Suwannee River Partnership

SUWANNEE RIVER NUTRIENT MANAGEMENT WORKING GROUP

MIDDLE SUWANNEE BASIN WORK PLAN
FEBRUARY 15, 2000

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WORK PLAN FOR THE SUWANNEE RIVER BASIN NUTRIENT MANAGEMENT WORK GROUP

I. Introductory Statement and the Purpose of the Plan

The Suwannee River Basin Nutrient Management Working Group was formalized in 1999 in response to increasing trends in nitrate-nitrogen concentration in the ground water, springs, and surface waters of the Middle Suwannee River basin. This plan is the culmination of the work to date of the Working Group to develop a strategy for addressing the water resource impacts of increasing levels of nitrate-nitrogen in ground and surface waters in the Middle Suwannee River Basin.

The plan is a guide for implementing the strategies and tasks needed to reduce nutrient loading to surface and ground waters, and evaluating the success of those efforts. The plan is based on other documents and reports prepared by Working Group members, and these documents and reports are referenced in the appendix. This plan is a resource for landowners, agricultural producers, local officials, and the general public for understanding nutrient management in the Middle Suwannee River Basin.

This work plan is also Florida's proposal for implementing requirements of the Federal Clean Water Act (CWA) related to impaired waters in the Middle Suwannee River and downstream estuary. While Section 303(d) of the CWA calls for the development of Total Maximum Daily Loads (TMDLs, the calculation of the assimilative capacity of the receiving water) for impaired waters, TMDLs are not required if proposed pollution control mechanism provide reasonable assurance that water quality standards will be met in the future. Work group members are committed to meeting the Clean Water Act goal to meet applicable water quality standards and have crafted this work plan to provide reasonable assurance that water quality standards will be met in the river.

Member agencies acknowledge that many nonpoint sources in the basin are outside of their regulatory authority, and have established this work plan as a proactive way to attain water quality standards. In fact, this plan represents an excellent example of Florida's approach to address waters that are impaired by nonpoint sources of pollution. This voluntary approach includes cooperative development of Best Management Practices (BMPs) to address the major sources of nitrate, incentives for farmers that implement applicable BMPs, and tracking of BMP implementation and maintenance. Working Group members have adopted this approach because they agree that voluntary, proactive participation by area stakeholders can achieve environmental results more quickly and effectively than traditional command and control approaches.

Document Organization

Section I, Introductory Statement and Purpose of the Plan, describes the intent of the Suwannee River Basin Nutrient Management Work Group, its partner organizations, and the overall purpose of the Work Plan.

Section II, Background, contains general information about the basin's hydrology, water quality, land use characteristics, and agricultural trends. This information is summarized from other reports and publications that are referenced in the Appendix.

Section III, Goals, Objectives and Strategies, summarizes what the Working Group intends to accomplish, and how the goal and mission will be achieved. This section includes cross references to the detailed work plans found in Section IV.

Section IV, Work Plans of the Technical Working Groups, contains the detailed work plans prepared by each group. These work plans include strategies and schedules for Animal Waste Management, Fertilizer Management, Human Waste Management, Resource Monitoring, and Outreach and Education.

Section V, Appendix, contains a summary description of relevant studies and reports related to nutrient loading and other water quality issues in the Suwannee River basin.

The Suwannee River Basin Nutrient Management Working Group Mission

Assess sources of nutrient loadings to the Suwannee River Basin and optimize reductions in loadings to the waters of the basin emphasizing voluntary, incentive-based programs for protection of the environment and public health.

Guiding Principles adopted by the Working Group:

1. Avoid duplication and maximize the efficient coordination of agency resources and programs, including consolidated, coordinated funding of projects.
2. Use a watershed management approach to encourage comprehensive problem solving.
3. Seek reasonable, incentive based solutions that can be embraced by leaders and stakeholders at all levels of government and community.
4. Focus on management approaches which are technically feasible, economically implementable, and protective of public health and the environment.
5. Develop consensus measures of success that include recognized risk management techniques.
6. Achieve results which satisfy regulatory requirements.
7. Focus initially on the Middle Suwannee River Basin.

The Working Group and this plan are built on the concepts of *partnership* and *coordination*. No additional agency authority is assumed or proposed through this effort. The Working Group oversees Plan implementation. Four components are identified in the Group's Agreement in Principle to help define the overall approach of the Group:

- Technical Working Groups develop and implement strategies for animal waste management, fertilizer management, human waste and stormwater management, monitoring, and outreach and education.

- Education and outreach are essential components for the Plan's success—participants have to understand the issues and solutions. Effective transfer of knowledge and technology is key to sharing the large amounts of data involved with the Plan's implementation.

- Stakeholder involvement is critical to the Plan's success. Participation is encouraged and facilitated through public meetings within the basin, meetings among partners, and periodic progress reports.

- Realistic performance measures that can effectively track progress towards long-term Plan implementation are important. These measures need to be carefully evaluated and adopted by the Working Group.

Successfully accomplishing the goals of this initiative depends on the commitment of all partners. A clear understanding of each partner's responsibilities and capabilities is essential. Table 1 on the following page outlines the general responsibilities of each partner related to implementing the Work Plan for the Suwannee River Basin Nutrient Management Working Group.

Coordinating the Plan's implementation is the responsibility of the Steering Group, comprised of the chairperson of each Technical Working Group. The Steering Group meets monthly to review progress and coordinate projects and activities and generally oversee development and implementation of this Plan.

Each Technical Working Group has prepared a plan of work that includes specific objectives and strategies to accomplish the mission of each group. The Steering Group has reviewed the five work plans and compiled the strategies according to five specific objectives, as detailed in Section III.

Table 1. General Responsibilities of the Suwannee River Basin Nutrient Management Working Group Partners

Partners	Responsibilities
Florida Department of Agriculture and Consumer Services	*Chair the Working Group, lead agency for the Animal Waste and Fertilizer Technical Working Groups, oversee BMP Quality Assurance, implement Nitrate Bill, and Agriculture Water Policy*
Florida Department of Environmental Protection	*Lead agency for Monitoring Technical Working Group, ambient monitoring, water quality standards and environmental regulations, Ch. 403, FS, wastewater permitting, grant funds management*
Florida Department of Health	*Lead agency for Human Waste Technical Working Group, state environmental health programs for public water supply and onsite sewage treatment and disposal*
Florida Department of Community Affairs	*Overseeing implementation of Florida's Growth Management Act, local land use planning*
United States Environmental Protection Agency	*Section 319, Clean Water Act, grant funds*
United States Department of Agriculture, Natural Resources Conservation Service	*Funding and technical planning assistance for Best Management Practices implementation, PL-566*
United States Geological Survey	*Water resource monitoring and research*
Suwannee River Water Management District	*Water resource monitoring, research, planning, and regulation*
Suwannee River Resource Conservation and Development Council, Inc.	*Farmer assistance, support for mobile irrigation lab, conservation equipment rental*
Lafayette and Suwannee River Soil and Water Conservation Districts	*Technical and follow-up assistance for BMP implementation*
Lafayette and Suwannee County Commissions	*Land use planning and administering local land development regulations*
University of Florida Institute of Food and Agricultural Sciences, Extension and Research	*Best Management Practices research, education, and extension services*
Florida A&M University, College of Engineering Sciences, Technology, and Agr.	*Best Management Practices research.*
Florida Rural Water Association Florida Cattlemen's Association Florida Poultry Federation, Inc. Florida Farm Bureau Florida Forestry Association Florida Fertilizer and Agrichemical Association Florida Septic Tank Association Gold Kist, Inc. Sunshine State Milk Producers	*Represent constituent and corporate interests, share technology and information with members and constituents, assist agencies with outreach and education programs, provide a means of communication among constituents and member agencies.*

II. Background

Water quality trends in the Suwannee River, specifically nitrate-nitrogen (nitrate-N) concentrations, indicate that corrective and preventive actions must be taken to prevent further threat to public health and degradation of the river system. Responsibilities for corrective and preventive action belong to public agencies and landowners alike.

Public health is at risk when drinking water supplies have nitrate-N levels above 10 milligrams per liter. Nitrate-N loading to the groundwater that feeds the springs and seeps of the Middle Suwannee River Basin can cause alterations to native ecological communities and, at certain levels, will causes an exceedances in the narrative nutrient water quality criterion in downstream surface waters.

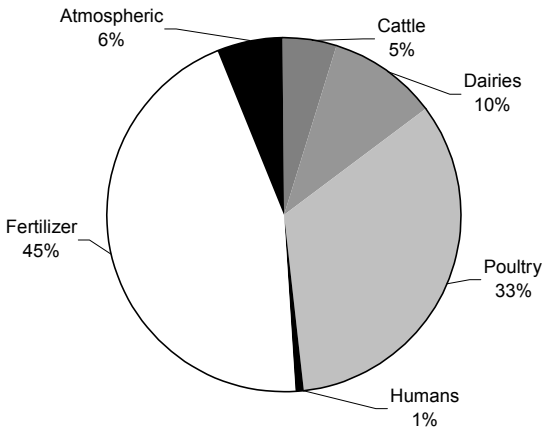
Nitrate-N is not the only nutrient of concern to the Working Group, but is the primary focus because previous monitoring[2] has demonstrated that the river and the downstream estuary are both nitrogen limited. This means that the river system is naturally low in nitrogen, and an infusion of excess nitrogen will trigger undesirable growth of plants and algae which can deplete oxygen in the water more rapidly, block light and flow, and displace or kill native plants and animals. It must also be recognized that at some distance off the mouth of the Suwannee River the estuary becomes phosphorus limited.

Rainfall infiltrates rapidly through the permeable sandy soils and into the underlying limestone of the Floridan aquifer system in the Middle Suwannee River basin. Nitrate-N and other contaminants in the recharge water are transported with the ground water via conduits and diffuse flow to the springs and seeps along the river corridor, into the river, and flowing down to the estuary.

Human activities are the predominant source of nitrate-nitrogen in the upper Floridan aquifer system in the Suwannee River basin. These activities include row crop, dairy, and poultry operations, septic tanks and wastewater disposal, and stormwater runoff.

Estimates of the relative proportion of each are shown on Figure 1. (Source: DACS, DEP, SRWMD)

Figure 1. Nitrate-N Sources



[2] Appendix B contains a summary of studies related to nitrate-N and water quality of the Suwannee River.

Figure 2. Location of the Middle Suwannee Basin relative to the overall Suwannee River Basin.

Basin location map goes on this page…

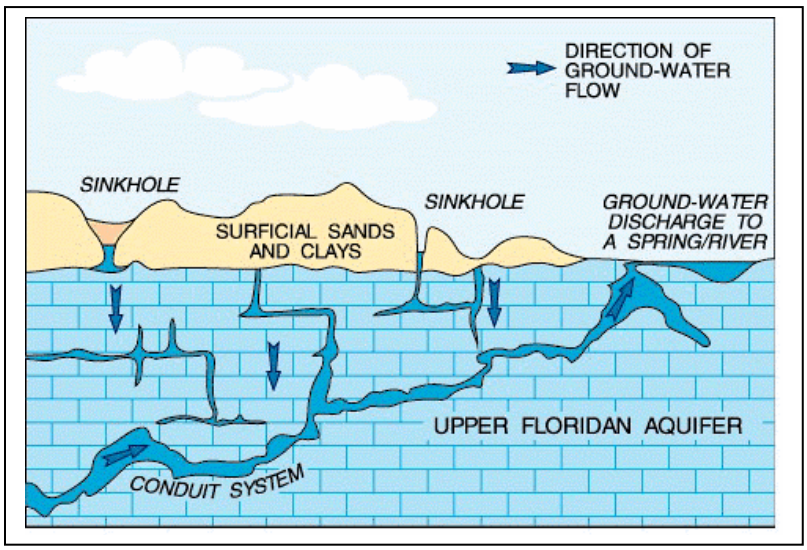
The Middle Suwannee Basin covers 865 square miles, or about 9% of the total area drained by the Suwannee River (approximately 9,950 square miles).

Water Resource Overview

The Suwannee River, second-largest in flow in Florida, originates in the Okefenokee Swamp in Georgia and winds some 235 miles to the Gulf of Mexico. The river changes character markedly along its path, from a small, blackwater stream to a wide, deep, swamp-lined river. Its dark, tannin-stained headwaters are supplemented by considerable spring flow, especially in the middle and lower reaches.

The Suwannee River basin, over half of which lies in Georgia, has complex drainage characteristics. The upper basin is dominated by surface drainage characterized by dendritic (or tree-like) drainage patterns, as shown on Figure 2. The lack of surface water features in the middle basin, indicated on Figure 2, shows the interior-drained areas where groundwater has a greater influence on the river.

Figure 3. Generalized cross section of the Middle Suwannee Basin



The extensive spring system in the Middle Suwannee River Basin is a characteristic of the karst topography[3] that defines the region, as illustrated in Figure 3 *(U. S. Geological Survey)*.

Not all groundwater flows through large conduits and caves in the limestone; in many areas of the basin groundwater flow is more diffuse. The conduits and caves act as a collector system for the springs. Several of the spring caves systems have been mapped by cave divers, some to several thousands of feet in length. These mapping and exploration excursions provide invaluable information about the complex hydrogeology of the basin that provides answers to some questions, but raise other questions in return. For example, the conduits feeding Troy Spring in Lafayette County flow from under the river bed and under Suwannee County. Intuitively, one might expect the spring's capture zone[4] to be directly upgradient in Lafayette County, not in Suwannee County.

[3] Karst topography is characterized by caves, sinkholes, springs, and other types of openings caused by dissolution of limestone (Florida Water Atlas, 1998).
[4] The capture zone of a spring is the land area that provides recharge to the spring. Other terms used in this sense include groundwater basin, catchment area, and recharge area.

