO3NTOT	26	0.250	1.100	0.709	0.200
NO2NTOT	26	0.050	0.050	0.050	0.000
NH3NTOT	61	0.010	0.042	0.021	0.010
PTOT	62	0.050	0.370	0.118	0.047
OPO4DISS	62	0.050	0.155	0.085	0.023
COLITOT	52	1.000	940.000	176.692	190.222
COLIFEC	52	1.000	276.000	38.250	43.830
STREPFEC	24	1.000	110.000	36.958	26.998

STATID=SFR070C1 Santa Fe River st US129

Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	61	0.500	5.500	2.492	1.295
TEMP	62	16.300	25.500	21.631	2.344
CONDF	61	90.000	491.000	308.393	62.608
CONDL	61	99.000	521.000	330.721	65.819
PHF	62	6.780	8.120	7.514	0.314
PHL	0	.	.	.	.
DO	62	3.100	8.600	5.648	1.125
SAL	35	0.000	0.000	0.000	0.000
COLORAP	62	1.000	500.000	89.129	111.160
TURB	62	0.170	5.100	0.998	0.824
BOD	26	1.000	4.200	1.623	0.785
RESFIXNF	18	4.000	8.000	4.778	1.114
RESDISS	50	127.000	350.000	203.420	35.918
RESVOLDS	24	10.000	95.000	45.458	24.539
RESVOLNF	42	4.000	6.000	4.214	0.470
RESVOL	6	8.000	53.000	32.833	21.151
RESTOT	18	140.000	250.000	212.778	25.160
ALKTOT	62	26.000	160.000	126.823	27.443
CHLA	26	0.120	4.900	0.858	1.022
TOC	62	1.000	32.000	9.115	7.604
DOC	12	2.000	22.800	8.158	7.101
KTOT	54	0.500	3.000	0.789	0.417
NATOT	54	2.800	8.200	5.067	0.815
MGTOT	54	1.900	8.000	5.928	1.189
CATOT	54	15.500	70.000	49.263	10.320
CLTOT	54	6.300	15.200	10.056	1.702
FTOT	54	0.100	0.460	0.157	0.057
SO4TOT	54	3.000	29.000	21.157	5.715
TKN	61	0.100	2.500	0.324	0.346
NOXNTOT	62	0.050	0.820	0.554	0.160
NO3NTOT	26	0.050	0.820	0.529	0.173
NO2NTOT	26	0.050	0.505	0.068	0.089
NH3NTOT	61	0.010	0.110	0.025	0.018
PTOT	62	0.050	1.200	0.134	0.146
OPO4DISS	62	0.050	0.150	0.080	0.024
COLITOT	61	1.000	1800.000	253.836	256.128
COLIFEC	62	1.000	310.000	66.790	67.447
STREPFEC	24	1.000	122.000	43.875	29.809

STATID=SMR010C1 Sampson River above Santa Fe River

Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	67	0.100	2.700	0.640	0.503
TEMP	67	9.500	29.000	21.096	5.063
CONDF	67	63.000	330.000	193.918	60.427
CONDL	67	63.000	365.000	210.149	62.916
PHF	67	5.030	7.670	6.720	0.506
PHL	0	.	.	.	.
DO	67	5.200	10.800	7.655	1.211
SAL	38	0.000	0.000	0.000	0.000
COLORAP	67	5.000	400.000	107.985	90.694
TURB	67	0.240	4.100	1.265	0.828
BOD	28	1.000	6.500	1.754	1.071
RESFIXNF	18	4.000	11.000	4.833	1.654
RESDISS	55	68.000	240.000	146.255	31.623
RESVOLDS	24	10.000	96.000	55.792	19.691
RESVOLNF	45	0.000	8.000	4.022	1.215
RESVOL	6	10.000	58.000	30.500	21.751
RESTOT	18	92.000	190.000	145.111	29.738
ALKTOT	67	9.000	94.000	27.155	21.164
CHLA	28	0.300	3.740	1.189	0.925
TOC	67	1.000	53.600	16.885	9.296
DOC	0	.	.	.	.
KTOT	59	0.500	2.800	1.025	0.460
NATOT	59	4.000	28.000	12.166	4.961
MGTOT	59	1.500	13.000	4.017	2.028
CATOT	59	4.900	30.000	17.583	5.005
CLTOT	59	11.000	72.000	30.941	13.095
FTOT	59	0.060	0.700	0.149	0.098
SO4TOT	59	3.000	46.000	18.327	11.231
TKN	66	0.140	1.700	0.640	0.265
NOXNTOT	67	0.020	0.880	0.096	0.138
NO3NTOT	28	0.050	0.530	0.090	0.095
NO2NTOT	28	0.050	0.050	0.050	0.000
NH3NTOT	66	0.010	0.276	0.035	0.038
PTOT	67	0.022	0.560	0.098	0.112
OPO4DISS	67	0.010	0.630	0.062	0.105
COLITOT	18	10.000	1600.000	518.889	470.468
COLIFEC	18	1.000	760.000	126.278	175.486
STREPFEC	0	.	.	.	.