Spring discharge and seepage from the aquifer in the river bed account for virtually all inflow to the river from Dowling Park to Branford. The U. S. Geological Survey measured the increase in river flow from this reach in 1995 (during low or base flow conditions) at 950 cubic feet per second, increasing river flow by almost 50 percent (see Table 2)[5]. Forty-one percent of this increase is attributed to eleven springs; the remaining 59 percent to all other springs and groundwater input. Surveys conducted by SRWMD in 1997-1999 during low flow identified a total of 53 springs along this reach of the river, with nitrate-N values ranging from 0.03 to 19.2 mg/L.

The springs, seeps, and conduits act as the interchange points between surface and ground water. Most of the time groundwater flows into the river, but during flood events when the hydrostatic pressure of river water is greater than that of groundwater, flow reverses and river water enters the Floridan aquifer system. Some wells that are miles from the river are affected during floods, and Falmouth Spring[6], 3 miles from the river, reverses flow when the river floods.

Flow rates in the upper Floridan aquifer system vary depending on the porosity of the limestone. Areas with diffuse flow may have flow rates measured in feet per day, while some of the major conduits and fissures have flow rates measured in miles per hour (similar to surface flow rates). Spring water in the basin is a mixture of shallow, "newer" water and deeper, older water. The U. S. Geological Survey analyzed the water from several springs in the basin and concluded that water containing high nitrate concentrations (dominated by fertilizer N inputs) is recharging the groundwater system on a timescale of less than 10 years, even though the overall average residence time of groundwater discharging to springs can be on the order of 20 to 40 years[7].

Table 2. Discharge and Nitrate-N, July 1995

Location	Discharge (ft^3/s)	Nitrate-N (mg/L)
Suwannee River at Dowling Park	2,020	0.46
Shirley Spring	1.5	1.7
Charles Springs	7.5	2.2
Blue Spring	77	1.7
Other inflow	264	0.05
Suwannee River near Luraville	2,370	0.46
Telford Springs	33	2.5
Running Springs	17	2.0
Convict Spring	1.7	8.2
Royal Spring	16	1.3
Mearson Spring	30	1.7
Troy Spring	132	1.7
Ruth Spring	9.9	3.4
Little River Spring	67	1.4
Other inflow	293	2.7
Suwannee River at Branford	2,970	0.83

USGS, WRI 97-4152

[5] Spring Contributions to Water Quantity and Nitrate Loads in the Suwannee River during Base Flow in July 1995, Water-Resources Investigations Report 97-4152, 1997

[6] Falmouth Spring, designated a first magnitude spring with an average flow of 160 cfs is actually a 400-foot long karst window. Flow usually emerges from the eastern end and flows west, reversing during floods. Falmouth is connected by conduit to Ellaville Spring.

[7] Sources and Chronology of Nitrate Contamination in Spring Waters, Suwannee River Basin, Florida. U. S. Geological Survey, Water-Resources Investigations Report 99-4252, 1999.

Figure 4. Potentiometric Surface of the Floridan Aquifer System in the Middle Suwannee Basin

Potentiometric surface map goes on this page…

The potentiometric surface of the aquifer is the level to which groundwater would rise in a tightly cased well, measured above mean sea level. Groundwater flows perpendicular to the contour lines, generally toward the Suwannee River. Note the more closely spaced lines in Lafayette County, indicating more dense limestone and a steeper hydraulic gradient than in Suwannee County.

Figure 5. Recharge Potential of the Floridan Aquifer System in the Middle Suwannee Basin

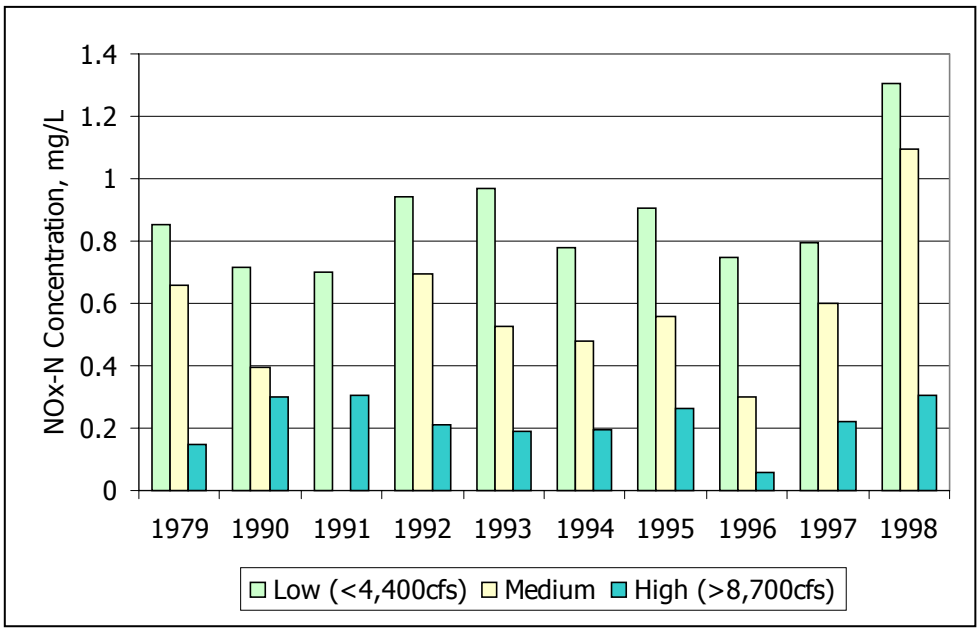
Recharge potential map goes on this page…

Water Quality Assessment

Many studies have been conducted on the water quality of the Suwannee River[8]. A common emerging theme relates to the need for managing the input of nutrients to the basin's water resources. Nitrate-nitrogen is the priority nutrient and, as described earlier, is introduced to the river system from a variety of land uses. Organic sources include humans, livestock, and other animals; inorganic sources are from manufactured fertilizers.

Nitrate-N concentrations in the Suwannee River at Branford increased by almost 5 percent per year from 1971 to 1991, or an increase of 0.02 mg/L per year[9]. Figure 2 shows average annual observed concentrations in the river (samples are collected and analyzed monthly at Branford). Low flow conditions (below 4,400 cubic feet per second) are when concentrations are highest; this correlates to periods when groundwater is the dominant source of the river's flow. High flow conditions (over 8,700 cfs) are when surface runoff is the dominant source of the river's flow. Background or unimpacted groundwater concentrations of nitrate-N are about 0.04 mg/L.

Figure 6. Observed Nitrate-N Concentrations in the Suwannee River at Branford, FL, During Low, Medium, and High Flow Conditions



Source: SRWMD and DEP data

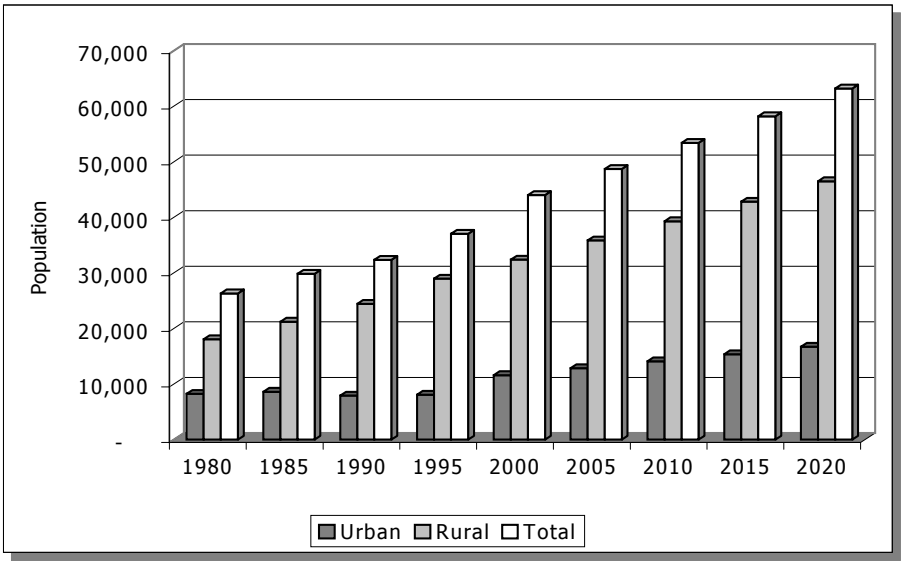
[8] Appendix A provides an annotated bibliography of water quality related publications and reports compiled by DEP.
[9] Flow-adjusted concentration as reported by the U. S. Geological Survey, Water Resources Investigations Report 96-4037

Population Growth in Lafayette and Suwannee Counties

Relatively steady, slow increases in population occurred in Lafayette and Suwannee counties since 1980, most of it in the rural areas. The basic trend is expected to continue through the year 2020. Population estimates and projections prepared by SRWMD[10] predict a 71% increase in population from 1995 to 2020. Over two-thirds of this projected increase will occur in the unincorporated area of the two counties, assuming that trends experienced since the 1970's will continue. This means that most of the population increase, if it occurs outside Live Oak or Mayo, will rely on onsite sewage treatment and disposal systems (septic tanks) and individual self-supply wells.

Many factors influence the population of the basin, and the possibility of a substantially greater population increase exists. Seasonal fluctuations in population occur as well, but usually involve a significant tourist population (which has not yet been established in the basin). Although the overall basin population is not expected to be excessive, it should be monitored for emerging trends on a periodic basis.

Figure 7. Population Estimates and Projections, Suwannee and Lafayette Counties, 1980 - 2020



1995 Population	
Lafayette Co.	6,516
Suwannee Co.	30,534
Total	37,050

2020 Population	
Lafayette Co.	11,500
Suwannee Co.	51,700
Total	63,200

Source: SRWMD 1998 Water Supply Assessment

[10] 1998 Water Supply Assessment, SRWMD

Land Use and Land Cover

The Middle Suwannee Basin has a variety of land cover types, and shows an area that has been settled for most of Florida's human history. About two-thirds of the basin has been put to use, the remaining one-third is still in a relatively undisturbed condition (mostly forested lands, wetlands, and water). Land use and land cover were mapped by SRWMD based on 1995 aerial photography and including 119 detailed classifications; these are generalized in the following table shown on Figure 8.

Generalized Land Cover Classification	*Acres*	
Urban, Built-Up Areas, Extractive, and Infrastructure	49,600	9%
Agricultural	175,300	32%
Pine Plantation	143,200	26%
Uplands and Forest	134,600	24%
Wetlands and Water	50,900	9%
Total	553,600	

Source: SRWMD 1995 Land Use and Land Cover. Acreage figures rounded to the nearest 100.

Figure 8. Generalized 1995 Land Use and Land Cover, Middle Suwannee Basin

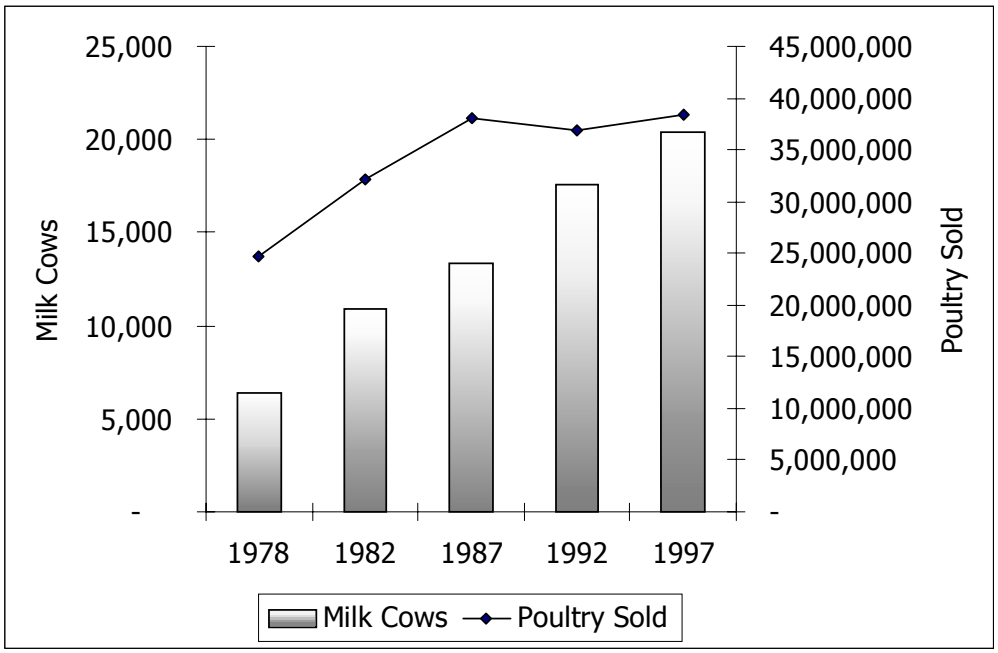
Land cover map goes on this page…

Agricultural Land Use Trends

Agricultural land uses define much of the landscape of the Middle Suwannee Basin area and include row crops, poultry operations, dairies, pasture, and pine plantations (silviculture). Farming has changed in the basin as new technologies and market forces have evolved, focusing more of the agricultural production towards more intensively managed operations. Some observations (derived from reported agricultural statistics) for Lafayette and Suwannee counties from 1978 to 1997 include[11]:

- Total land area in farms decreased 19% to 251,840 acres
- Total number of farms decreased 29% to 1,061
- Average farm size increased in Lafayette, decreased in Suwannee
- Harvested cropland decreased 34% to 55,723 acres
- Irrigated land increased 26% to 19,109 acres
- Nitrogen fertilizer sales increased 16% although fertilized acreage decreased 33%
- The value of products sold increased 158% to over $175 million
- Broilers/other chickens sold increased 56% to over 38 million
- The number of milk cows increased 218% to 20,434

Figure 9. Dairy and Poultry Trends in Lafayette and Suwannee Counties



[11] Statistical summaries are provided by the U. S. Dept. of Agriculture at http://www.nass.usda.gov/census/ and through previous U. S. Bureau of the Census publications.