STATID=NEW010C1   New River at SR18

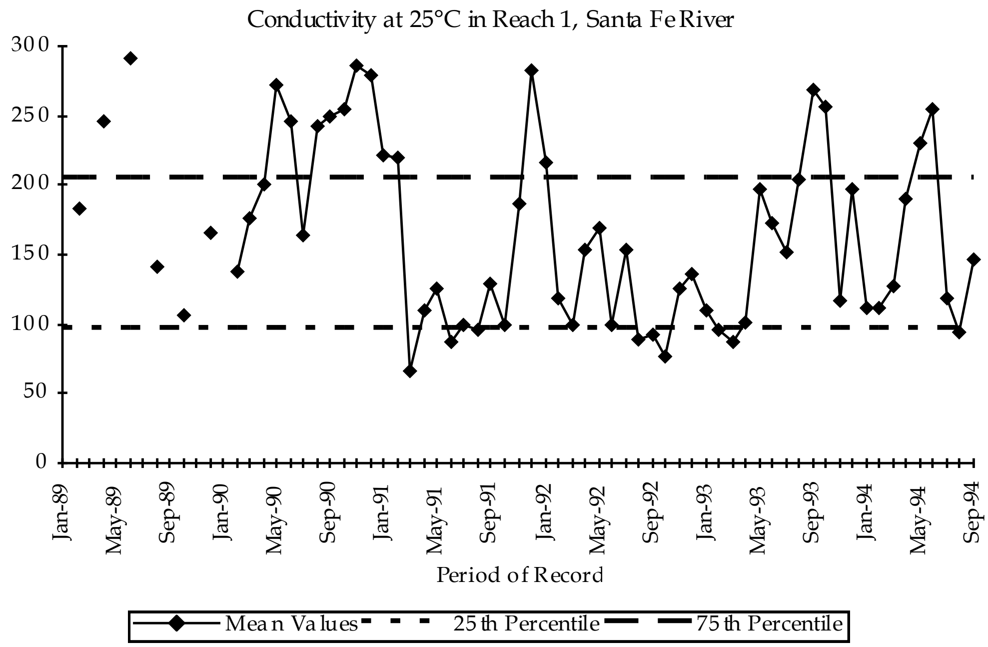
Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	65	0.100	1.000	0.504	0.212
TEMP	65	7.700	27.000	19.285	5.082
CONDF	65	38.000	348.000	132.723	76.106
CONDL	65	41.000	337.000	148.646	80.704
PHF	65	5.130	7.930	6.642	0.711
PHL	0	.	.	.	.
DO	65	3.900	9.800	6.718	1.366
SAL	38	0.000	0.000	0.000	0.000
COLORAP	65	40.000	880.000	294.692	192.459
TURB	65	0.400	8.200	2.754	1.416
BOD	26	1.000	6.800	2.188	1.672
RESFIXNF	18	4.000	16.000	6.000	3.581
RESDISS	53	62.000	190.000	135.906	23.340
RESVOLDS	23	10.000	118.000	64.130	26.403
RESVOLNF	44	0.000	7.000	3.977	1.151
RESVOL	6	18.000	80.000	47.667	25.727
RESTOT	18	120.000	190.000	142.222	17.675
ALKTOT	65	5.200	100.000	37.152	29.395
CHLA	26	0.060	2.900	0.742	0.630
TOC	64	3.000	52.000	30.558	13.724
DOC	0	.	.	.	.
KTOT	57	0.500	3.000	1.367	0.653
NATOT	57	1.800	29.000	8.612	5.022
MGTOT	57	1.200	12.000	4.691	2.684
CATOT	57	3.500	26.000	10.889	5.577
CLTOT	57	5.000	27.000	15.367	5.388
FTOT	56	0.080	1.200	0.191	0.167
SO4TOT	57	1.000	25.000	8.104	5.908
TKN	64	0.240	3.700	1.019	0.535
NOXNTOT	65	0.030	0.870	0.248	0.197
NO3NTOT	26	0.050	0.540	0.203	0.125
NO2NTOT	26	0.050	0.050	0.050	0.000
NH3NTOT	64	0.010	0.320	0.043	0.045
PTOT	65	0.050	6.000	0.696	0.878
OPO4DISS	64	0.050	1.700	0.453	0.381
COLITOT	65	1.000	1319.000	416.415	288.428
COLIFEC	65	1.000	960.000	166.446	191.979
STREPFEC	27	1.000	260.000	103.926	60.024