III. Goals, Objectives, and Strategies

The overall purpose of the Middle Suwannee Basin Work Plan is reflected in the mission statement of the Suwannee River Basin Nutrient Management Working Group:

> ***Assess sources of nutrient loadings to the Suwannee River Basin and optimize reductions in loadings to the waters of the basin emphasizing voluntary, incentive-based programs for protection of the environment and public health.***

Successfully achieving the mission depends entirely on the commitment of the agencies, producers, landowners, and other partners of the Working Group. Government agencies must commit adequate funds and staff resources to follow through, and producers and landowners must fulfill their contracts and obligations to manage their operations in accordance with the best management practices. Most of all, the spirit of mutual cooperation and trust, built on open channels of communication, must be maintained.

The goal of the Middle Suwannee Basin Work Plan is to use all available resources to:

Achieve an 80% participation level in the implementation of BMP's for row crop in the basin. This goal is to be accomplished as follows:

- ***80% of the basin's producers will have signed letters of intent to participate in BMP implementation by 2002***
- ***80% of the basin's producers will have completed an NRCS or equivalent nutrient management plan and will have begun implementing applicable interim measures or adopted BMPs by 2008. These plans and practices will be continually maintained.***

Achieve a 100% participation level in the implementation of adopted BMP's for animal producers (poultry and dairy) in the basin. This goal is to be accomplished as follows:

- ***All dairy operations will have signed letters of intent to participate in BMP implementation by 2000***
  - ***Currently, 42 of 44 dairy operations in the basin (95%) have signed letters of intent with NRCS to participate in BMP implementation***
- ***Participating agencies will work with poultry producers and integrators to have signed letters of intent to participate in BMP implementation by 2002***
- ***All poultry producers will have completed NRCS or equivalent nutrient management plans and have implemented applicable interim measures or adopted BMPs by 2008***

The Working Group selected this participation rate as a goal for two reasons: it prioritizes agricultural sources of nitrate-N as the best opportunity for active reduction of nitrate-N loading and the goal recognizes that voluntary, proactive participation by area stakeholders can achieve environmental results more quickly and effectively than a traditional regulatory approach.

The Working Group also selected this goal in acknowledgement of the unique hydrogeology of the basin. Because the vast majority of nitrate-N loading to the river system is from nonpoint sources transported by groundwater, it is very difficult to identify, monitor, and assess individual sources of nitrogen and their subsequent contributions to loading in the river and downstream estuary. A key component of this approach is continuous monitoring—if it appears in subsequent years that the participation rate achieved is not enough, or that voluntary BMP implementation is insufficient to reduce nitrate-N loading, the Working Group will initiate development of a water quality based nitrogen target for the river system.

Working Group members are confident that this eight year time frame to meet the participation rate goals is as aggressive as possible, yet still realistic. It will take considerable effort to develop BMPs (particularly for row crop operations) and adopt them by rule, develop conservation plans at individual farms, apply for and obtain cost share funding, and then actually construct or implement the BMPs.

Success of this program is recognized as being largely dependent upon funding subsidies and technical assistance. Support from the NRCS and other agencies to work with farmers to develop conservation plans will be critical. Soil and Water Conservation District conservation technicians will conduct producer outreach regarding available BMPs, and help deliver the technical assistance, incentives and problem-solving services needed to maintain BMPs once put in place. Soil and Water Conservation District conservation technicians will provide feedback from the grower community to resource management and other agencies on technical assistance, cost share, and research needs and also provide feedback to the Working Group on the success of voluntary efforts.

The Soil and Water Conservation District conservation technicians will assist DACS, SRWMD and Soil and Water Conservation Districts in delivering a state cost-share assistance program in conjunction with federal cost-share programs (e.g., Environmental Quality Incentives Program). The conservation technicians and NRCS conservation specialists will provide in-field producer outreach and follow-up to help producers implement and maintain their chosen BMP(s). The conservation technicians will also help provide early identification of schedule or operational problems, so that others may step in to provide technical assistance. For example, a producer may need assistance in operational aspects of an irrigation system used for land application or a waste management system. In these cases, the conservation technician will serve as a point of contact between

the producer and a Mobile Irrigation Laboratory or the Department of Environmental Protection circuit rider program, which can offer the producer in-field assistance. Soil and Water Conservation District conservation technicians will also rely on University of Florida Institute for Food and Agricultural Sciences and NRCS partners to serve as technical assistance providers to producers (e.g., in crop research, production and management, planning, design, engineering, and cost-share).

Soil and Water Conservation District conservation technicians will also participate in local Soil and Water Conservation District, IFAS, association and other education programs for producers and citizens, to provide information about BMP programs and to conduct outreach activities. The conservation technicians will assist the Working Group in completing the baseline practices survey for dairy, poultry, and other operations in the Middle Suwannee Basin to provide a complete description of the operation and nutrient uses in each area.

Five objectives define the Work Plan, each of which has specific strategies defined in the Technical Working Group Work Plans. These objectives are of equal priority and aspects of each are being implemented concurrently:

1. *Inventory* existing conditions and practices
2. *Monitor* water quality and participation
3. *Implement* BMPs and other improvements
4. *Communicate* to share information, educate, and increase participation
5. *Evaluate* alternatives and implementation effectiveness

Performance Measures and Indicators of Success

These measures and indicators will be compiled and reported annually, with a cumulative total to show long-term progress towards goal achievement.

Participation (by commodity group, assessed as appropriate for each commodity)

- Number and percent of producers that have signed letters of intent
- Number and percent of producers with conservation plans
- Number and percent of producers implementing adopted BMPs or interim measures (including acreage if applicable)
- Number and percent of producers with completed BMP structures and ongoing operational maintenance

Agency Performance

- Number and percent of Work Plan strategies initiated, in progress, and completed according to schedule.
- Number of interim measures developed and BMPs approved and adopted by DACS

- Number of Conservation Plans developed

Environmental Response

- Changes in nitrate-N concentrations in groundwater at monitored farms that are implementing adopted BMPs.

Monitoring is an important part of measuring performance. Each Technical Working Group Work Plan includes appropriate forms of monitoring, all of which help provide the data necessary to track implementation. The various monitoring activities fall into three general types of monitoring:

Research and Effectiveness Monitoring—measures the success of BMPs in reducing nitrate-N and other nutrient loading to groundwater. Development of the BMPs will largely be accomplished through the state Institute of Food and Agricultural Sciences (IFAS) at the University of Florida. Documentation of BMP effectiveness will be accomplished by DACS and IFAS through research conducted on selected farms within the basin. Following development, DACS will be responsible for adopting the BMP by rule. The rule development process will provide for review by participating agencies and the public at large. Verification of the BMP effectiveness will be provided through targeted monitoring of selected farms with implemented BMPs.

Implementation Monitoring—measures the degree to which BMPs are developed and installed on the ground. This will be accomplished through surveys of BMP implementation, operation, and maintenance conducted by DACS. Where BMP implementation for dairy operations are found to be deficient, the operator will be notified of the necessary corrective actions with specified timeframes. Failure to implement corrective actions will result in an appropriate response consistent with the state Concentrate Animal Feeding Operation (CAFO) Compliance Assurance Plan (CAP). All dairies will have a Comprehensive Nutrient Management Plan developed by NRCS by September 2001. All dairies will be evaluated for BMP implementation and operation and maintenance, by participating agencies, by 2005. Facility specific inspections and reporting mechanisms will be developed.

FDACS and DEP staff will cooperate in conducting BMPs Quality Assurance Program visits. Checklist reviews will be conducted on dairy, poultry, and row crop/forage farms each year in the Middle Suwannee River Basin. The checklist will consist of a list of BMPs implemented through conservation plans, including review of nutrient management practices and record keeping. A report summarizing BMPs participation levels, acreage, and production levels in each area will help assure best available technology is being used by the agriculture industry to protect water quality and will allow participating farms to continue in a voluntary program.

Resource Monitoring—measures nitrate-N and related parameters of concern in the river, ground water, springs, and the Suwannee River Estuary. This will be accomplished by SRWMD, DEP, and DOH as part of ongoing programs and initiatives specific to the Middle Suwannee Basin (e.g., private drinking well surveys). A resource monitoring plan is included in Section IV of this work plan.

The process for measuring performance and success will have to remain flexible as the Work Plan is implemented, recognizing that data availability, agency resources, and public support will all influence how accurately the activities can be undertaken and measured. Periodic review of the effectiveness of this process is part of the overall monitoring strategy of the Work Plan.

In this Work Plan, the terms "baseline" and "existing conditions" are intended to be synonymous, and are meant to reflect conditions at the time the Agreement was signed—January 1999. The terms refer simply to the starting point against which future conditions will be compared to measure the success of the Working Group's collective efforts in the Middle Suwannee Basin.

Objective 1: **Complete a comprehensive inventory of existing conditions in the Middle Suwannee River Basin.**

TWG	Lead	Strategy*	Schedule
Animal	DACS	[A1] Baseline Practices Survey	6/00
	DACS	[A3] Inventory available BMPs; ongoing research and demos in basin	3/00
	DACS	[A4] Review existing data (effectiveness evaluation); classify BMPs; identify data gaps (priorities)	Ongoing
Fertilizer	IFAS	[F1] Evaluate the water quality impacts of existing representative practices (319)	12/00
	DACS	[F2] Inventory status of existing crop nutrient/irrigation recommendations for primary cropping systems	12/01
Human	DOH	[H1]. Prepare inventories of human waste nutrient sources including wastewater, stormwater, solid waste	6/99
Monitoring	SRWMD	[M1]. Establish existing nitrate-N conditions in ground water.	1998
	SRWMD	[M2] Establish existing spring nitrate-N conditions	1998
	SRWMD	[M3] Establish existing river nitrate-N conditions	1998
	SRWMD	[M4] Establish existing river algal growth potential	2002
	SRWMD	[M5] Establish existing estuarine conditions--physical, chemical, biological	
	SRWMD	[M6] Map current areal extent of seagrasses	2001
	SRWMD	[M7] Determine current estuarine algal standing crop	1999
	SRWMD	[M8] Quantify potential nitrate-N loading from major sources	Ongoing

* The Technical Working Group Work Plans in the following section provide more detail about the strategies summarized here.

Objective 2: **Maintain a monitoring program to continually and regularly check water quality conditions and related biological conditions, and provide data and reports to interested parties and Working Group partners.**

TWG	Lead	Strategy*	Schedule
Monitoring	DEP/SRWMD	[M1] Monitor groundwater nitrate-N	Ongoing
	DEP/SRWMD	[M2] Monitor spring nitrate-N	Ongoing
	DEP/SRWMD	[M3] Monitor river nitrate-N	Ongoing
	DEP/SRWMD	[M5] Monitor estuary nitrate-N	Ongoing
	DEP/SRWMD	[M4] Monitor riverine algal growth potential	Ongoing
	DEP/SRWMD	[M7] Monitor estuarine algal growth potential, other biological	Ongoing
	SRWMD	[M8] Monitor potential nitrate-N loading from major sources	Annually
	DEP/DOH	[M9, M10] Private well survey	2000
	DACS	[M11] Monitor the effectiveness of BMPs in private wells near selected land uses	Ongoing

* The Technical Working Group Work Plans in the following section provide more detail about the strategies summarized here.

Objective 3: **Implement Best Management Practices and other improvements and activities to reduce nitrate-N loading in the Middle Suwannee River Basin.**

TWG	Lead	Strategy*	Schedule
Animal	NRCS	[A6] Develop programs for cost-share, planning, and technical assistance to implement proven BMPs. (PL566)	Ongoing
	DACS	[A8] Coordinate/leverage state and federal cost-share funding	Ongoing
	SWCD's	[A12] Conduct BMP demonstration projects	Ongoing
	DACS	[A13] Incorporate cooperative efforts of integrators and cooperatives	6/00
	DACS	[A14] Coordinate in developing clear regulatory thresholds	2/00
Fertilizer	DACS	[F3] Integrate best nutrient recommendations with existing representative practices	12/02
	DACS	[F4] Adopt interim measure which formally avails grower community with best nutrient recommendations, liability waiver	12/03
	DACS	[F6] Adopt BMP's which consist of the most practicable and feasible recommendations	2002 – 2005
Human	DOH	[H8] Prioritize options, recommend to agencies, identify funding sources	6/00
	DOH	[H9] Implement recommendations	Ongoing

* The Technical Working Group Work Plans in the following section provide more detail about the strategies summarized here.

Objective 4: **Involve the public, landowners, producers, interest groups, agencies, and local governments through active outreach and education efforts to share information, develop consensus, and provide feedback.**

TWG	Lead	Strategy*	Schedule
Animal	DACS	[A15] Develop and implement outreach and education programs for producers	Ongoing
	DACS	[A16] Coordinate ongoing local/regional efforts--public participation, consensus building, advisory forum	Ongoing
	DACS	[A17] Develop an outreach program--website and printed materials	Ongoing
Fertilizer	DACS	[F7] Initiate and maintain dialog with grower community (FTWG and Nitrogen BMP Program)	Ongoing
	DACS	[F8] Establish grower advisory group to solicit input	Ongoing
	DACS	[F9] Establish a grass roots public workshop process during formal BMP adoption process	1999 – 2005
	DACS	[F10] Initiate an extensive education and follow-up process subsequent to BMP adoption	Ongoing
	DACS	[F11] Meet one-on-one with growers to determine needed support to adopt BMPs	Ongoing
Outreach	Florida Farm Bureau	[OE1] Identify and target outreach audiences	Ongoing
	FFB	[OE2] Determine effective channels of communication	
	FFB	[OE3] Assess current levels of understanding about the Working Group mission	
	FFB	[OE4] Implement the CARES program	
	FFB	[OE5] Coordinate outreach products among Working Group members	
	FFB	[OE6] Establish clear identify for working group	
	FFB	[OE7] Compile and make available project information	
	FFB/DACS	[OE8] Basin product differentiation marketing plan	
	FFB/DACS	[OE9] Waste product recycling marketing plan	

* The Technical Working Group Work Plans in the following section provide more detail about the strategies summarized here.

Objective 5: **Evaluate the range of management options and effectiveness of implementation strategies through research, monitoring, fieldwork, and cooperative projects; and maintain a periodic review of program effectiveness.**

TWG	Lead	Strategy*	Schedule
Animal	DACS	[A2] Use Baseline Survey to check progress in BMP participation	12/00
	DACS	[A5] Determine long-term "effectiveness data" needs	12/03
	DACS	[A7] Track PL-566, EQIP, other cost-share and other efforts.	12/00
	DACS	[A9] Using baseline survey and inventory results, prepare R&D plan for BMPs	
	DACS	[A10] Estimate needed levels of producer adoption of BMP's to achieve nutrient reduction	12/05
	DACS	[A11] Establish BMP Quality Assurance program	
Fertilizer	DACS	[F5] Collaboratively identify modified practices and evaluate water quality impacts	1999 – 2005
Human	DOH	[H2] Determine treatment requirements for each human waste source	9/99
	DOH	[H3] Quantify nutrient loads from human waste sources, by county and river reach	9/99
	DOH	[H4] Estimate future (20-year) increases of nutrients from human sources	9/99
	DOH	[H5] Compare location of existing human sources to sensitive areas	3/00
	DOH	[H6] Compare relative basin nutrient loads from human sources to other sources	3/00
	DOH	[H7] Evaluate technologies for current/future human waste sources	6/00
Monitoring	DEP	[M12] Evaluate effectiveness of BMPs at individual agricultural operations	
	DEP	[M13] Complete isotope analyses to determine nitrate-N sources, relate sources to flow, and evaluate variability factors	

* The Technical Working Group Work Plans in the following section provide more detail about the strategies summarized here.

IV. Work Plans of the Technical Working Groups

Included in this section are the work plans developed by the Technical Working Groups of the Suwannee River Basin Nutrient Management Working Group. The Technical Working Groups and the lead agencies are as follows:

Animal Waste Management Technical Working Group
Chair: Department of Agriculture

Fertilizer Management Technical Working Group
Chair: Department of Agriculture

Human Waste Technical Working Group
Chair: Department of Health

Monitoring Technical Working Group
Chair: Department of Environmental Protection

Outreach and Education Technical Working Group
Chair: Florida Farm Bureau

The strategies that are summarized in the preceding tables correspond to the strategies identified in each technical working group plan in consecutive order, as follows:

Strategies [A1] through [A17]—Animal Waste Management

Strategies [F1] through [F11]—Fertilizer Management

Strategies [H1] through [H9]—Human Waste

Strategies [M1] through [M13]—Monitoring

Strategies [OE1] through [OE11]—Outreach and Education

Middle Suwannee Basin Plan
Animal Waste Management Technical Working Group

GOAL 1:
Identify existing animal waste sources of nutrients in the basin, and prioritize existing practices for remedial actions to reduce nutrient impacts.

Objective 1.1:
Determine practices for animal waste management currently in use by producers in the basin.

[A1]**Strategy 1.1.1**:
Compile baseline practices through a Baseline Practices Survey, including information on adoption of BMPs, and status in BMP implementation programs (e.g., cost-share). The Baseline Practices Survey is intended to fulfill the AWTC need for data while satisfying informational needs associated with EPA/DEP CAFO program.

Responsible Agency:
Responsibility for this strategy was assigned to a AWTC Baseline Practices subcommittee, which will generate a survey vehicle based on a consensus regarding what data are needed, how data will be collected, and how data will be used to meet AWTC objectives.

Cooperators:
DACS, DEP, SRWMD, NRCS, IFAS, Goldkist, Sunshine State Milk Producers, Farm Bureau

[A2]**Strategy 1.2**:
Use Baseline Practices Survey to generate a marker against which progress will be made in producer participation in BMP programs, adoption of nutrient management plans, and other activities.

Objective 2.2:
Inventory current best management practices (BMPs) available for use by animal producers.

[A3]**Strategy 2.2.1**:
Produce an inventory of available BMPs and ongoing research and demonstration of BMPs in the basin, and evaluate the basis for recommendations for available BMPs related to nutrient reduction. Include a matrix of BMPs, and a report regarding ongoing research. Place report on web page.

Responsible Agency:
Responsibility for this strategy was assigned to the AWTC BMP Performance and Tracking subcommittee, which will compile and assess existing BMPs for animal waste management.

Cooperators:
SRWMD, DACS, DEP, NRCS, IFAS, DOH, Goldkist, Sunshine State Milk Producers, Farm Bureau

Objective 2.3:
Evaluate the effectiveness of existing practices and available BMPs to reduce nutrient impacts to the basin.

[A4]**Strategy 2.3.1**:
Review existing data to evaluate the effectiveness of current practices and available BMPs (matrix) in managing nutrient impacts to the basin. Classify BMP according to engineering or management category, to determine type and degree of support data required to document effectiveness. Identify priority areas (e.g., gaps) for development of support data for animal waste management BMPs. Data may include existing research and monitoring data from permitted operations.

Responsible Agency:
Responsibility for this strategy was assigned to the AWTC BMP Performance and Tracking subcommittee, which will compile and assess existing BMPs for animal waste management.

Cooperators:
SRWMD, DACS, DEP, NRCS, IFAS, DOH, Goldkist, Sunshine State Milk Producers, Farm Bureau

Schedule/Status:
Schedule for this task should be tied to 319 funding cycles.

[A5]**Strategy 2.3.2**:
Determine long-term steps needed to generate effectiveness data for applied BMPs and BMPs under development. This will include field validation research and demonstration monitoring, and determining how effectiveness is best measured. The AWTC may wish to select certain practices for monitoring benefits in support of recommendations to producers, and to provide a sound technical basis for estimates of nutrient reduction associated with chosen practices.

GOAL 3:
Reduce nutrient impacts to the basin associated with animal waste management.

Objective 3.1:
Apply findings from Goals 1 and 2 to implement practices which are shown to work best to reduce nutrient inputs.

[A6]**Strategy 3.1.1**:
Develop programs for cost-share, planning, and technical assistance to promote and assist producers in implementing proven BMPs. This includes providing continuing training on critical management aspects of BMP implementation.

Objective 3.2:
Document progress under existing programs, considering producer participation and project status.

[A7]**Strategy 3.2.1**:
Track PL 566 program for dairies and poultry; EQIP animal operations cost-share; SRWMD/DACS cost-share; industry and other animal waste management efforts.

Objective 3.3:
Develop and apply cost-share as a primary incentive tool in implementing BMPs.

[A8]**Strategy 3.3.1**:
Coordinate/leverage state and federal cost-share funding to maximize assistance to producers in BMP planning and design, construction, and operation and maintenance.

Objective 3.4:
Initiate BMP research and development for priority practices and areas to reduce nutrient impacts to the basin.

[A9]**Strategy 3.4.1**:
Using Baseline Practices Survey and BMP inventory results, prepare a research and development plan for animal waste management BMPs.

Objective 3.5:
Establish short- and long-term measures of success for producer acceptance and implementation of BMPs, and for on-site demonstration of BMP effectiveness.

[A10]**Strategy 3.5.1**:
Using Baseline Practices Survey as a marker, estimate levels of producer adoption of BMPs needed over a specified time period to achieve needed reduction in nutrient inputs to the basin. Set these levels as a short-term measure of success.

Objective 3.6:
Implement BMP performance and tracking measures, to document the effectiveness of BMPs and track the adoption and management of BMPs by basin animal producers.

[A11]**Strategy 3.6.1**:
Establish a process to monitor the adoption, proper management and performance of BMPs by animal producers in the basin. This process is based on field-level technical support to provide both outreach and technical follow-up assistance to producers as BMPs are implemented, and includes tracking and problem-solving associated with operation and maintenance/management of BMPs.

Responsible Agency:
Responsibility for this strategy was assigned to the AWTC BMP Performance and Tracking subcommittee, which will develop a BMP implementation tracking recommendation for animal waste management.

Cooperators:
SRWMD, DACS, DEP, NRCS, IFAS, DOH, Goldkist, Sunshine State Milk Producers, Farm Bureau

Within the Middle SR Basin, BMP implementation tracking will be required for 44 dairies and 150 poultry operations, over a minimum of ten years, using DACS programs (e.g., Animal Industry/Dairy divisions), Suwannee River and Lafayette soil and water conservation districts, and other partners. This will require additional field resources (staff and/or expense). Funding for a circuit rider program will be needed.

[A12]**Strategy 3.6.2**:
Conduct BMP demonstration projects at representative on-farm sites to document the effectiveness of research-based and engineering BMPs across all types of animal operations.

Responsible Agency:

Presently, responsibility for this strategy rests in SRWMD, DEP and DACS, through an ongoing 319 grant project including fertilizer/irrigation management for cropping systems and nutrient management for animal waste.

Cooperators:
SRWMD, DACS, DEP, IFAS, Sunshine State Milk Producers, Farm Bureau

Schedule/Status:
The cropping system component of this 319 project is underway at Suwannee Farms. Dairy and poultry cooperators are being sought for a future phase demonstrating animal waste management practices.

[A13]**Strategy 3.6.3**:
Incorporate the cooperative efforts of integrators and cooperatives in demonstrating the application and effectiveness of BMPs by contract producers.

Responsible Agency:
Responsibility for this strategy will be shared by integrators, Sunshine State Milk Producers, and Farm Bureau.

Cooperators:
SRWMD, DACS, DEP, IFAS, NRCS

[A14]**Strategy 3.6.4**:
Develop clear regulatory thresholds for animal production operations. Under this strategy, regulatory programs would be applied **only where** problems were encountered in producer implementation of BMPs, BMP management and performance, implementation schedules, or producer willingness to solve problems through adoption of BMPs. Regulatory agencies may apply programs under their jurisdiction if an operation has a discharge problem and chooses **not to participate** in BMP implementation or problem-solving.

Responsible Agency:
Responsibility for this strategy will be shared by DEP, DACS and SRWMD.

Cooperators:
IFAS, NRCS, Sunshine State Milk Producers, Farm Bureau

Schedule/Status:
AWTC set a schedule of 9/99, for a draft document, with final by 12/99.

Objective 3.7:
Conduct outreach activities to promote the adoption of BMPs by the producer community, and provide education regarding practices available.

[A15]**Strategy 3.7.1**:
Develop and implement programs to provide improved outreach and education to basin animal producers in proper animal waste management techniques, including programs associated with the cooperative extension service and soil and water conservation districts. This incorporates improved education programs in management of BMPs, and animal operator certification and third party certification initiatives.

Objective 3.8:
Conduct public awareness and education programs to inform the public, local government and concerned citizens regarding ongoing and planned activities to reduce nutrient impacts to the basin.

[A16]**Strategy 3.8.1**:
Coordinate ongoing local and regional efforts to organize public participation and consensus planning, to establish a citizen advisory forum, and to provide status reports and technical information to landowners, producers and the public.

[A17]**Strategy 3.8.2**:
Develop and outreach program which includes and basin technical web page with agency links for posting status reports, updates on technical information, and data. Prepare follow-up printed material in association with web page.

Responsible Agency:
Responsibility for this strategy will be shared by DACS and SRWMD.

Cooperators:
DEP, IFAS, NRCS, Sunshine State Milk Producers, Farm Bureau

Schedule/Status:
A web page for the SRB initiative has been established as of 3/99. Pathname is http://www.srwmd.state.fl.us/waterquality/srbnmwg.html

Middle Suwannee Basin Plan
Fertilizer Management Technical Working Group

BACKGROUND

Water Quality Data

Water quality data collected by the Suwannee River Water Management District (SRWMD) and the cooperating agencies indicate the need for public agencies, educators, researchers, the private sector and citizens to develop mutually acceptable solutions to the water quality impacts resulting from human activities in the basin. Nitrogen has been identified as the primary nutrient causing potential water quality impairment in the Middle Suwannee Basin. Surface water data indicate an increasing trend for nitrate-N concentration in Reach 3 (Dowling Park to Branford) of the Suwannee River. Mean nitrate nitrogen concentrations in ground water have increased between October 1985 and September 1997. Similar results have been noted in a number of the major springs which contribute flow to the Suwannee River as well as the with nitrate-N loading to the Suwannee River Estuary.

Sources of Nutrient Loadings to the Basin

Preliminary data indicate that the largest input of nitrogen in the basin is the application of inorganic fertilizers to cropping systems.

Nitrogen BMP Program

One management tool available to the technical working group is the Department of Agriculture and Consumer Services' Nitrogen BMP Program. The program consists of funding for research and outreach, and incentives for implementation consistent with the mission of the Suwannee River Basin Nutrient Management Working Group.

The enactment of recent legislation authorized the Department of Agriculture and Consumer Services (DACS) to promulgate rules to reduce the amount of nitrogen entering ground water as a result of the commercial application of fertilizers containing nitrogen. The implementation of this program involves the development of research-based best management practices (BMPs) that, when placed into practice, will prevent nitrate levels in ground water form exceeding nitrate ground water standards. Paramount to satisfying the intent of the law and to the success of this voluntary program is that BMPs must be economically and technically feasible. This requires collaboration between the Department, this working group, cooperating state agencies, the scientific community, and the grower community.

Goal 1: Evaluate and prioritize current and future threats to water quality in the Middle Suwannee Basin and downstream, particularly the river's estuary.

Objective 1.1:
Determine impact of existing fertilizer and irrigation practices on water quality.