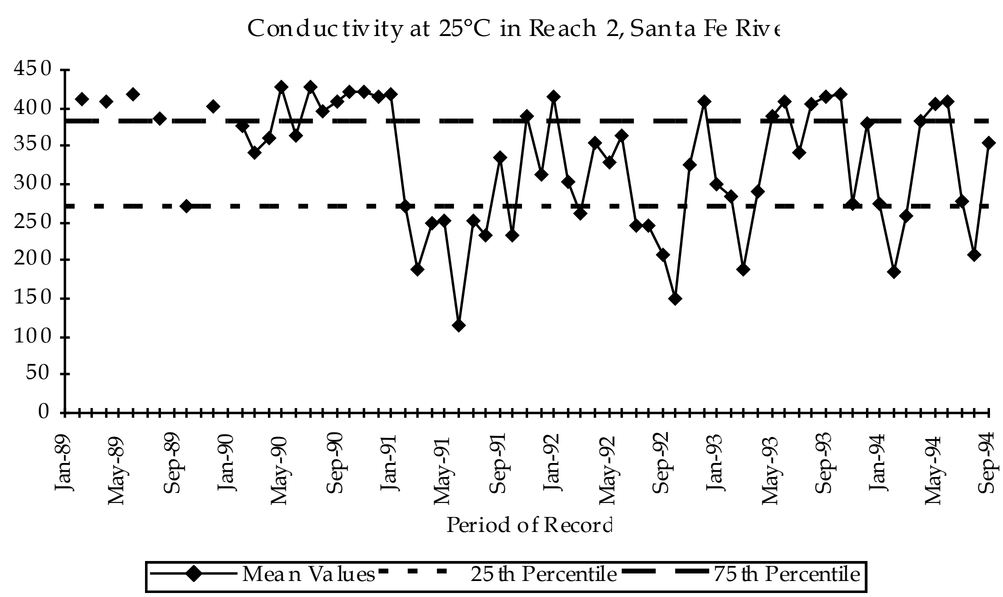
STATID=OLS010C1 Olustee Creek at SR18

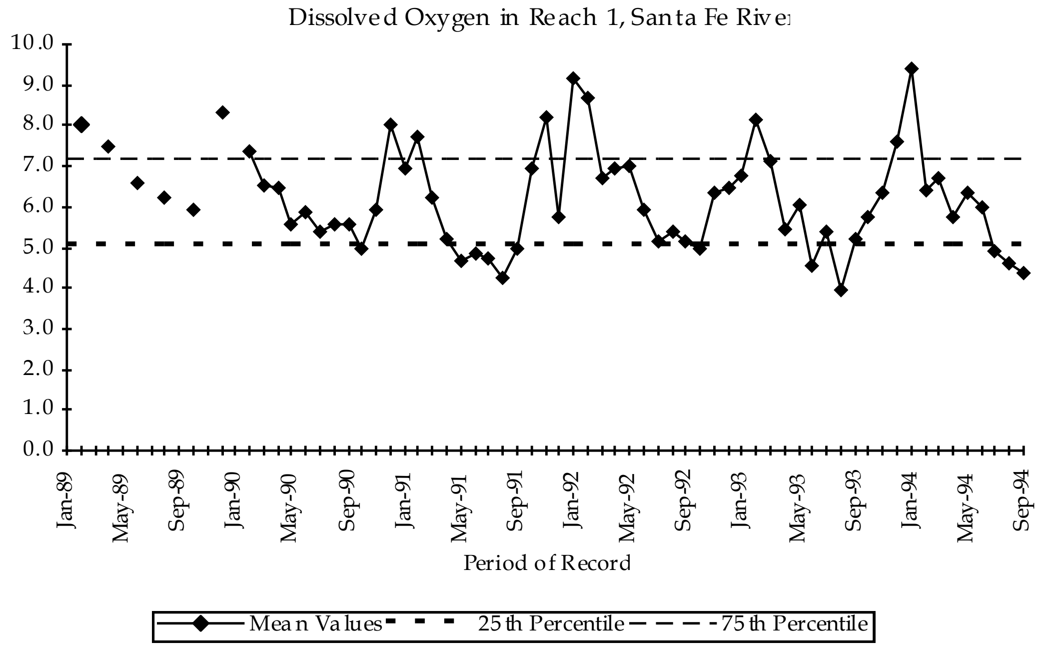
Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	64	0.200	0.900	0.418	0.182
TEMP	64	8.700	30.700	20.552	5.178
CONDF	64	30.000	153.000	79.609	34.115
CONDL	64	34.000	171.000	87.453	37.017
PHF	64	4.390	7.240	5.808	0.888
PHL	0	.	.	.	.
DO	64	0.600	9.200	4.853	2.337
SAL	37	0.000	0.000	0.000	0.000
COLORAP	64	5.000	1000.000	344.219	224.036
TURB	64	0.400	5.600	2.059	1.266
BOD	26	1.000	4.200	2.150	0.807
RESFIXNF	18	4.000	11.000	5.056	1.798
RESDISS	52	23.000	181.000	111.269	26.540
RESVOLDS	23	10.000	140.000	69.174	31.608
RESVOLNF	44	0.000	9.000	4.386	1.781
RESVOL	6	27.000	92.000	59.000	21.513
RESTOT	18	69.000	180.000	111.333	24.574
ALKTOT	64	0.400	127.000	25.353	23.629
CHLA	26	0.100	70.000	11.090	16.679
TOC	64	5.000	62.000	37.100	13.754
DOC	0	.	.	.	.
KTOT	56	0.300	3.000	0.921	0.577
NATOT	56	0.500	6.800	4.082	1.000
MGTOT	56	1.100	8.100	3.268	2.043
CATOT	56	2.600	18.000	6.745	3.631
CLTOT	56	4.200	14.000	9.764	2.030
FTOT	56	0.060	2.300	0.204	0.295
SO4TOT	56	1.000	18.000	5.725	4.461
TKN	63	0.220	3.300	1.113	0.449
NOXNTOT	64	0.010	0.500	0.065	0.062
NO3NTOT	26	0.050	0.500	0.077	0.090
NO2NTOT	26	0.050	0.050	0.050	0.000
NH3NTOT	63	0.010	0.190	0.045	0.037
PTOT	64	0.103	1.700	0.397	0.288
OPO4DISS	64	0.050	0.760	0.271	0.197
COLITOT	18	1.000	990.000	228.389	269.560
COLIFEC	17	1.000	120.000	33.647	40.381
STREPFEC	0	.	.	.	.