[F1]**Strategy 1.1.1:**
Evaluate the water quality impacts of existing practices representative of the basin or currently published fertilizer recommendations for the primary cropping systems.

Schedule: Initiated in Spring of 1998 in large research plot; will be completed by year end 2000. Initiated in Spring of 1999 on commercial scale; will be completed by year end 1999.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: DEP, IFAS, SRWMD, NRCS, Private Land Owner

Goal 2: Reduce Impacts and Threats

Objective 2.1:
Determine the effectiveness of management options for water quality improvement/protection in the most vulnerable areas, assigning preference/priority to those options that are cost effective, technically feasible, and able to be undertaken by all involved parties. Assure that implementation actions are coordinated among all involved parties according to authorities, responsibilities, and capabilities.

[F2]**Strategy 2.1.1:**
Inventory status of existing crop nutrient/irrigation recommendations for primary cropping systems (either the recommendations represent the best information available or need to be updated).

Schedule: Initiated Spring 1998; will continue through year end 2001.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: DEP, SRWMD, IFAS, FAMU

[F3]**Strategy 2.1.2:**

Integrate best nutrient recommendations published by the Land Grant Universities with existing practices representative of the basin (as a result of Strategy 1 in Goal A) collaboratively with growers and interested parties as candidate practices for adoption as interim measures.

Schedule: Will be initiated in 1999 and will continue through 2002.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: DEP, SRWMD, NRCS, IFAS, FAMU, Ag. Industry, Environmental Interests

[F4]**Strategy 2.1.3:**

Adopt interim measure which formally avails grower community with best nutrient recommendations and waiver of liability.

Schedule: Initiated in 1999 for Hay and Vegetables; will be completed for primary cropping systems by year end 2003.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: All Signatories

[F5]**Strategy 2.1.4:**

Collaboratively identify modified practices and evaluate water quality impacts on a commercial scale. Successful practices become candidates for the development of Best Management Practices as defined in Chapter 576.045, F.S.

Schedule: Initiated in 1999 and will continue through 2005.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: DEP, SRWMD, NRCS, IFAS, FAMU

[F6]**Strategy 2.1.5:**

Adopt Best Management Practices which consist of the most practicable and economically feasible nutrient and irrigation recommendations consistent with the protection of water quality.

Schedule: Initiated in 2002 and will continue through 2005.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: All Signatories

Objective 2.2:
Achieve successful implementation of adopted interim measures and BMPs voluntarily by 80% of the acres of each commodity grown in the basin based on preceding three year averages.

[F7]**Strategy 2.2.1:**
Initiate and maintain dialog with grower community regarding the objectives of the fertilizer technical working group and the mechanics of the Nitrogen BMP Program through existing grower educational programs administered by the Cooperative Extension Service and cooperating agencies and grower associations.

Schedule: Initiate early 1999 and continue throughout the program.

Primary Responsibility: Nitrogen BMP Program DACS, IFAS

Cooperators: DEP, SRWMD, NRCS, IFAS, FAMU

[F8]**Strategy 2.2.2:**
Establish grower advisory group to solicit input regarding candidate activities for adoption as interim measures and BMPs.

Schedule: Initiate in 1999 and continue throughout program.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: NRCS, IFAS, FAMU, Private Partners

[F9]**Strategy 2.2.3:**
Establish a grass roots public workshop process during the formal adoption of interim measures and BMPs by rule.

Schedule: Initiate in 1999 and continue through 2005.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: All Signatories

[F10]**Strategy 2.2.4:**
Initiate an extensive educational and follow up process subsequent to the formal adoption of interim measures and BMPs to maximize grower awareness, understanding, and voluntary implementation.

Schedule: Initiate in 1999 and continue throughout program.

Primary Responsibility: Nitrogen BMP Program DACS

Cooperators: All Signatories

Objective 2.3:
Assess BMP effectiveness on improving water quality trends on farm and on a regional basis.

Schedule: Initiate framework for performance monitoring prior to implementation of interim measures or BMPs - as soon as possible.

Primary Responsibility: DEP

Cooperators: DACS, SRWMD, USGS

Objective 2.4:
Identify and implement additional meaningful incentives to encourage growers to voluntarily adopt interim measures and BMPs.

[F11]**Strategy 2.4.1:**
Meet one-on-one with growers to determine what types of assistance/support would be sufficient to maximize voluntary adoption of interim measures and BMPs.

Middle Suwannee Basin Plan
Human Waste Management Technical Working Group

GOAL 1:
Define existing water quality conditions and the physical factors influencing water quality and maintain an integrated monitoring network to track changes in conditions. (To be accomplished by the Monitoring Committee.)

GOAL 2:
Evaluate and prioritize current and future (20-year) threats to water quality associated with human wastes in the Middle Suwannee Basin (Suwannee and Lafayette Counties) and downstream, particularly the river's estuary.

Objective 1:
Quantify the amount of existing and future (20-year) nutrient contributions associated with human wastes including determining the treatment technologies currently occurring and currently required.

[H1]**Strategy 1:**
Prepare inventories of human waste nutrient sources including onsite sewage treatment and disposal systems (OSTDS), domestic wastewater facilities, nutrient generating industrial wastewater facilities, stormwater systems, and solid waste disposal facilities.

Responsible Agency: DOH is responsible for preparing an inventory of OSTDS and septage land application sites; DEP is responsible for preparing inventories for domestic wastewater facilities and residuals land application sites, nutrient generating industrial wastewater facilities, and solid waste disposal facilities; and the SRWMD is responsible for preparing an inventory of stormwater systems.

Resources: Existing staff.

Schedule: Initiated in Fall of 1998; will be completed in Summer of 1999.

Status: Inventories of OSTDS and septage land application sites are complete. See Appendix 1. Inventories of domestic wastewater facilities, residuals land application sites, and nutrient generating industrial wastewater facilities are complete. See Appendix 4. Inventory of solid waste disposal facilities is complete. See Appendix 7.

[H2]**Strategy 2:**
Determine treatment requirements for each human waste source based upon permits or best estimates of treatment performance.

Responsible Agency: DOH is responsible for determining treatment performance of OSTDS; DEP is responsible for determining treatment performance for each domestic and industrial wastewater facility and for each solid waste disposal facility; and the SRWMD is responsible for determining treatment performance of stormwater systems.

Resources: Existing staff.

Schedule: Initiated in Fall of 1998; will be completed in Summer of 1999.

Status: Treatment performances for OSTDS and septage management facilities have been estimated. See Appendices 2 and 3. Treatment performances for domestic and industrial wastewater facilities and residuals land applications sites have been determined. See Appendices 5 and 6. Treatment performance for solid waste disposal facilities has been estimated. See Appendix 7.

[H3]**Strategy 3:**

Quantify nutrient loads from human waste sources based upon the above findings, broken down by county or reach of the Suwannee River.

Responsible Agency: DOH is responsible for quantifying nutrient loads for OSTDS; DEP is responsible for quantifying nutrient loads for each domestic and industrial wastewater facility and for each solid waste disposal facility; and the SRWMD is responsible for quantifying nutrient loads associated with stormwater systems.

Resources: Existing staff.

Schedule: Initiated in Fall of 1998; will be completed in Summer of 1999.

Status: Nutrient loads have been quantified for OSTDS and septage management facilities. See Appendices 2 and 3. Nutrient loads have been quantified for domestic and industrial wastewater facilities and residuals land application sites. See Appendices 5 and 6. Nutrient loads have been quantified for solid waste disposal facilities. See Appendix 7.

[H4]**Strategy 4:**

Estimate future (20-year) increases of nutrients associated with human wastes from OSTDS, domestic wastewater facilities, nutrient generating industrial wastewater facilities, stormwater systems, and solid waste disposal facilities.

Responsible Agency: SRWMD will provide future (20-year) population projections based on local government comprehensive plans and identify the proposed wastewater management system for the growth. DOH will estimate the increased nutrient load from OSTDS and septage land application sites; DEP will estimate the increased nutrient load from domestic wastewater facilities and residuals land application sites, nutrient generating industrial wastewater facilities, and solid waste disposal facilities; and the SRWMD will estimate the increased nutrient load from stormwater systems.

Resources: Existing staff.

Schedule: To be completed in Summer of 1999.

Status: Future nutrient loads have been estimated for OSTDS and septage management facilities. See Appendices 2 and 3. Future nutrient loads have been estimated for domestic and industrial wastewater facilities and residuals land application sites. See Appendices 5 and 6. Future nutrient loads have been estimated for solid waste disposal facilities. See Appendix 7.

Objective 2:
Evaluate the adequacy of existing treatment technologies for human waste nutrient sources, and relative basin or subbasin nutrient loads.

[H5]**Strategy 1:**
Using information gathered from Goal 1, compare the location of existing human waste sources to sensitive areas including aquifer vulnerability, surface water classifications, and ground water quality.

Responsible Agency: DOH is responsible for comparing the location of OSTDS and septage land application sites to sensitive areas; DEP is responsible for comparing the location of domestic and industrial wastewater facilities, residuals land application sites, and solid waste disposal facilities to sensitive areas; and the SRWMD is responsible for comparing the location of stormwater systems to sensitive areas.

Resources: Existing staff.

Schedule: Six months following input from Goal 1.

Status: Pending completion of input from Goal 1.

[H6]**Strategy 2:**
Compare relative basin or subbasin nutrient loads from human waste sources to other sources (e.g. animal wastes and fertilizers).

Responsible Agency: DOH, DEP, and SRWMD.

Resources: Existing staff.

Schedule: Fall of 1999.

Status: Existing nitrogen sources are presented in pie-chart by SRWMD.

GOAL 3:
Reduce impacts and threats associated with human waste nutrient sources in the Middle Suwannee Basin.

Objective 1:
Determine the effectiveness of management options for human waste sources for water quality improvement and protection, assigning preference and priority to those options that are cost effective, technically feasible, and able to be undertaken by all involved parties. Assure that implementation actions are coordinated among all involved parties according to authorities, responsibilities, and capabilities.

[H7]**Strategy 1:**
Evaluate nutrient reduction technologies for current and future (20-year) human waste sources, considering achievable nutrient reduction and cost effectiveness.

Responsible Agency: DOH is responsible for evaluating nutrient reduction technologies for OSTDS; DEP is responsible for evaluating nutrient reduction technologies for domestic and industrial wastewater facilities and for solid waste disposal facilities; and the SRWMD is responsible for evaluating nutrient reduction technologies for stormwater systems.

Resources: Existing staff.

Schedule: Initiated in Fall of 1998; will be completed in Summer of 1999.

Status: Nutrient reduction technologies for OSTDS are identified in two reports by Ayers Associates, Technology Assessment of Onsite Wastewater Treatment Systems Prepared for the Monroe County Sanitary Wastewater Master Plan, June 1998, and Florida Keys Onsite Wastewater Nutrient Reduction Systems Demonstration Project, March 1998. Nutrient reduction technologies for domestic wastewater facilities are identified in a report prepared by CH2M Hill, Evaluation of Nitrogen and Phosphorus Removal Technologies for Small Wastewater Treatment Plants, July 1998. Nutrient reduction technologies are not feasible for solid waste disposal facilities.

[H8]**Strategy 2:**
Prioritize options, make recommendations as to responsible agencies, and identify funding sources to reduce current and future (20-year) nutrient loads from human waste sources based upon all of the above considerations.

Responsible Agency: DOH is responsible for making recommendations to the Human Waste Committee to reduce nutrient loads for OSTDSs; DEP is responsible for making recommendations to the Human Waste Committee to reduce nutrient loads for domestic and industrial wastewater facilities and for solid waste disposal facilities; and the SRWMD is responsible for making recommendations to the Human Waste Committee to reduce nutrient loads for stormwater systems. The Human Waste Committee will prioritize options and make final recommendations.

Resources: Existing staff.

Schedule: To be completed in Summer of 2000.

Status: Pending completion of Goal 2, Objective 2, Strategies 1 and 2; and Goal 3, Objective 1, Strategy 1.

[H9]**Strategy 3:**
Implement recommendations to reduce current and future (20-year) nutrient loads from human waste sources ensuring coordination among all involved parties.

Responsible Agency: Depends on recommendations proposed.

Resources: Depends on recommendations proposed.

Schedule: Depends on recommendations proposed.

Status: Pending completion of Goal 3, Objective 1, Strategy 2.

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Goals, Objectives, and Strategies
Middle Suwannee River Basin
Monitoring Technical Working Group

Background

The Florida Department of Environmental Protection and the Suwannee River Water Management District have been monitoring water quality of the Suwannee River Basin for over 25 years. Currently, at least 47 stations are being monitored on a regular basis. Over the years, the Surface Water Improvement Management, the Surface Water Ambient Monitoring and the Ground Water Quality Monitoring Programs have each documented elevated concentrations of nutrients in the water resources of the Middle Suwannee River Watershed (MSRW). As a response to these findings, the Middle Suwannee River Basin Nutrient Management Working Group (Working Group) was formed. The mission of the Working Group is "..to assess sources of nutrient loadings to the Suwannee River Basin and optimize reductions in loadings to the waters of the basin emphasizing voluntary, incentive-based programs for protecting the environment and public health." Members of the Working Group include federal, state, regional, and local government agencies, as well as universities and industry associations. One of the major objectives of the Working Group is to reduce nutrients in both the ground waters and surface waters of the watershed.

This document is the report from the Monitoring Subcommittee (MS) of the Working Group. The report provides goals, objectives and strategies that have been designed to quantify the progress of the Working Group in its efforts to reduce nutrient loadings to the water resources of the watershed. Monitoring strategies outlined in this report should allow the Working Group to quantify changes in nutrient loadings over time and to evaluate the resultant changes in environmental condition of the water resources in the watershed. It should be pointed out that the Working Group will need to obtain additional funding to support all of the monitoring projects proposed in this document.