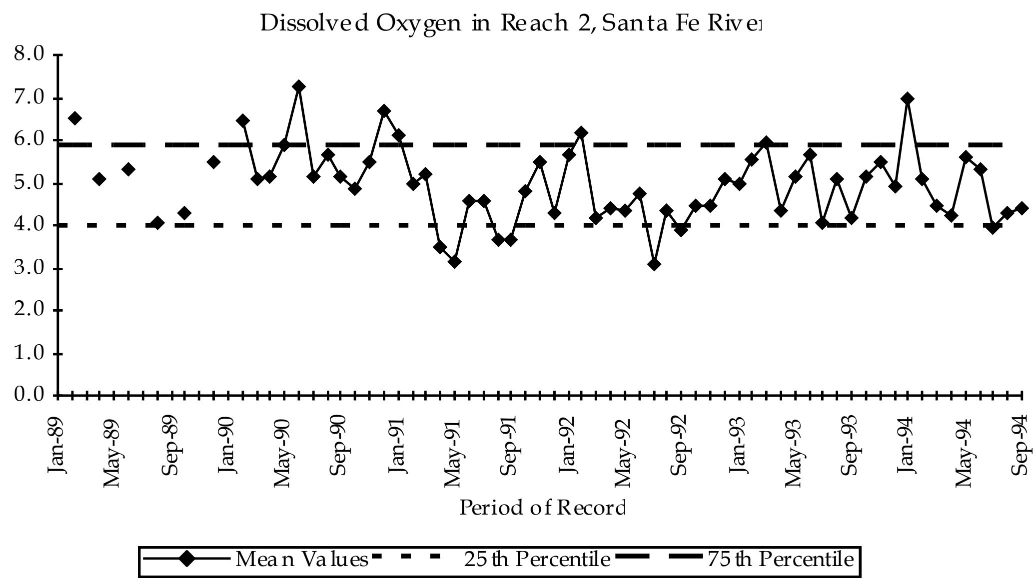
STATID=ICH010C1 Ichetucknee River at US27

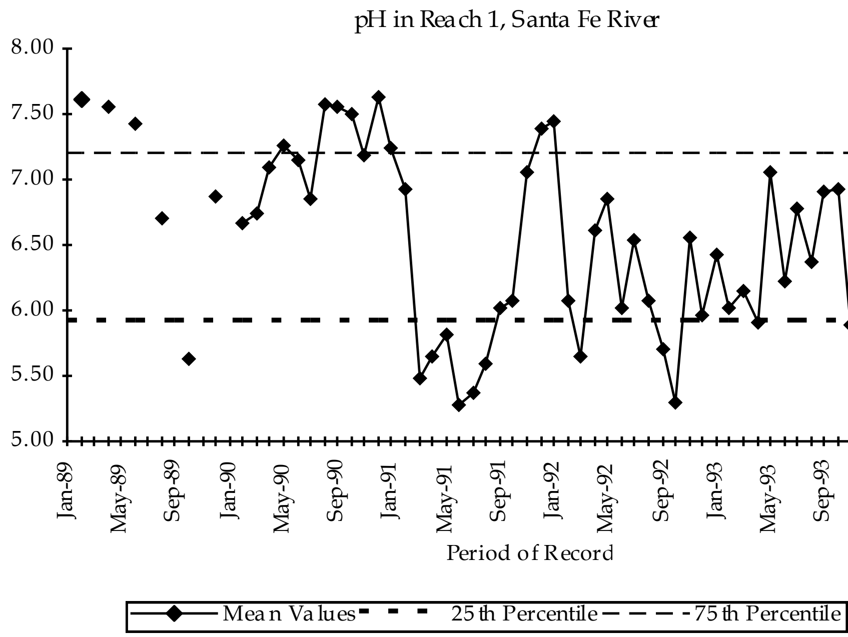
Variable	N	Minimum	Maximum	Mean	Std Dev
SECCHI	65	0.500	4.000	1.259	0.645
TEMP	65	18.000	23.500	21.391	1.165
CONDF	65	270.000	378.000	295.892	13.328
CONDL	65	271.000	378.000	318.062	13.313
PHF	65	6.460	8.220	7.610	0.329
PHL	1	7.800	7.800	7.800	.
DO	65	3.300	7.500	5.362	0.958
SAL	38	0.000	0.000	0.000	0.000
COLORAP	64	1.000	750.000	17.719	93.043
TURB	64	0.070	2.100	0.414	0.283
BOD	26	1.000	6.100	1.642	1.067
RESFIXNF	17	4.000	17.000	5.118	3.100
RESDISS	53	120.000	270.000	180.358	24.112
RESVOLDS	24	10.000	142.000	32.958	29.386
RESVOLNF	44	0.000	8.000	3.955	1.275
RESVOL	6	5.000	130.000	32.333	48.285
RESTOT	18	130.000	210.000	178.889	17.786
ALKTOT	64	14.000	150.000	135.391	18.200
CHLA	26	0.140	1.700	0.505	0.415
TOC	64	0.400	14.000	2.783	2.289
DOC	0	.	.	.	.
KTOT	57	0.500	4.000	0.828	0.683
NATOT	57	2.900	6.500	3.609	0.619
MGTOT	57	5.300	7.400	6.267	0.482
CATOT	57	43.200	57.600	50.425	3.411
CLTOT	57	0.300	14.000	6.074	1.679
FTOT	57	0.100	0.200	0.151	0.036
SO4TOT	57	7.100	29.000	12.377	3.549
TKN	64	0.020	2.320	0.158	0.281
NOXNTOT	65	0.330	0.900	0.490	0.091
NO3NTOT	26	0.330	0.900	0.493	0.117
NO2NTOT	26	0.050	0.050	0.050	0.000
NH3NTOT	64	0.010	0.052	0.020	0.011
PTOT	65	0.048	0.350	0.087	0.049
OPO4DISS	65	0.012	0.147	0.051	0.016
COLITOT	29	2.000	940.000	326.241	269.787
COLIFEC	30	1.000	800.000	104.100	162.819
STREPFEC	12	1.000	250.000	100.667	73.096


Conductivity at 25°C in Reach 1, Santa Fe River
300
250
200
150
100
50
0
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Period of Record
Mean Values
25th Percentile
75th Percentile


Conductivity at 25°C in Reach 2, Santa Fe Rive
450
400
350
300
250
200
150
100
50
0
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Period of Record
Mean Values
25th Percentile
75th Percentile


Dissolved Oxygen in Reach 1, Santa Fe River
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Period of Record
Mean Values
25th Percentile
75th Percentile


Dissolved Oxygen in Reach 2, Santa Fe River
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Period of Record
Mean Values
25th Percentile
75th Percentile


pH in Reach 1, Santa Fe River
8.00
7.50
7.00
6.50
6.00
5.50
5.00
Jan-89
May-89
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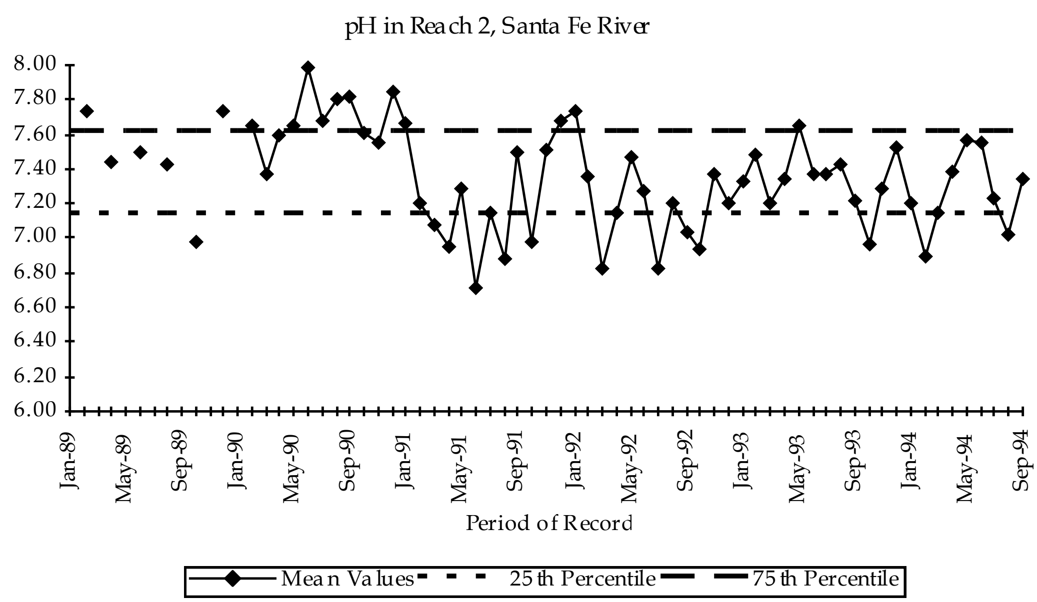
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Period of Record
Mean Values
25th Percentile
75th Percentile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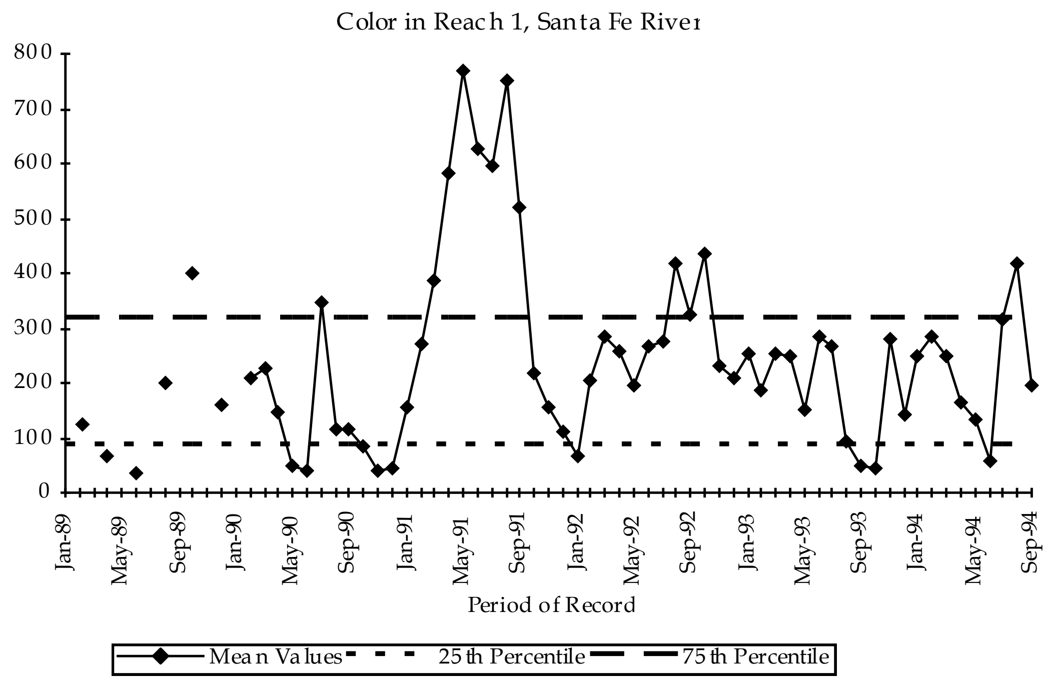
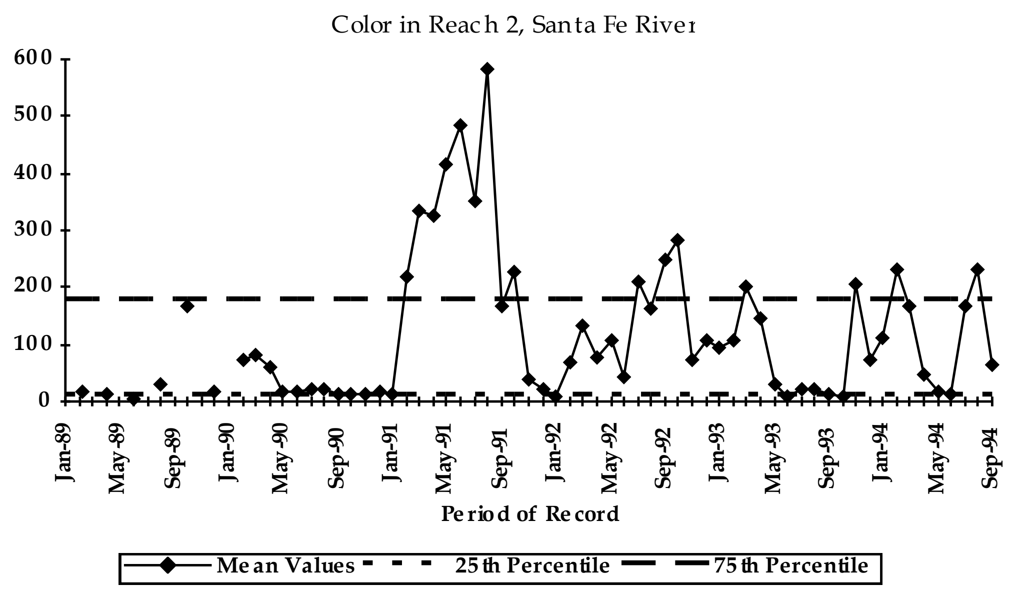
8.00
7.80
7.60
7.40
7.20
7.00
6.80
6.60
6.40
6.20
6.00
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Period of Record
Mean Values
25th Percentile
75th Percentile