Although there are a several nutrients of concern to the Working Group, the Working Group focused on nitrate-nitrogen (nitrate-N) because previous monitoring has demonstrated that the river and the downstream estuary are both nitrogen limited (as far as nutrients are concerned). It should be pointed out, however, that at some distance off the mouth of the Suwannee River, the estuary becomes phosphorus limited.

In the MSRW, the Floridan aquifer is unconfined and extremely susceptible to contamination. Recharge infiltrates rapidly through the permeable sandy soils and into the underlying karstic limestones of the aquifer. Nitrate and other contaminants in the recharge water are transported with the ground water via conduits to springs and by discrete flow to discharge points along the Suwannee

River. Once in the Suwannee River, the nitrate-N flows directly into the Suwannee River Estuary.

While nitrate-N is the main nutrient of concern and is the focus of much of the monitoring outlined in this report, the report also addresses monitoring of other parameters that represent the environmental response to nitrate loading (chlorophyll *a*, for example). While nitrate-N loading may have limited impact on the river itself because it is a dark water system and tends to limit plant growth, once the light limitation is relaxed, such as during low flow conditions or in the downstream estuary, significant plant growth (eutrophication) can occur if nutrients are readily available. The initial result is an increase in macroalgae, phytoplankton, fish biomass, and possible changes in species composition. Secondary effects may include reductions in submerged aquatic vegetation (including seagrasses) due to shading, hypoxia (low dissolved oxygen), nuisance algal blooms, and behavioral effects to the aquatic fauna.

It should be noted that there are other sources of nitrate-N to the downstream estuary and that it is not the intent of the monitoring described in this document to determine cause and effect relationships between individual sources of nitrate-N in the MSRW and downstream changes in the estuary. However, given the environmental significance and fragile nature of the downstream estuary, the Working Group thought it was very important to include estuarine monitoring in its effort to evaluate the effectiveness of its efforts to reduce nitrate-N loadings to the river and develop a better understanding of the nutrient and algal dynamics in the estuary.

Goals, Objectives and Strategies

Goal 1:
Determine the existing conditions and monitor the changes over time of nitrate-N concentrations, nitrate-N loading, and other pertinent indicators in the MSRW in: (a) ground water, (b) springs, (c) the Suwannee River and its relevant tributaries, and (d) the Suwannee River Estuary (SRE). Note, the monitoring of nitrogen input to the land surface is critically important. This effort will be conducted by other Working Group subcommittees.

Recently, a subcommittee member suggested we add a new objective under Goal 1. The proposed objective and strategy (**L1**) would quantify the potential nitrogen input in the MSRW from all major sources on an annual basis by both amounts and amounts pre unit area and monitor the changes over time. We would like the Steering Committee's input on who should be responsible for tracking nitrogen inputs into the system.

Objective GW1:
Determine the current ground water quality conditions, and aerial extent of elevated values, with respect to nitrate-N concentrations in the MSRW and monitor the changes in the conditions over time.

[M1]**Strategy GW1**:
Establish and monitor the changes in the overall conditions of nitrate-N concentrations in ground water. This will be accomplished by sampling a set of randomly selected wells from a list of existing wells in the MSRW twice per year (wet and dry seasons).

Primary Responsibility: SRWMD and DEP
Schedule Commence in July 2000. Evaluate data semi-annually and produce annual report.

Objective SP1:
Determine nutrient concentrations and loadings in a network of springs in the MSRW and monitor the changes in the conditions over time.

[M2]**Strategy SP1**:
Establish a network of springs and determine baseline conditions of nitrate-N concentrations and loadings in the springs and monitoring the changes over time.

Primary Responsibility: SRWMD and DEP
Schedule: Commence in October 1999. Evaluate data quarterly and produce annual report.

Objective SW1:
Determine the current water quality conditions and monitor the changes over time with respect to nitrate-N concentrations and loadings in a network of SRWMD surface water stations in the MSRW.

[M3]**Strategy SW1**:
Establish baseline conditions of nitrate-N concentrations in the selected river water stations by evaluating historical data from the SRWMD Monitoring stations and monitoring the changes over time.

Background: The SRWMD currently monitors several surface water stations along the Suwannee River. We propose to use, at a minimum, Ellaville (surface waters entering the MSRW, Branford (river water exiting the MSRW), Ft. White (river water from the major tributary at the bottom of the MSRW), and Fowler Bluff (river water entering the Suwannee River Estuary).

Primary Responsibility: SRWMD and DEP

Schedule: On going. Evaluate data quarterly and produce annual reports.

Objective SW2:
Establish baseline conditions of algal growth potential (AGP) in the selected river water stations by evaluating historical data from the SRWMD Monitoring stations and monitoring the changes over time.

[M4]**Strategy SW2**:
Background: We recommend monitoring for AGP because it will allow us to determine whether nutrients are bioavailable while the river is largely light limited. AGP can also be used to determine where along the river nutrients become a factor in limiting growth.

Primary Responsibility: SRWMD and DEP
Schedule: Commence in 2000. Evaluate data quarterly and produce annual reports.

Objective SRE1:
Determine the current water quality conditions and monitor the changes over time with regard to nutrients in the Suwannee River Estuary.

[M5]**Strategy SRE1**:
Select a network of stations and establish baseline conditions of key physical, chemical, and biological characteristics (for example, nutrients, chlorophyll *a*, transparency, algal assays, AGP, and metered parameters) in the SRE by evaluating historical data from the SRWMD stations, using newly acquired data, and monitor the changes over time.

Primary Responsibility: SRWMD and DEP
Schedule: On going Evaluate data semi-annually and produce annual reports.

Objective SRE2:
Seek assistance (funding) and determine the current water quality conditions and monitor the changes over time with regard to the aerial extent of seagrasses in the SRE.

[M6]**Strategy SRE2**:
Map aerial extent of seagrasses using low level aerial photography.

Primary Responsibility: SRWMD and DEP
Schedule: Commence in 2000. Seek financial assistance, and if successful, commence mapping and monitoring by 2001. Evaluate data, produce initial report; evaluate changes over time and document as necessary.

Objective SRE3:
Determine phytoplankton dynamics of the estuary.

[M7]**Strategy SRE3**:
Determine the algal standing crop and species composition and monitor changes over time in the SRE.

Primary Responsibility: SRWMD and DEP
Schedule: On going. Evaluate data semi-annually and produce annual reports.

Objective L1:
Determine potential nitrogen loadings in the MSRW and monitor changes over time.

[M8]**Strategy L1**:
Quantify the potential nitrogen loadings from all major sources on an annual basis by both: (1) amounts and (2) amounts per unit area and monitor the changes over time.

Goal 2:
Determine the percentage of private drinking water wells in the MSRW with nitrate-N concentrations in excess of the State of Florida Maximum Contaminant Level (MCL) for drinking water of 10 mg/L.

Objective 2a:
Investigate the relationship of the concentrations of nitrate-N and land uses in private drinking water wells in the MSRW.

[M9]**Strategy 2a1**:
Evaluate data generated from a survey of private drinking water wells in the MSRW.

*Background***:** During the summer of 1998, a joint SRWMD-DEP-DOH survey of private drinking water wells in the northwestern quadrant of Lafayette County revealed that wells located within 300 feet of animal husbandry operations are susceptible to elevated nitrate-N concentrations.

Primary Responsibility: DOH
Cooperators: DEP, SRWMD
Schedule: Survey complete. Document results by August 1999.

[M10]**Strategy 2a2**:
Seek assistance (funding), develop a sampling plan, and complete a survey of nitrate concentrations in private drinking water wells located near selected land uses in the remaining portions of the MSRW.

Primary Responsibility: DOH
Cooperators: DEP, SRWMD
Schedule: Complete survey design by October 1999, complete survey of entire MSRW by December 2000; and complete documentation of survey by June 2001.

[M11]**Strategy 2a3**:
Depending on the results of the private drinking water well survey, monitor the effectiveness of the best management strategies with respect to reducing nitrate-N concentrations in a subset of private wells located near selected land uses.

Background: It is standard procedure for DOH to notify well owners about any exceedances of MCLs and for DEP to provide remediation; typically a reverse osmosis, point of use system. However, this strategy will evaluate other remediation measures and their effectiveness. We also plan to notify the other committees of the Working Group of the results of this sampling so they can further evaluate the BMPs used.

Primary Responsibility: DOH
Cooperators: DEP, SRWMD
Schedule: Commence in July, 2001. Evaluate data semi-annually and produce annual report.

GOAL 3:
Determine the reduction of nitrate-N loading to ground water from the major sources of nitrogen in the MSRW, including, but not limited to, dairy, beef, poultry, silviculture, septic tanks, and row crops.

Objective 3a:
Measure the concentration of nitrate-N in ground water at representative Best Management Practice (BMP) research study sites in the MSRW and evaluate the effectiveness of (BMPs) at reducing nitrate-N loadings to ground water.

[M12]**Strategy 3a**:
Complete an IFAS study designed to measure nitrate-N concentrations at major agricultural operations (dairy operations, poultry farms, and row crop farms) and to evaluate the effectiveness of BMPs at selected agricultural operations.

Primary Responsibility: Nitrogen BMP Program, IFAS
Cooperators: DACS, DEP, IFAS, SRWMD, NRCS, USGS, and
Private Land Owners

Schedule: On schedule. Plan to produce quarterly progress reports and document the results of the IFAS study by December 2002.

Objective 3b:
Evaluate the relationship of the sources of nitrate-N concentrations in ground water and springs to land uses in the MSRW.

[M13]**Strategy 3b**:
Complete a USGS isotope analysis study designed to: (1) determine sources of nitrate-N in the ground water and springs, (2) relate sources of nitrate-N to land uses and ground water flow patterns and (3) evaluate the factors controlling the temporal variability and the sources of nitrate-N from various land uses.

Primary Responsibility: USGS
Cooperators: DEP, SRWMD
Schedule: On schedule. Plan to produce quarterly progress reports and document the results of the study by September 1999.

Miscellaneous
Note, an appendix to this document will be generated by the MC by Spring of 2000. The appendix will discuss the network design, including the specific analyte list, the stations to be monitored, and the frequency of sampling. The analyte list will include other nutrients (in addition to nitrate-N)that are to be monitored.

By the fall of 2000, a Data Analysis Protocol document will be developed by the MC that describes the procedures (including statistics) used to address the performance measures.

Goals and Objectives
Middle Suwannee Basin Plan
Outreach and Education Technical Working Group

GOAL:
Foster understanding and support among stakeholders and the general public that will enable SRBNMWG to accomplish its mission.

OBJECTIVE 1:
Establish and maintain channels of communication with appropriate publics and stakeholders.

[OE1]**STRATEGY 1:**
Periodically identify and target publics and stakeholders for education and outreach activities.

[OE2]**STRATEGY 2:**
Determine most effective channels of communication to reach those publics and stakeholders.

Data developed under Objective 2, Strategy 1, below, will be analyzed and most effective channels of communication will be determined. The Education and Outreach Committee plan will be revised to take this information into consideration.

OBJECTIVE 2: Increase favorable attitudes toward the SRBNMWG, its mission, and its work products.

[OE3]**STRATEGY 1:**
Assess and quantify current levels of understanding and support for SRBNMWG's mission among those publics and stakeholders

Employ focus groups to assess levels of awareness and concern among (1) producers and (2) residents. Focus groups will be interviewed in January. Written summaries will be developed from these focus groups and utilizing any other research that might be available. A search of literature will me made to determine if other, relevant data exists.

[OE4]**STRATEGY 2:**
Foster public recognition of farmers' positive contribution to improved water quality by executing the CARES Program.

[OE5]**STRATEGY 3:**
Coordinate outreach products and services with the other Technical Working Groups that will effectively communicate to publics and stakeholders

SRBNMWG's mission and the steps it is taking toward accomplishing that mission.

It is anticipated that the outreach products and services will include:

• Speakers Bureau. Carefully selected presenters who are actively promoted by a "booking agent" and supported with visual aids, training and presentation outlines that will assure consistency of message.

• Media Promotion, including news releases and an active media relations program.

• High-profile special events that recognize successful cooperators and engage the public in dialogue regarding the goals and objectives of the Working Group.

• Traveling display

• Public web site

• Reports produced by the Working Group members

[OE6]**STRATEGY 4:**
Establish clear identity for Working Group among publics and stakeholders.

Develop and test an effective name and logo, and promulgate use of the logo on all documents, communications and signage.

OBJECTIVE 3: Facilitate communication between and among Technical Working Groups and cooperators by acting as clearing house and coordinator for outreach activities of working groups and cooperators.

[OE7]**STRATEGY 1:**
Documentation: Collect all information on the project from all possible sources and organize that information into a library that is readily accessible to the education and outreach committee and all cooperators.

Assure all activities of committee are documented through photographs. Develop photo files for use on website, in presentations and media releases.

OBJECTIVE 4: Investigate feasibility of developing a marketing plan with the goal of product differentiation and value enhancement of the Middle Suwannee agricultural products.

[OE8]**STRATEGY 1**:
Investigate and promote product differentiation approaches that recognize the steps taken by basin producers to accomplish nutrient reductions.

[OE9]**STRATEGY 2:**

Investigate and promote beneficial use of excess nutrients and composted waste products from the basin—promote creation of a marketable product such as organic fertilizer from dairy and poultry waste.

Appendix A. Summary of Studies Concerning Nitrate Contamination in the Lower Suwannee River Basin

The problem of elevated nitrate concentrations in the Suwannee River Basin is not new; the problem has been investigated and documented in past studies and research efforts. The following is a brief description of major studies and their results.

Survey of Suwannee River, June - August 1965*, Florida* State Board of Health, Bureau of Sanitary Engineering, by J.R. Carver, Jr., and W. M. Beck, Jr., 1966.