Color in Reach 1, Santa Fe River
800
700
600
500
400
300
200
100
0
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Period of Record
Mean Values
25th Percentile
75th Percentile


Color in Reach 2, Santa Fe River
600
500
400
300
200
100
0
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
May-93
Sep-93
Jan-94
May-94
Sep-94
Period of Record
Mean Values
25th Percentile
75th Percentile

Appendix B. Governmental Units with Jurisdiction in the Santa Fe River Watershed

FEDERAL AGENCIES

U. S. Army Corps of Engineers
Responsibilities include wetlands dredge and fill permitting and navigation channels.

U. S. Environmental Protection Agency
Responsibilities include permitting point sources of pollution and overseeing state water quality programs consistent with the Clean Water Act.

U. S. Fish and Wildlife Service
Responsibilities include National Wildlife Refuge management and Endangered Species Act administration and enforcement.

STATE AGENCIES

Department of Environmental Protection
Responsibilities include permitting point sources of pollution, landfills, and linear transmission facilities, water quality classifications and monitoring, State land acquisition and management, SWIM program administration, and oversight of water management districts.

Department of Transportation
Responsibilities include state roads and associated stormwater management systems.

Department of Agriculture and Consumer Services, and Division of Forestry
Responsibilities include pesticide and herbicide management, consumer affairs, State Forest management, and biennial review of forestry BMPs compliance.

Department of Community Affairs
Responsibilities include local comprehensive plan review administration, Developments of Regional Impact, and the State Land Development Plan.

Department of Health and Rehabilitative Services
Responsibilities include administration of onsite sewage treatment and disposal system regulations in conjunction with county public health units.

Game and Fresh Water Fish Commission
Responsibilities include Wildlife Management Areas, fisheries research, and administering and enforcing game and fish regulations.

Department of Corrections
Responsibilities include the operation of state correctional facilities and prisons.

REGIONAL AGENCIES
Suwannee River Water Management District
Responsibilities include storm water, water use, well construction, and wetlands regulations, SWIM plan development and implementation, water quality and quantity monitoring, land acquisition and management, and environmental education.

St. Johns River Water Management District
Responsibilities include storm water, water use, well construction, and wetlands regulations, SWIM plan development and implementation, water quality and quantity monitoring, land acquisition and management, and environmental education.

North Central Florida Regional Planning Council
Responsibilities include Strategic Regional Policy Plan development and implementation, Developments of Regional Impact, review of Federal projects (A-95 review), and providing technical planning assistance to local governments.

LOCAL GOVERNMENTS
Responsibilities include local comprehensive plan development and implementation, administering land development regulations, and the operation and maintenance of public facilities.

COUNTIES	*CITIES*
Alachua County	Alachua, High Springs, Waldo, Lacrosse
Baker County	
Bradford County	Brooker, Hampton, Lawtey, Starke
Clay County	
Columbia County	Lake City, Fort White
Gilchrist County	
Suwannee County	
Union County	Lake Butler, Worthington Springs