This study summarizes the results of a background survey that was conducted on the Suwannee River during the months of June, July, and August, 1965. The survey was designed to determine background levels of various chemical constituents in the Suwannee River before the initiation of phosphate mining at Swift Creek. A total of 22 stations were sampled in the Suwannee River Basin, including stations on the Alapaha River, the Withlacoochee River, and the Santa Fe River. Several parameters were measured, including fluoride, chloride, nitrate, phosphate, and dissolved oxygen. Biological sampling was also carried out, and a summary was prepared of biological sampling results in the Suwannee Basin back to 1951.

Nitrate and Ammonia nitrogen concentrations were determined "as a check on possible sewage pollution." The authors found that the results were ambiguous, but in line with published results of samples taken from wells and springs in the area. In those samples collected in the Lower Suwannee Basin, nitrate concentrations are generally low, but show an increase in average concentration downstream from Dowling Park.

Location	Average Concentration NO3 mg/l as N
Dowling Park	0.069
Luraville	0.110
Branford	0.150
Suwannee River at Hwy. #340	0.210

An interesting finding by the authors concerned phosphate. Because phosphate mining was proposed, but had not yet begun, this was considered to be one of the most important items in the survey. To quote the authors:

> Phosphate concentration was in the range of 0.85 mg/l to 1.50 mg/l from the uppermost sampling station to the last station at Vista. This is an extremely high concentration of phosphate for a natural body of water. It

can only be explained by the knowledge that the acidic waters of the Suwannee River pass through areas of phosphate rock formation continuously dissolving rock as it flows.

Chemical Character of Florida's Waters 1951, Florida State Board of Conservation, Division of Water Survey and Research: Water Survey and Research Paper No. 6, by A.P. Black and Eugene Brown, 1951.

This rare document is a compendium of all known water quality analyses for public water supply wells and springs in the state of Florida up to 1950. The only spring with nitrate analyses in the Lower Suwannee Basin was Fanning Springs, with a nitrate concentration of 2.0 mg/l measured on 07/24/46. Elevated nitrate concentrations were measured in the City of Live Oak well #3 in 1907 (0.6 mg/l) and 1923 (2.4 mg/l). Although the information available for the Suwannee is limited in this document, it may be useful in other areas, especially central Florida. The document can be examined at the FSU library, or a circulating copy in poor condition can be obtained from the Jacksonville Public Library through interlibrary loan.

"Identification of Groundwater Geochemical Patterns in the Western Portion of the Suwannee River Water Management District, Florida," in *Studies of the Hydrogeology of the Southeastern United States: 1981,* Barry F. Beck, ed., Georgia Southwestern College, Americus, Georgia: Special Publication 1, by R.E. Copeland, 1981.

This report contains water quality material also found in an unpublished report on the Coastal River Basin in the Suwannee River Water Management District, written by R.E. Copeland and T.Q. Burnson in 1984.

The author analyzed the results of water quality sampling of the Floridan aquifer system in Taylor, Dixie, Lafayette, and southern Madison Counties. Statistical analysis revealed that 13 chemical parameters could be grouped into five water types with distinct areal distribution patterns. One of the water types had nitrate and potassium concentrations elevated above the mean value for the study area. This water type showed an areal distribution that fell within mapped areas of agricultural activity. Both nitrate and potassium are found in inorganic fertilizer.

Quality of Surface Water in the Suwannee River Basin, Florida, August 1968 Through December 1977. WRI 80-110. Hull, R.W., Dysart, J.E., and Mann IV, W.B., 1981.

This report summarizes the results of basin wide sampling conducted by the USGS from August, 1968 through December, 1977. Sampling stations were located on 9 streams and several springs. In their analysis of the sample results, the authors found:

- The water quality of tributary wetlands controls the water quality of the upper Suwannee River headwaters,
- Ground water substantially affects the water quality of the Suwannee River basin streams below these headwaters,
- The water quality of the Suwannee River is variable and not solely related to discharge, and
- Development in the Suwannee River basin has had observable effects on the quality of surface waters.

Samples were collected for most of the sampling stations twice a year, usually in May and November, to sample the high water and low water conditions of the river. Mean concentrations for each constituent were calculated at each station. For nitrate, it was found that mean concentrations increased downstream, with 0.01 mg/l at Benton, 0.03 mg/l at White Springs, 0.18 mg/l at Suwannee Springs, 0.16 mg/l at Ellaville, and 0.33 mg/l at Branford.

Statistical Summary of Nitrate, Total as N

Location	**No. Samples**	**Mean**	**Standard Deviation**	**Range**	**Median**
Benton	15	0.01	0.01	0.00-0.04	0.00
White Springs	39	0.03	0.06	0.00-0.27	0.00
Suwannee Springs	49	0.18	0.26	0.00-1.5	0.09
Ellaville	6	0.16	0.13	0.02-0.35	0.09
Branford	73	0.33	0.22	0.00-0.75	0.36
Wilcox	36	0.31	0.17	0.00-0.59	0.36

In their analysis of water quality in the Suwannee River from Ellaville to Branford, the authors made the following points:

- There is a continued high input of groundwater in this area.
- Analyses of water collected from springs in counties adjoining the Suwannee River in this reach have nitrate-nitrogen concentrations ranging from 0.42 mg/l to 2.90 mg/l. “These springs are likely to provide at least one source of nitrate to the river, but the load they provide depends on the river to aquifer head relation. Their input is more observable at lower (or falling) river stages.” (p. 88)
- “The nitrate found in the Floridan aquifer spring waters would likely come from agricultural area recharge since no natural source of nitrate exists within the basin.” (p. 89)

It should be noted that the data summarized in this report was collected from August, 1968 through December, 1977, prior to the Outstanding Florida Water Designation.

Springs of Florida, Florida Geological Survey Bulletin No. 31, Rosenau, Jack C., Faulkner, Glen L., Hendry, Charles W., Jr., and Robert W. Hull, 1977.

Water quality data for several springs in the Suwannee River Basin are available in Springs of Florida.

Spring	County	Sampling Date	Nitrate (NO3 as N)
Fletcher Spring	Lafayette	11/03/72	0.56
Owens Spring	Lafayette	09/10/73	0.50
Troy Springs	Lafayette	11/22/60	0.30
Troy Springs	Lafayette	10/16/73	0.95
Turtle Spring	Lafayette	11/03/72	0.42
Branford Spring	Suwannee	11/03/72	0.60
Charles Spring	Suwannee	11/19/73	13.0
Falmouth Spring	Suwannee	11/15/73	0.69

Although this is limited information, it does indicate that nitrate levels elevated above the median level of 0.05 mg/l for nitrates in the Floridan aquifer system in SRWMD (Maddox, et. al., 1992) were detected in at least one spring in the Suwannee River Basin in the early 1960's, and were found in several area springs by the 1970's..

Quality of Storm Runoff to Drainage Wells in Live Oak, Florida, April 4, 1979. USGS Open File Report, 79-1073. Hull, Robert W. and Michael C. Yurewicz (1979)

For several decades, drainage wells were used in the Live Oak area to dispose of stormwater runoff and wastewater. In Live Oak, drainage wells which disposed of runoff from sanitary sewers were implicated in the contamination of the city wells by coliform bacteria in the 1940's.

The authors examined the water quality of stormwater draining into drainage wells in the Live Oak area during a storm event in 1979. They found that several of the stormwater runoff samples had values which equaled or exceeded the primary drinking water standards for lead, turbidity, and total coliform bacteria. A maximum value of 3.8 mg/l of dissolved nitrate nitrogen was found in one of the runoff samples. Mean sample concentrations were less than 1.0 mg/l.

Nitrate in Ground Water and Spring Water near Four Dairy Farms in North Florida, 1990-93, US Geological Survey, Water Resources Investigation 94-4162 by W. J. Andrews, 1994

The following is from the abstract of this report. I have been unable to obtain a full copy yet.

This study examined the quality of groundwater at four dairy farms along the Suwannee River in Lafayette and Suwannee Counties. A total of 51 monitoring wells were installed to varying depths. Water from these wells, along with water discharging from three nearby springs, was collected and analyzed for nitrate and other selected water quality characteristics periodically for two years. Shallow wells tapped the upper ten feet of the uppermost aquifer; deep wells were screened 20 feet deeper than the shallow wells. Shallow wells were either completed in a sandy surficial aquifer or in the karstic Floridan aquifer system. They were located near waste-disposal areas such as wastewater lagoons and defoliated, intensive use areas near milking barns. Blue Springs, Telford Springs and Convict Springs were the sampled springs.

- Ground water from shallow wells generally had the highest concentrations of nitrate, ranging from <0.2 mg/l to 130 mg/l. Nitrate concentrations commonly exceeded 10 mg/l, the Primary Drinking Water Standard.
- Upgradient from waste areas, nitrate concentrations were commonly less than 1.0 mg/l.
- Samples from deep wells generally had lower concentrations of nitrate than shallow wells, ranging from <0.2 mg/l to 84 mg/l.
- Water samples from the three monitored springs had nitrate concentrations ranging from 1.5 to 6.5 mg/l, which were higher than those in the sampled upgradient wells or in regional background wells.
- Nitrogen isotope analyses indicated that leachate from animal waste was the principal form of nitrate in groundwater adjacent to disposal areas on the monitored farms.
- Nitrogen isotope analyses also indicated that leachate from a combination of fertilizers, soils and animal waste appeared to be the source of nitrate in groundwater downgradient from pastures and wastewater spray fields and in the three springs that were sampled.
- Although denitrifying bacteria were present in counts sometimes exceeding 240,000 colonies/100 ml in water from dairy farm monitoring wells, groundwater in the uppermost aquifers in Suwannee and Lafayette Counties generally contain too much oxygen for denitrification to remove nitrate from shallow groundwater.

Limnology of the Suwannee River, Florida, Department of Environmental Regulation, Biology Section, Division of Environmental Programs, March 1985

This report summarizes the results of a two year investigation of the Suwannee River during 1982 and 1983. Eleven stations along the river were sampled monthly for a wide array of parameters. An additional 23 stations were established for additional chemical monitoring. The goals of the investigation

were to determine existing river conditions and to quantify effects of major dischargers to the river.

The report contains much information about water chemistry and biological community health, as well as background information about the river system. The following summarizes the report's findings on nitrate concentrations in the Suwannee River.

- Nitrite + Nitrate Nitrogen values in the river ranged from 0.17 mg/l to 0.990 mg/l.
- Concentrations increased downstream.
- Potential sources listed were application of inorganic fertilizers, surface runoff and waste products from sewage treatment plants, and industrial sources.

An Investigation of the Geology, Hydrogeology, and Hydrochemistry of the Lower Suwannee River Basin. RI 96. Crane, James J. (1986)

As a part of his investigation, Crane analyzed groundwater quality in the Lower Suwannee Basin. He used water quality data for all wells located within the basin that had been sampled by SRWMD staff between Fall, 1975 and April, 1981. He found that nitrate values were generally low, but ranged from 0 to 26.8 mg/l.

Suwannee River System SWIM Plan (1991)

High nitrate values in selected springs along the middle Suwannee are cited as an example of possible contamination of the river by contaminated groundwater. The SWIM Plan lists a more thorough understanding of the interaction of groundwater and surface water within the Suwannee Basin as a priority issue. A water quality monitoring network was initiated in the Suwannee River and its tributaries in 1989. Water quality samples are collected monthly at 33 locations and analyzed for physical characteristics, major ions, and nutrients. Biological monitoring is conducted quarterly at 10 stations along the river.

Reconnaissance of Water Quality at Nine Dairy Farms in North Florida, 1990-91, U.S. Geological Survey, Water Resources Investigations Report 92-4058 by William J. Andrews, 1992

Water quality on dairy farms in north Florida (mainly in Lafayette and Suwannee Counties) was examined by sampling water from wastewater lagoons, monitoring wells, and supply wells on nine dairy farms quarterly for one year. The authors found that monitoring wells that tap the surficial aquifer system showed the worst water quality, with a median concentration of dissolved nitrite plus nitrate nitrogen of 29 mg/l. Median nitrate concentration in monitoring wells in the unconfined Floridan aquifer system was 9.6 mg/l. The authors also found that the particular

type of activity that occurred on the land adjacent to the monitoring wells also affected nitrate concentrations, with more intensive uses creating higher nitrate concentrations. Intensive areas with more cattle and wastewater sprayfields were associated with higher nitrate levels in monitoring wells; pastures and wastewater lagoons were associated with lower levels of nitrate.

Florida's Ground Water Quality Monitoring Program Background Hydrochemistry, Florida Geological Survey Special Publication 34, by Gary L. Maddox, Jacqueline M. Lloyd, Thomas M. Scott, Sam B. Upchurch and Rick Copeland, 1992.

Statewide data from the Ambient Groundwater Quality monitoring network were examined in this report. Nitrate distribution was characterized by aquifer and by water management district. In the Suwannee River Water Management District, median nitrate concentration in the Floridan aquifer system was below the detection limit of 0.05 mg/l. Nitrate concentrations from individual wells ranged form less than 0.01 mg/l to 7.10 mg/l.

Statewide, elevated nitrate concentrations were found in areas with high recharge potential and were often found in areas with agricultural land uses.

Nitrate in Ground Water and Spring Water near Four Dairy Farms in North Florida, 1990-93, US Geological Survey Water Resources Investigation 94-4162 by W. J. Andrews, 1994.

The Following is the abstract for this publication. I have been unable to obtain the complete report.

Concentrations of nitrate and other selected water-quality characteristics were analyzed periodically for two years in water from 51 monitoring wells installed at four farms and in water discharging from three nearby springs along the Suwannee River in Lafayette and Suwannee Counties to examine the quality of groudwater at these farms ad the transport of nutrients in groundwater to the nearby spring-fed Suwannee River.

Effects of Waste-Disposal Practices on Ground-Water Quality at Five Poultry (Broiler) Farms in North-Central Florida, 1992-93, US Geological Survey Water Resources Investigations Report 95-404 by Hilda H. Hatzell, 1995.

This project was designed to determine if increases in concentrations of nitrate and other chemical constituents were occurring in groundwater at poultry operations in north Florida and to relate these increases to specific waste disposal practices. Four broiler farms in Suwannee County and one broiler farm

in Lafayette County were chosen as monitoring sites. The results indicated that increases in concentrations of nitrate and other constituents did occur in the vicinity of broiler farms. Increases in median concentrations relative to an upgradient well of 5.4 mg/l and 9.0 mg/l occurred at two different chicken houses, an increase of 2.0 mg/l for a fallow field that received applications of used chicken litter and a 2.0 mg/l increase from a dead chicken pit. Median nitrate values in the vicinity of waste disposal areas at one site was 45.5 mg/l for a set of two chicken houses.

Analysis of Nutrients in the Surface Waters of the Georgia-Florida Coastal Plain Study Unit, 1970-91, US Geological Survey Water Resources Investigations Report 96-4037, by Lisa K. Ham and Hilda H. Hatzell, 1996.

Existing information on nutrients was compiled and evaluated for a large area of the Florida-Georgia coastal plain. The authors found that nutrient concentrations were low in the Suwannee River Basin, but that phosphorous levels at most sites within the basin exceeded the USEPA guideline of 0.1 mg/l to discourage excessive growth of aquatic plants in flowing waters. They also examined long term trends in the data and found that nitrate concentrations in the Suwannee River near Branford increased at a rate of 0.02 mg/l per year between 1970 and 1991 with a median nitrate value for the period of 0.5 mg/l .

Surfacewater Quality and Biological Monitoring Network Annual Report 1996, Suwannee River Water Management District, WR-97-03, by David Hornsby and Rob Mattson, 1996.

An ambient surface water quality monitoring network was established by SRWMD in 1989 and is sampled regularly. This report summarizes the results of the sampling for water years 1995 and 1996.

- Water quality was rated good for most monitored water bodies. Reaches 3, 4, 5, and 6 of the Suwannee River were rated as fair.
- Data identifies the Middle Suwannee River, Reach 3, as being affected by nitrate-nitrogen enrichment. Lower reaches of the Suwannee and reach 2 of the Santa Fe River, a Suwannee tributary, also show nitrate-nitrogen enrichment.
- During high flow conditions in April, 1996, nitrate-nitrogen concentrations in the Suwannee River ranged from below detection limit (<0.01 mg/l) to 0.14 mg/l. During low flow conditions in July, 1996, nitrate nitrogen concentrations ranged from 0.04 to 0.99 mg/l. Highest concentration was observed at Branford.
- Nitrate concentrations in July, 1996 doubled between Luraville and Branford. This is a stretch of the river with no surface water inflow, but large amounts of groundwater inflow. The authors state that the most likely source of the increased nitrate in this part of the Suwannee is groundwater.

- Periphyton biomass has shown an increase in Reaches 3 and 4. According to the authors, this corresponds to the increased concentration of nutrients indicated by the chemistry data. A biological response to the increased nitrate-nitrogen concentrations appears to be occurring, indicating an ecological effect.

Spring Load Contributions to Water Quantity and Nitrate Loads in the Suwannee River during Base Flow in July 1995, US Geological Survey Water Resources Investigations Report 97-4152, by John R. Pittman, Hilda H. Hatzell and Edward T. Oaksford, 1997.

This study was conducted during a low flow phase to determine how springs and other groundwater inflows affect the quality and quantity of water in the Suwannee River. A 33 mile stretch of the river, from near Dowling Park downstream to Branford was selected because all inflow is derived from groundwater. Water samples and discharge data were collected at 11 springs and 3 river sites during a three day period in July, 1995. The authors found that:

- Groundwater inflow increased the river discharge by 47 percent over the 33 mile reach.
- The 11 measured springs contributed 41 percent of the increased discharge; other groundwater flow contributed the remaining 59 percent.
- River nitrate loads increased downstream from 2,300 to 6,000 kilograms per day, an increase of 160 percent.
- Most of the increase in nitrate load occurred in the lower two thirds of the studied reach. Only 11 percent of the increase of nitrate load for the study reach occurred in the first 11 miles; the remaining 89 percent occurred in the remaining 22 miles.
- Measured springs were the major source of nitrate load in the upper part of the reach and other groundwater inflow was the major source in the lower part of the reach.
- Differences in nitrate loads between the upper and lower river segments are probably controlled by factors such as type of land use, magnitude of spring discharge, size and location of spring basins, and differences in hydrologic characteristics of the individual spring basins.
- Nitrate concentrations in measured springs ranged from 1.3 to 8.2 mg/l.

"Interactions Between Ground Water and Surface Water in the Suwannee River Basin, Florida," Journal of the American Water Resources Association, Volume 33, Number 6, December, 1997 by Brian G. Katz, Rodney S. DeHan, Joshua J. Hirten, and John S. Catches, 1997.

The objective of this study was to "evaluate hydrologic and water quality data for the Suwannee River Basin in Florida to better understand the interactions between ground water and surface water within the context of watershed management concerns." The report addresses interaction between surface

water and groundwater in the basin, the extent to which surface water basins and groundwater basins coincide during different hydrologic conditions, and the ability of natural processes to attenuate nitrate concentrations in the groundwater.

Interaction between groundwater and surface water in the basin was demonstrated using water chemistry of river water and groundwater. Areal boundaries for surface water and groundwater subbasins were examined during dry, low flow and during wet, high flow conditions. It was found that generally, ground water basins do not coincide with surface water drainage basins. A decrease in nitrate concentrations measured in wells in the Lafayette County VISA area in 1991, as opposed to higher levels measured in 1990 and 1994, was attributed to natural denitrification processes within the aquifer during the high water levels that occurred in 1991. Slower rates of groundwater movement, increased amounts of organic carbon from river water in the aquifer, and lower dissolved oxygen levels in the groundwater combined to produce a favorable environment for denitrification.

A Preliminary Assessment of Sources of Nitrate in Springwaters, Suwannee River Basin, Florida, US Geological Survey Open-File Report 98-69, by Brian G. Katz and H. David Hornsby, 1998.

This study evaluated sources of nitrate in water from selected springs and zones in the upper Floridan aquifer in the Suwannee River Basin. Samples were collected from six springs and two wells and analyzed for major ions, nutrients, dissolved organic carbon, environmental isotopes of oxygen, hydrogen, carbon and nitrogen, chlorofluorocarbons (CFCs) and tritium.

Results of nitrogen isotope analysis indicates that nitrate in five of the sampled springs most likely originates from a mixture of inorganic fertilizer and animal waste sources, with the nitrate at Lafayette Blue Springs mostly derived from animal waste. Analysis of samples from both wells, which are located near dairy and poultry farms, indicates an organic source for the nitrate found in the wells. Analysis of CFC results shows a mean residence time for water in springs from about 12 to 25 years. CFC-modeled recharge dates for the water in sampled wells range from 1985 to 1989.

The next phase of this study will involve collection and analysis of water from approximately 20 sites, including springs, wells, rainfall, and the Suwannee and Santa Fe Rivers.

Recharge Rates to the Upper Floridan Aquifer in the Suwannee River Water Management District, US Geological Survey, Water Resources Investigations Report 97-4283, by J.W. Grubbs, 1998.

Four different methods were used to estimate long-term, average-annual recharge rates to the upper Floridan aquifer. The authors found that recharge was controlled by the degree of confinement of the aquifer. Where the Upper Floridan aquifer is confined by low permeability sediments (in the Northern Highlands physiographic province in the northern portion of the Suwannee River Basin), recharge is less than 12 inches per year. In unconfined areas, such as the lower Suwannee Basin, results indicate that recharge is probably within a range of 16 to 31 inches per year.

Groundwater Quality Report, 1997, Suwannee River Water Management District WR-98-02, by Ron Ceryak and David Hornsby, 1998.

This report summarizes the results of the most recently completed sampling and analysis conducted at SRWMD's groundwater quality monitoring network. This network consists of 235 background network wells, and 85 municipal wells. An additional 36 wells and 7 springs are used to assess the effects of land use on groundwater quality in two Very Intense Study Areas (VISA).

Page 16 of the report summarizes results of analyses for nitrate nitrogen. The authors make the following points:

- Mean nitrate nitrogen concentrations above background concentration (0.05 mg/l) exist in all or part of every county in the District for the period of record
  The areas with consistently elevated nitrate nitrogen concentrations are in Suwannee and Lafayette Counties.
- The District has the largest area of elevated nitrate nitrogen concentrations in the state.
  Elevated nitrate nitrogen levels in the groundwater are affecting nitrate nitrogen concentrations in the Suwannee River under low flow conditions when the river receives a large percentage of groundwater flow through springs and seeps.
- Increased concentrations of nitrate in the Floridan aquifer system are caused by human activities. Possible sources of nitrate include fertilizers, animal waste, and septic tanks.
  Generally, as groundwater levels increase, nitrate nitrogen concentrations decrease because of mixing with rainwater and surface water.
- Sixteen samples exceeded the Primary Drinking Water Standard of 10 mg/l for nitrate nitrogen. The average concentration for the wells that exceeded the standard is 18.4 mg/l.

Surfacewater Quality and Biological Monitoring Network Annual Report, 1997, Suwannee River Water Management District, WR-98-03, by David Hornsby and Rob Mattson, 1998.

An ambient surface water quality monitoring network was established by SRWMD in 1989 and is sampled regularly. This report summarizes the results of the sampling for water years 1996 and 1997.

- Water quality was rated as good for most monitored water bodies; 11 water bodies and 39 springs were rated as fair and 1 water body and 21 springs were rated as poor.
- Reaches 3, 4, 5, and 6 of the Suwannee River are affected by increasing nitrogen nitrate concentrations. Reach 2 of the Santa Fe River shows similar increases in nitrate nitrogen.
- The Middle Suwannee River Basin accounts for 30% of the annual nitrate-nitrogen load transported to the Suwannee River estuary, but its area only comprises 8.9 % of the total basin area. The Santa Fe River Basin accounts for 20% of the nitrate-nitrogen delivered to the Suwannee estuary, while accounting for 13.9% of the total area in the Suwannee River Basin.
- For water year 1997, 5461 tons of nitrate-nitrogen was transported to the Suwannee River estuary.
- Nitrogen sources include the atmosphere, fertilizer, animal waste, and human waste. Suwannee (28,992,636 pounds of N per year), Lafayette (13,819,763 pounds of N per year), and Gilchrist (12,780,083 pounds of N per year) are the counties with the highest estimated gross nitrogen inputs. These counties are wholly or partially in the basins of the Suwannee and Santa Fe Rivers where nitrogen loading to the Suwannee River is highest.
- Data continues to indicate an increase in periphyton biomass in Reaches 3 and 4 of the Suwannee River. This is interpreted as the biological response to increased nitrate-nitrogen levels in these portions of the Suwannee River.

Agricultural Land Use and Groundwater Quality in the Lafayette County, Florida Very Intense Study Area (VISA) *in* Ambient Newsletter, Volume Two, Number One, by Gary Maddox, Cindy Cosper and Penn Craig, January, 1998.

The VISA monitoring network was established in the late 1980's to quantify the effects of various land uses on regional groundwater quality. The Lafayette County VISA comprises a 28 mile square area adjacent to the Suwannee River with intensive agricultural use. The Florida aquifer system is at or near the land surface and highly vulnerable to contamination. Nineteen wells and seven springs were sampled for a variety of major ions, metals, pesticides and herbicides. Wells were sampled in April 1990, March 1991, June 1994, and

June 1997. Results of analyses were compared to data from wells in the background network in the same area.

No pesticides or herbicides were detected. Nitrate-nitrogen concentrations were found to be significantly greater in the VISA wells and springs than in the Background wells. The authors attributed the elevated nitrate levels in the vicinity of the VISA network to different land use activities and/or intensity coupled with the highly vulnerable nature of the Floridan aquifer system in this area.

Sources and Chronology of Nitrate Contamination in Spring Waters, Suwannee River Basin, Florida, US Geological Survey, Water Resources Investigations Report 99-4252, Brian G. Katz, H. David Hornsby, Johnkarl F. Bohlke, and Michael F. Mokray, 1999

This study was conducted to better understand sources and chronology of nitrate contamination in spring waters discharging to the Suwannee and Santa Fe rivers. Water samples were collected and analyzed from 24 springs and two wells for major ions, nutrients, dissolved organic carbon, and selected environmental isotopes (to indicate the relative age of the waters).

Historic land use trends were used to estimate nitrogen inputs from nonpoint sources within the basin. The heavy use of fertilizers in the basin is corroborated by nitrogen isotope data; fertilizer use peaked in the 1970's for most of the counties studied. Fertilizer sales data indicate that fertilizer use increased substantially in Lafayette and Suwannee counties during 1993 – 1997.

Isotope analyses indicated that the waters issuing from the springs is a mixture of older water from deeper in the Floridan aquifer system and younger water from the upper aquifer. Generally, the larger springs discharge older water from deeper in the aquifer while the smaller springs discharge water of more recent origin from the uppermost parts of the aquifer. The mixture of older and younger waters, with varying concentrations of organic and inorganic nitrate, issuing from the springs makes it difficult to pinpoint the origin of source loads.

Modeling results indicate that water containing high nitrate concentrations (dominated by fertilizer N inputs) is recharging the groundwater system on a time scale of less than 10 years, even though the overall average residence time of ground water discharging to springs can be on the order of 20 to 40 years. The report concludes with the statement that even if nitrogen inputs were reduced substantially, it may take decades for nitrate concentrations in the groundwater system to return to concentrations near background levels.