Appendix C. Proposed Santa Fe River Swim Budget

PROGRAM	1995	1996	1997
Resource Monitoring			
Salaries, Benefits, Expenses, Equipment	$51,505		
Contracts	$163,860		
SWIM Trust Fund (80%)	*$172,292*		
SRWMD Match (20%)	*$43,073*		
Total	**$215,365**	**$100,000**	**$100,000**
Resource Planning			
Salaries, Benefits, Expenses, Equipment	$26,100		
Contracts	$91,663		
SWIM Trust Fund (80%)	*$94,210*		
SRWMD Match (20%)	*$23,553*		
Total	**$117,763**	**$80,000**	**$330,000**
Program Implementation			
Salaries, Benefits, Expenses, Equipment	$42,300		
Contracts	$36,643		
SWIM Trust Fund (80%)	*$63,154*		
SRWMD Match (20%)	*$15,789*		
Total	**$78,943**	**$95,000**	**$95,000**
Restoration Implementation			
Salaries, Benefits, Expenses, Equipment	$0	$5,000	$5,000
Contracts	$0	$20,000	$20,000
SWIM Trust Fund (80%)	$0	*$20,000*	*$20,000*
SRWMD Match (20%)	$0	*$5,000*	*$5,000*
Total	**$0**	**$25,000**	**$25,000**
Waterbody Planning			
Salaries, Benefits, Expenses, Equipment	$31,600	$10,000	$20,000
Contracts	$898	$0	$5,000
SWIM Trust Fund (80%)	*$25,998*	*$8,000*	*$20,000*
SRWMD Match (20%)	*$6,500*	*$2,000*	*$5,000*
Total	**$32,498**	**$10,000**	**$25,000**
Annual Total Budget	**$444,569**	**$310,000**	**$575,000**

Appendix D. Glossary of Terms

Acidic--Waters which have a pH value less than 7.0 (neutral).

Alkaline--Waters which have a pH value greater than 7.0 (neutral).

Ambient--The natural background or surrounding conditions of surface or ground water.

Aquifer--A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Base flow--Sustained or fair-weather flow of a stream. In most places, base flow is derived from ground water in-flow to the stream channel.

Basin--See "Drainage Basin" and "Watershed".

Benthic organism- A form of aquatic life that lives on the bottom or near bottom of streams, lakes, or the oceans.

Carbonate--A salt or ester of carbonic acid; a compound containing the radical CO_3.

Cation- An atom that has a positive electrical charge- for example, sodium and calcium ions.

Color--The physical measurement of water's lightness or darkness as measured in platimun-cobalt units (PCU). Water color determines the amount of sunlight that penetrates the water column and, as a result, the amount of aquatic vegetation present.

Confined aquifer--An aquifer in which ground water is confined under pressure which is significantly greater than atmospheric pressure. Synonym: artesian aquifer.

Confining bed--A body of relatively impermeable materials (usually clay in this document) stratigraphically adjacent to one or more aquifers.

Consumptive use--Any use of water which reduces the supply from which it is withdrawn or diverted.

Cubic feet per second--The rate of discharge representing a volume of one cubic foot (7.48 gallons) passing a given point during one second.

Diatoms--Species of algae characterized by the presence of an outer layer or cell wall composed of silica.

Discharge area--Area in which subsurface water, including both ground water and vadose water, is discharged to the land surface, to bodies of surface water, or to the atmosphere.

Drainage basin--A subdivision of a watershed.

Effluent--Treated wastewater from municipal or industrial wastewater treatment plants.

Endemic--A species native to, and found exclusively within, a specific geographic area or ecological community.

Epibenthic (epifaunal or epifloral)--Living on the surface of the bottom.

Escarpment (scarp)--A steep slope of some extent along the margin of an elevated area.

Estuary--A semi-enclosed body of water that has a free connection with the open sea and within which seawater is diluted measurably with freshwater that is derived from land drainage.

Eutrophic--Water bodies or habitats with high concentrations of nutrients.

Eutrophic lake--A standing body of water containing an excessive concentration of plant nutrients, especially phosphorus and nitrogen, which results in excessive algal production, especially blue-green algae.

Eutrophication--The process by which waters become enriched with plant nutrients, especially phosphorus and nitrogen.

Evapotranspiration--A collective term that includes water lost through evaporation from the soil and surface-water bodies and by plant transpiration.

Flood Stage--The level at which flood waters cause damage to property.

Floodplain--The land area subject to inundation by flood waters from a river, watercourse, lake, or coastal waters. Floodplains are delineated according to their estimated frequency of flooding. A 100-year floodplain is the area with a one percent risk of inundation in any given year.

Floodprone area--Interior areas which are subject to inundation from storm events due to closed drainage, low permeability soils, high water table, or a combination of factors.

Freshwater--Water that generally contains 1-1,000 milligrams per liter of dissolved solids.

Ground water--In the broadest sense, all subsurface water, as distinct from surface water; as more commonly used, that part of the subsurface water in the saturated zone.

Groundwater availability--The potential quantity of water which can be withdrawn without resulting in significant harm to the water resources or associated natural systems.

Hydrogeology--The science that deals with subsurface waters and related geologic aspects of surface waters.

Hydrograph--A graph showing stage, flow, velocity, or other property of water with respect to time.

Hypoxia--Very low levels of dissolved oxygen in a waterbody.

Instream use--Water use taking place within the stream channel. Examples are hydroelectric power generation, navigation, water-quality improvement, fish propagation, recreation, and other uses. Also called nonwithdrawal use or inchannel use.

Karst--A type of topography that results from dissolution and collapse of limestone, dolomite, or gypsum beds, and characterized by closed depressions or sinkholes, caves, and underground drainage.

Land Development Regulations--Ordinances and regulations adopted by local governments pursuant to Chapter 163, Part II, Florida Statutes, to implement Local Comprehensive Plans. The regulations typically include stormwater management, floodplain management, zoning, subdivision, and the protection of environmentally sensitive areas.

Litter--Accumulations of dead leaves in various states of fragmentation and decomposition.

Littoral--The shoreline zone of a water body.

Local Comprehensive Plan--A county or city comprehensive plan prepared and adopted according to Chapter 163, Part II, Florida Statutes. The plan includes the adopted goals, objectives, and policies of the local government and supporting data and analyses.

Lotic or Lotic Ecosystem--

Macrophyte--An individual alga large enough to be seen easily with the unaided eye.

Mean--The average of a range of values.

MSL/NGVD--Elevation or altitude in feet above or below mean sea level (MSL), or in feet above or below National Geodetic Vertical Datum (NGVD).

Nonpoint source of pollution--Pollution from sources that cannot be defined as originating from discrete points. Examples include areas of fertilizer and pesticide application and leaking sewer systems.

Nutrients--Those constituents required by plants.

Oligotrophic--Water bodies or habitats with low concentrations of nutrients.

Organic--Deriving from living organisms.

Parameter--A constituent sampled in a water body which has variable values, e.g., pH.

Periphyton--Species of microscopic algae which are attached to underwater surfaces.

Period of Record--The time period in which samples are taken or conditions measured at a given location. Longer periods of record more accurately account for variability at that location.

Permeability--The capacity of a porous rock, sediment, or soil for transmitting a fluid without altering its physical structure; a measure of the relative ease of fluid flow under pressure.

pH--The acidity or alkalinity of water ($-\log_{10}$ of the activity of hydronium ions in water).

Physiography (geomorphology)--The study of the genesis and evaluation of land forms.

Phytoplankton--The photosynthesizing organisms residing in the plankton.

Plankton--Organisms living suspended in the water column and incapable of moving against water currents.

Point source of pollution--Pollution from any confined or discrete source, such as the outflow from a pipe, ditch, tunnel, well container, concentrated animal-feeding operation, or floating craft.

Population density--Number of individuals per unit area.

Porosity--The ratio of the aggregate volume of interstices in a rock or soil to its total volume. It is usually stated as a percentage.

Potable water--Water that is safe and palatable for human use and consumption.

Potentiometric surface--An imaginary surface representing the static head of ground water in tightly cased wells that tap a particular water bearing rock unit (aquifer), or, in the case of unconfined aquifers, the water table.

Recharge--The process of addition of water to the zone of saturation.

Reuse--The deliberate application of reclaimed water, in compliance with DEP and District rules, for a beneficial purpose.

River Stage--The height at which a river's water level is measured using a staff gage whose elevation above mean sea level is known.

Runoff--That part of precipitation or snow melt that appears in streams or surface-water bodies.

Sedimentary--A rock resulting from the consolidation of loose sediment that has accumulated in layers either mechanically, by precipitation from solution, or from the remains or secretions of plants and animals. Also applied to processes leading to, or resulting from, the formation of such rocks.

Semiconfined aquifer--An aquifer that is partially confined by a layer (or layers) of low permeability through which recharge and discharge occur.

Silviculture--A branch of forestry dealing with the development and care of forests.

Sinkhole--A general term for a closed depression in an area of karst topography that is formed either by solution of the surficial limestone or by collapse of underlying caves. Its form is generally basinlike or funnel-shaped.

Sinking stream (stream-to-sink watersheds)--A surface stream that disappears into an underground channel (e.g., a stream in a karst region that disappears into a sinkhole and follows a definite channel through limestone caves).

Spring--The resurgence of ground water at the land's surface or into a surfacewater body.

Stormwater Runoff--Rainfall that, due to saturated soil conditions or impervious surfaces, is carried by gravity over tha land's surface to a receiving water body (including lakes, streams, rivers, wetlands, and aquifers).

Subwatershed--A geographic subunit of a watershed, also referred to as a basin or sub-basin.

Taxa--The classification and naming system for organisms used in biological science..

Topographic map--A map of a sufficiently large scale showing, in detail, selected man-made and natural features of a part of a land surface, including its relief (generally by means of contour lines) and certain physical and cultural features (vegetation, roads, drainage, etc.).

Transpiration--The process by which water in living organisms, primarily plants, passes into the atmosphere.

Tributary--A branch of a stream or river which provides additional surface waters.

Turbidity--The state, condition, or quality of opaqueness or reduced clarity of a fluid due to the presence of suspended matter.

Unconfined aquifer--An aquifer whose upper surface is a water table free to fluctuate up or down under atmospheric pressure.

Vadose zone--Zone of aeration; usually refers to unsaturated layers in soil or rock formations.

Water Quality Classifications--The Department of Environmental Protection, through Chapter 62-302, F.A.C., has classified surface waters according to present and future most beneficial uses as follows:

Class I	Potable Water Supplies
Class II	Shellfish propagation or harvesting
Class III	Recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife
Class IV	Agricultural water supplies
Class V	Navigation, utility, and industrial use

Watershed--The land area which contributes to the flow of water into a receiving body of water.

Watershed Assessment--A systematic process for evaluating trends and conditions within a watershed or subwatershed, especially for water quality, hydrologic, ecological, or other concerns.

Water table--The water surface in an unconfined aquifer at atmospheric pressure. It is the water level in wells that penetrate the uppermost part of an unconfined aquifer.

Wellhead protection area--An area designated by a local government to protect the groundwater source for a well intended for human consumption for a community water system and includes the surface and subsurface area surrounding a potable water well field. The wellhead protection area may include all or part of the zone of contribution. Within the protection area zones establishing differing levels of protection may be established based on an evaluation of the risk to human health and the environment.

Wetland--Those areas that are inundated or saturated by surface water or ground water at a frequency or duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils.