ELEMENTS OF FLORIDA'S WATER MONITORING AND ASSESSMENT PROGRAM

Florida Department of Environmental Protection

Division of Environmental Assessment and Restoration
Bureau of Assessment and Restoration Support
Tallahassee, Florida

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Executive Summary

The Florida Department of Environmental Protection (FDEP) is committed to protecting and restoring Florida's waters, and providing sound, scientific water quality monitoring information. Water resources cannot be managed without comprehensive water quality monitoring and assessment. The goal of FDEP's monitoring activities is to determine the overall quality of the state's surface waters and ground waters, how they are changing over time, and the effectiveness of protection programs.

This document articulates the overall goals, objectives, strategy, and design of FDEP's Integrated Water Resources Monitoring (IWRM) Program to meet federal Clean Water Act (CWA) requirements and Florida's statutory and regulatory requirements. Under the CWA, states are required to determine whether waters meet water quality standards (i.e., attain their designated uses, or functional classifications); identify impaired waters; identify the causes and sources of water quality impairments; support the implementation of water management programs; establish, review, and revise water quality standards; establish special monitoring for unique resources; and support the evaluation of program effectiveness. Under Florida's statutes and rules, FDEP is also required to carry out various types of monitoring, including ground water monitoring, and to coordinate monitoring activities statewide.

Chapter 1 of this report provides background information, describes Florida's monitoring goals, and describes the watershed management approach that has been implemented for protecting and restoring water resources. Chapter 2 discusses Florida's monitoring objectives. Chapter 3 describes FDEP's IWRM water monitoring strategy to achieve these objectives.

The IWRM strategy has three tiers, ranging from the general to the specific, as follows:

Tier I addresses statewide and regional (within Florida) questions It consists of a probabilistic monitoring network (the Status Network) and a fixed station network (the Trend Network), which are used to develop statistical estimates of statewide surface and ground water quality and examine changes in water quality over time throughout the state.

Tier II addresses basin-specific and stream-specific questions. Example Tier II monitoring efforts include the strategic monitoring for the Total Maximum Daily Load (TMDL) Program, which addresses impaired waters in individual basins and stream segments in order to develop and implement TMDLs, and the Springs Initiative, which focuses on freshwater springs across the state.

Tier III addresses site-specific questions. It includes intensive surveys for TMDLs, monitoring to establish or revise water quality standards, monitoring to evaluate site-specific alternative criteria (SSACs), and fifth-year inspections for wastewater facilities under the National Pollutant Discharge Elimination System (NPDES) Program.

The IWRM strategy covers the core monitoring programs in FDEP's Division of Environmental Assessment and Restoration (DEAR). The strategy addresses the 10 elements described in the U.S. Environmental Protection Agency's (EPA) guidance document, *Elements of a State Water Monitoring and Assessment Program* (Office of Wetlands, Oceans and Watersheds, March 2003, EPA 841-B-03-003, available at http://www.epa.gov/owow/monitoring/elements/). These elements are as follows: monitoring objectives, monitoring program strategy, monitoring design, indicators, quality assurance, data management, data analysis and assessment, reporting, programmatic evaluation, and general support and infrastructure planning.

Monitoring objectives and strategy are discussed in Chapters 2 and 3, respectively. Chapters 4 through 11 discuss FDEP's individual monitoring networks under the IWRM strategy. For each network, EPA Elements 3 through 9 are addressed (i.e., monitoring design, indicators, quality assurance, data management, data analysis and assessment, reporting, and programmatic evaluation). This approach leads to some repetition throughout the report, since the descriptions of elements such as quality assurance are repeated in different chapters. However, it also allows the reader to review each monitoring network independently.

Section 12 of the report discusses general support and infrastructure planning (EPA Element 10) for all of FDEP's core programs. Chapter 13 addresses monitoring program evaluation and planning steps needed to support and expand on the success of monitoring programs in Florida.

This document has been prepared to meet requirements specified under CWA Section 106.

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SECTION A: BACKGROUND

Chapter 1: Introduction

Background

Both the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP) recognize that water resources cannot be managed without monitoring. At the federal level, Section 305(b) of the Clean Water Act (CWA) (Federal Water Pollution Control Act, 33 U.S. Code 1251–1375, as amended) directs each state to (1) prepare and submit a report every two years that includes a description of water quality of all of its navigable surface waters to the EPA, and (2) protect balanced indigenous populations. Furthermore, Section 106 (e)(1) of the CWA directs the EPA to determine whether states meet the prerequisites for monitoring their aquatic resources.

This report articulates the goals, objectives, strategy, and design of FDEP's Integrated Water Resources Monitoring (IWRM) Program as it pertains to (1) meeting CWA requirements, (2) meeting Florida's statutory and regulatory requirements, and (3) fulfilling Florida's commitment to protect and restore water resources by providing sound, scientific water quality monitoring. Florida addresses the federal CWA responsibilities through programs implemented by FDEP, including the establishment of total maximum daily loads (TMDLs) for impaired Florida waters and the production of the biennial 305(b) Integrated report on water quality, as directed in the 2008 EPA guidance document, *Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions*, available at: http://www.epa.gov/owow/tmdl/2008_ir_memorandum.html. A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet the waterbody's designated uses (such as recreation or drinking water use).

Monitoring is also required under Florida law through a series of rules that govern FDEP's regulatory activities. The 1997 Water Quality Assurance Act (Section 403.063, Florida Statutes [F.S.]) directs FDEP to establish and maintain a ground water quality monitoring network designed to detect or predict contamination of the state's ground water resources. In addition, Section 62-40.540, Florida Administrative Code (F.A.C.), Florida's Water Policy, states that FDEP ". . . shall coordinate district, state agency, and local government water quality monitoring activities in order to improve data quality and reduce costs."

Monitoring Goals

The goal of FDEP's monitoring activities is to answer the following questions, in order to meet federal and state requirements:

1. *What is the overall quality of waters in the state?*
2. *To what extent is water quality changing over time?*
3. *What are the problem areas, and which areas need protection?*

4. *What level of protection is needed?*
5. *How effective are clean water projects and programs?*

Chapter 2 discusses FDEP's water quality monitoring objectives as they relate to these specific goals.

Monitoring Activities

Starting in 1996, FDEP initiated a redesign of its water resource monitoring activities to create a more efficient, multi-resource, comprehensive monitoring network, in order to fulfill many of its monitoring goals. FDEP's comprehensive water resource monitoring strategy is implemented through the Division of Environmental Assessment and Restoration (DEAR), which is responsible for a variety of programs designed to assess and restore Florida's surface water and ground water resources. Working in watershed-based partnerships across the state, FDEP's Bureau of Assessment and Restoration Support (BARS) and the Bureau of Watershed Restoration coordinate many of these water activities, including tiered monitoring programs, to develop watershed-based aquatic resource goals and pollutant loading limits. Equally important, the bureaus develop and implement management actions to protect and restore water resources.

The Watershed Management Approach

Watershed management is a comprehensive approach to managing water resources on the basis of hydrologic units—which are natural boundaries such as river basins—rather than arbitrary political or regulatory boundaries. Florida's watershed management approach, which was initiated in 2000, provides a mechanism to focus resources on specific units (i.e., river or estuary basins), rather than trying to work on all state waters at one time. An important feature contributing to the success of watershed monitoring is the involvement of all the stakeholders who have an interest in an individual basin, in a cooperative effort to define, prioritize, and resolve water quality problems. Existing programs are coordinated to manage basin resources without duplicated effort.

The principal features of Florida's watershed management approach are as follows:

*The **basin management unit,** or geographic or spatial unit, is used to divide the state into smaller areas for assessment—generally groups of hydrologic unit codes (HUCs). HUCs are a nationwide cataloging system commonly used for watershed assessment and management. They provide a common framework for delineating watersheds and their boundaries at different geographic scales.*

*A five-year **watershed management cycle** provides a set schedule that organizes work activities and helps to ensure that all waters are addressed in a timely manner. At the conclusion of the cycle, the process begins anew, allowing TMDL basin managers and stakeholders to respond to changing conditions or adjust strategies that have not performed as anticipated.*

*A statewide **schedule and monitoring plan** ensures that each of the state's basins is assessed annually.*

*A **Basin Management Action Plan,** or BMAP, developed for each TMDL basin in cooperation with stakeholders and local communities, coordinates and guides management actions. Other plans that provide reasonable assurance that water quality goals will be met may also be used. The BMAP specifies how pollutant loadings from point and nonpoint sources of pollution will be allocated and reduced to meet TMDL requirements.*

***Forums and communication networks** help participants collect information, fill data gaps, and reach a consensus on solutions to the basin's problems.*

To implement the watershed management approach, Florida's 52 basins (51 HUCs plus the Florida Keys) have been divided into 29 groupings. These have been further subdivided into 5 groups within each of FDEP's 6 districts statewide. There are 5 basins each in the Northwest, Northeast, Southwest, South, and Southeast Districts, and 4 basins in the Central District. One basin in each district is assessed each year. The order and specific time frame for evaluating each basin in each district was initially established based on a number of priority factors, including watersheds that contained surface water sources of drinking water, watersheds requiring TMDL development, and watersheds where existing Surface Water Improvement and Management (SWIM) plans were under way.

The Bureau of Assessment and Restoration Support (BARS) coordinates the Tier 1 Status and Trend statewide monitoring programs from FDEP headquarters in Tallahassee. Field personnel are located in Tallahassee and FDEP regional offices, and at Water Management Districts (WMDs). Similarly, the Bureau of Watershed Restoration TMDL Program is headquartered in Tallahassee, with monitoring activities supported principally at the FDEP district level. Watershed assessment technical personnel from Tallahassee participate in investigations when gathering information for intensive surveys, or data for verification of listed waterbodies. Furthermore, staff from Tallahassee helps collect data from the Suwannee and St. Johns River WMD basins. The Springs program employs staff from the Florida Geological Survey (FGS) to collect springs water quality (WQ) samples.

All field staff has been instructed to employ Standard Operating Procedures (SOPs) for sample collection following a comprehensive set of SOPs set forth in Chapter 62-160, Florida Administrative Code (F.A.C.), and specified in the FDEP document, *Standard Operating Procedures for Field Activities* (DEP-SOP-001/01, December 3, 2008). More information on QA is discussed in the chapters addressing each of the program areas.

Samples are sent to the FDEP Central laboratory for analysis for all programs, and to a lesser degree to other laboratories for limited analyses, such as bacteriological tests and turbidity. FDEP has SOPs for handling and analyzing samples, reporting precision, accuracy and method detection limits that apply, and reporting data. Laboratory certification is maintained per Rule 62-160.300, F.A.C.

A generalized Organizational chart of the relationship between programs, sampling and the laboratory analysis is found in Appendix 1.

Chapter 2: Monitoring Objectives

The Florida Department of Environmental Protection's (FDEP) approach to comprehensive monitoring is designed to meet the monitoring-related requirements of the federal Clean Water Act (CWA), as well as Florida's statutory and regulatory monitoring requirements. These are as follows:

Determine water quality standards attainment and identify impaired waters,

Identify the causes and sources of water quality impairments,

Establish, review, and revise water quality standards,

Support the implementation of water management programs,

Establish special monitoring for unique resources, and

Support the evaluation of program effectiveness.

To meet federal and state requirements, FDEP monitoring activities collectively address the following broad objectives:

Identify and document the condition of Florida's water resources with a known certainty;

Determine the proportion of the state's waterbodies that meet water quality thresholds and other indicators of ecosystem health;

Identify water quality changes over time in the state, in individual basins, and in specific waterbodies;

Collect data on important chemical, physical, and biological parameters to characterize waterbodies that do not meet the applicable Florida water quality standards and criteria in Chapters 62-302 and 62-303, Florida Administrative Code (F.A.C.). The latter is referred to as the Impaired Waters Rule (IWR) for surface waters;

Conduct monitoring that is consistent with the criteria set forth in the IWR;

Verify whether waters on the planning list of potentially impaired waters are impaired and should be listed on the 303(d) list, or if they are no longer determined to be impaired;

Collect data for waters that are suspected to be impaired that were originally not on the 303(d) list;

Collect data on waterbodies that currently have few or no data for assessing their impaired status;

Continue to collect data that will be useful in assessing changes over time in the status of impaired waters;

Establish a scientific database that can be useful in determining the status of a watershed's long-term overall health;

Provide reliable data to help refine management decision making;

Establish a water database with known data quality objectives and quality assurance that can be used to help establish water quality standards;

Help provide data to evaluate the effectiveness of clean water projects and programs; and

Provide technically sound information to managers, legislators, agencies, and the public.

The following sections discuss the specific objectives of FDEP's monitoring programs as they relate to the federal and state requirements listed at the beginning of this chapter.

a. Determining Water Quality Standards Attainment and Identifying Impaired Waters

FDEP uses an integrated approach to measure the attainment of water quality thresholds and determine waterbody impairments. Three of its core monitoring programs—the Status Network, the Trend Network and the Total Maximum Daily Load (TMDL) Program—work together to achieve these goals.

Florida's Status and Trend Network objectives are designed to help meet Section 305(b) CWA requirements that are more broad and spatially comprehensive, such as determining the proportion of the state's waterbodies that meet water quality thresholds or indicators of resource condition, and tracking those changes over time. FDEP's TMDL Program is designed to meet very specific, targeted requirements under Section 303(d) of the CWA that are related to evaluating locations and degrees of waterbody impairment.

b. Identifying the Causes and Sources of Water Quality Impairments

FDEP implements a variety of monitoring activities designed to identify the causes and sources of water quality impairments. For example, as part of the strategic monitoring activities, FDEP staff evaluate waters listed on the planning list for Dissolved Oxygen and bioassessment failures to identify the causative pollutants. FDEP's Watershed Evaluation and TMDL Section staff also conduct intensive surveys for TMDLs to provide a detailed, time-limited investigation of the condition of specific surface water resources that are identified as impaired (i.e., not meeting their designated use, or functional classification, for one or more parameters). These data are then used in creating watershed and waterbody models to determine assimilative capacity and the benefits of ongoing and proposed watershed management activities.

Other efforts include bacteria source tracking to determine the source of bacterial loading to surface waters. Under contract with FDEP, the University of South Florida is evaluating bacteria that can best be used to specifically determine human contributions.

c. Establishing, Reviewing, and Revising Water Quality Standards

Under Section 305(b) of the CWA, the state determines the extent to which its waters meet the objectives of the CWA, attain applicable water quality standards, and provide for the protection and propagation of balanced populations of fish, shellfish, and wildlife (40 CFR 130.8).

FDEP's Bureau of Assessment and Restoration Support is charged with developing, evaluating, and revising new and existing surface water quality standards. Surface water quality standards comprise the designated use (classification) of a waterbody, the numeric and narrative criteria protective of the use, the antidegradation policy, and any moderating provisions (e.g., mixing zones, variances, or site-specific alternative criteria [SSACs]). In developing or revising water quality criteria, any monitoring data must be of sufficient quality to result in the adoption of scientifically valid and defensible concentrations sufficient to protect aquatic life and human health.

d. Supporting the Implementation of Water Management Programs

Chapters 62-302 and 62-4, F.A.C., allow for the development of moderating provisions for surface water quality standards. These include SSACs, mixing zones, and temporary changes (e.g., use attainability analyses and variances). In the case of SSACs, Section 62-302.800, F.A.C., states that a waterbody, or a portion thereof, may not meet a particular ambient water quality criterion specified for its classification, due to natural background conditions or human-induced conditions that cannot be controlled or abated. Since each SSAC is unique to a parameter as well as a waterbody, FDEP-developed SSACs will follow the requirements set out by rule.

FDEP's Wastewater Compliance Evaluation Section has developed a comprehensive approach that helps assess compliance of wastewater facilities through sound environmental monitoring and permitting practices. At the same time, this approach supports the state's water quality management objectives as well as the federal National Pollutant Discharge Elimination System (NPDES) permitting program. While the NPDES Program implements a variety of inspections, the Fifth-Year Inspection (FYI) is worth mentioning as it uses a combination of various facility inspections and ambient monitoring techniques to determine a facility's chemical and biological impacts on the receiving waters when a permit is renewed. The information can be used to make critical permitting decisions that may result in permit modifications or plant changes that would improve effluent and receiving water quality.

e. Establishing Special Monitoring for Unique Resources

Special monitoring programs arise due to public interest, or to help further delineate an issue of significance to the state. Examples include the FDEP's plan to develop numeric nutrient criteria, which is addressed in a separate document (http://www.dep.state.fl.us/water/wqssp/nutrients/docs/fl-nutrient-plan-v030309.pdf), and an initiative to evaluate criteria associated with designated uses, http://www.dep.state.fl.us/secretary/designateduse.htm.

The Florida Springs Initiative evaluates Florida's unique spring ecosystems (http://www.dep.state.fl.us/springs). The objective of the Springs Initiative monitoring is to stop the degradation of water quality and the loss of flow in spring systems, begin restoring Florida's springs to their former health, and enhance the understanding of Florida's springs. The Florida Springs Water Quality Monitoring Network (FSWQMN) is designed to delineate changes over time in spring water quality and discharge, in order to measure progress towards these goals.

As a part of the Springs Initiative, water quality measurements are collected from selected springs throughout the state. This is the final year of a planned five-year program consisting of two parts: a baseline measurement and ongoing monitoring. A one-time expanded list of inorganic and metals analytes at all selected springs provides information for the Florida Geological Survey (FGS) *Springs of Florida* update. Quarterly monitoring using a basic list of analytes is carried out at selected springs in a long-term investigation of the health of springs under state or federal ownership. Additional analytes may be added to this list as necessary.

Since the focus of the investigation is to evaluate the quality of the water as it first enters the spring system, samples will be collected at the spring vent, where the discharge enters the system. Other water quality sampling efforts overseen by FDEP's Bureau of Laboratories and the Bureau of Assessment and Restoration Support focus on the biological health of spring systems; the latter are addressing the surface water component, which is separate from the Springs Initiative.

f. Supporting the Evaluation of Program Effectiveness

Florida's Status Network monitoring objectives are designed to generate data to meet CWA requirements. Tier I surveys, which provide information on statewide and regional trends, are a valuable tool to help focus further investigations, including setting basin- and indicator-specific priorities. Tier I monitoring can answer questions such as the following:

What percentage of river miles statewide meets applicable water quality standards (defined as X, Y or Z)?

What number or area of lakes in a region exceeds standards for fecal coliforms?

Has statewide water quality significantly improved or worsened for the measured indicators since the last reporting period?

Together, the Status and Trend Networks and the TMDL basin assessments help to provide a mechanism for periodically determining the overall success of water quality management programs in Florida.

Chapter 3: Monitoring Program Strategy

This chapter describes Florida's strategy for meeting the objectives discussed in Chapter 2. In researching how other states have approached monitoring design, the Florida Department of Environmental Protection (FDEP) reviewed several excellent reports on water quality monitoring networks. Guidance from the U.S. Environmental Protection Agency (EPA) document, *Elements of a State Water Monitoring and Assessment Program* (March 2003, EPA 841-B-03-004, available at http://www.epa.gov/owow/monitoring/elements/), provided a template that addressed the many considerations for well-designed water quality monitoring networks, as well as the EPA's requirements for state monitoring plans to meet the intent of the Clean Water Act (CWA) and subsequent grant programs.

Subsequent chapters in this report use the EPA's "*Elements*" approach to describe Florida's water monitoring programs. Each chapter contains sections on monitoring design, indicators, quality assurance, data management, data analysis and assessment, reporting, and programmatic evaluation. The final chapter addresses infrastructure requirements for all FDEP monitoring programs.

Florida's Tiered Monitoring Approach

Florida has adopted a three-tiered approach to monitoring water quality, ranging from the general to the specific, as follows (***Tables 1a-1c*** summarize monitoring activities for each tier):

Tier I *consists of FDEP's statewide surface water and ground water Status and Trend Networks. The Status Network (http://www.dep.state.fl.us/water/monitoring/status.htm) uses a probabilistic monitoring design to estimate water quality across the entire state, based on a representative subsample of water resource types. The Trend Network (http://www.dep.state.fl.us/water/monitoring/trend.htm) uses a fixed station design to examine changes in water quality over time in river systems and in ground water throughout the state. The objective of these networks is to provide scientifically defensible information on the important chemical, physical, and biological characteristics of surface waters and major aquifer systems of Florida. Both networks are designed to measure condition using a variety of threshold values, including water quality standards, water quality indices, and other appropriate ecological indicators.*

Tier II *includes the Strategic Monitoring Program, designed to address questions in specific basins and stream segments that are associated with determinations of waterbody impairment for the Total Maximum Daily Load (TMDL) Program. Monitoring in response to citizen concerns and environmental emergencies is also considered Tier II. This tier also includes the Springs Initiative, which encompasses all of the extensive* *monitoring activities begun in 1999 to address the needs of Florida's freshwater spring systems. This fragile and unique resource type is considered to be at risk.*

Tier III *generally answers site-specific questions that are regulatory in nature. Examples of Tier III monitoring activities include monitoring to determine whether moderating provisions such as site-specific alternative criteria (SSACs) should apply to certain waters, all monitoring tied to regulatory permits issued by FDEP, monitoring to establish TMDLs (intensive surveys), and monitoring associated with evaluating the effectiveness of best management practices (BMPs). On a much more infrequent basis, when state water quality standards are under evaluation for revision or new development, Tier III also includes monitoring activities associated with these efforts.*

The information in this report focuses on the freshwater portion of the state's monitoring programs. Extensive and complementary levels of monitoring, using key ecological indicators help to estimate the condition of the state's surface waters. FDEP, the water management districts, and counties are predominantly responsible for freshwater monitoring components.

The Florida Fish and Wildlife Conservation Commission (FWCC), the EPA Environmental Monitoring and Assessment Program (EMAP), programs of the National Oceanographic and Atmospheric Administration (NOAA), including the National Estuarine Research Reserve (NERR) Program, oversee marine monitoring networks. These are not addressed in this report.

Overarching Issues between the Monitoring Tiers/Programs

Florida's monitoring strategy recognizes that there will be some potential for overlap between the tiers, both spatially and temporally. For example, a regularly scheduled lake sampling for the Status Network might coincide with the need for an additional sample for the impaired waters assessment of the same lake or another, nearby resource. For this reason, coordination of monitoring efforts has become more important than ever, to reduce monitoring costs wherever possible. One way to conserve resources in monitoring is to use citizen monitoring programs to alert FDEP to potential water quality violations or areas of concern, or to enlist the assistance of a monitoring organization already scheduled to sample the area in question. The two examples of monitoring coordination can only be done with the full knowledge of monitoring activities in a watershed.

Figure 1 shows the relationships among monitoring activities in FDEP's Integrated Water Resources Monitoring (IWRM) network. The regulated community will monitor for permit-specific analytes and for indicators that are similar to those of Tier I and II monitoring programs. The flow of data and information from Tier I to Tier II, and from Tier II to Tier III will ensure that the monitoring efforts of the various tiers are not isolated from one another and that the different levels of monitoring are integrated.

Table 1a. Summary of FDEP's Statewide (Tier I) Monitoring Programs

Program	***Summary***	***Resources Addressed***
Status Network	Consists of a probabilistic monitoring design to estimate water quality across the entire state based on a representative subsample of water resource types.	Large lakes Small lakes Large rivers Small streams Confined aquifers Unconfined aquifers
Trend Network	Comprises a fixed station design to examine changes in water quality and flow over time throughout the state.	Large rivers Small streams Confined aquifers Unconfined aquifers

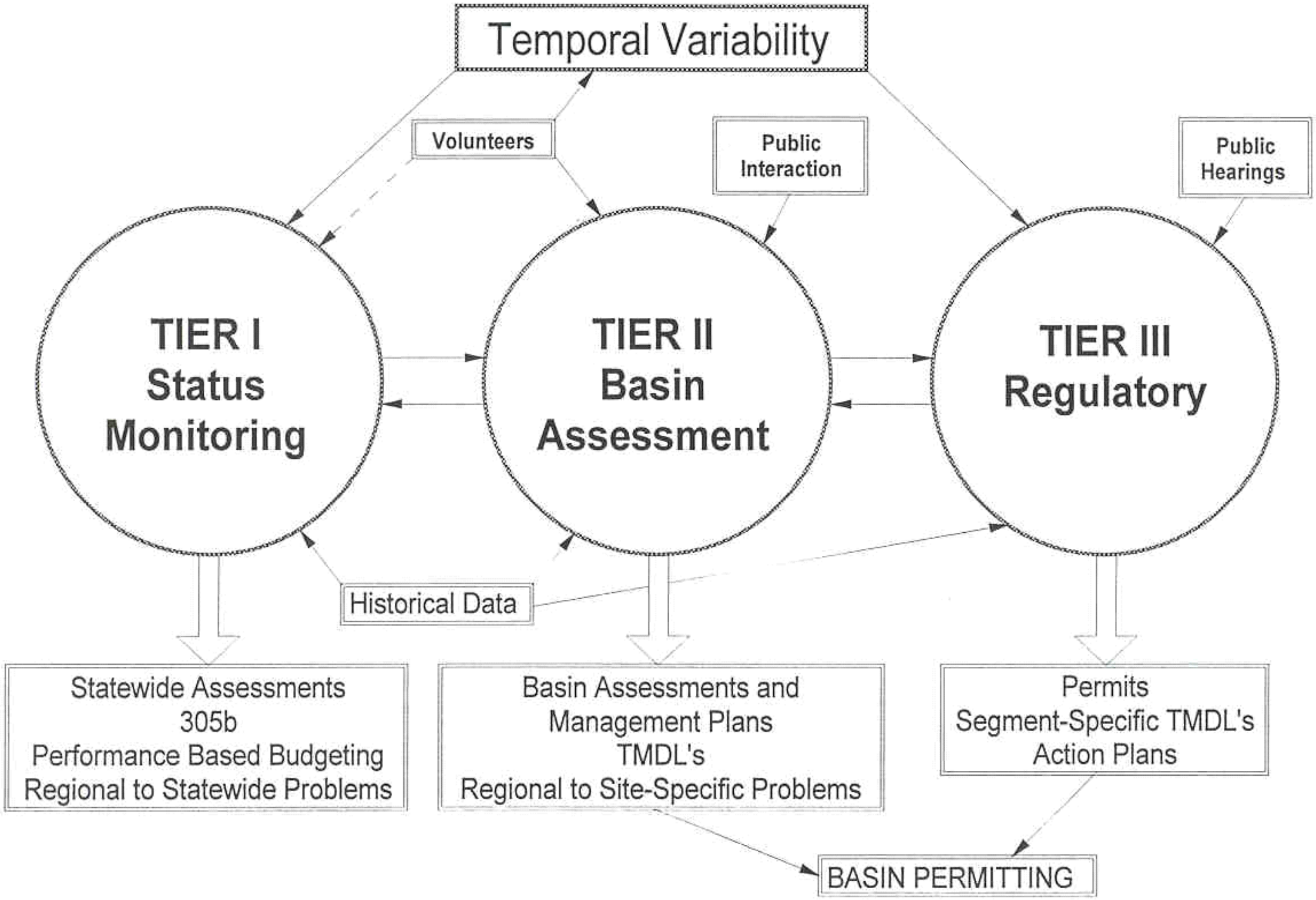
Table 1b. Summary of FDEP's Basin Specific (Tier II) Monitoring Programs

Program	***Summary***	***Resources Addressed***
Springs Initiative	Consists of a fixed station network of freshwater springs intended to enhance the understanding of Florida's springs, stop the degradation and loss of spring flow, and restore springs to their former health.	First-magnitude springs Second-magnitude springs Subaquatic conduits River rises Coastal submarine springs
Strategic Monitoring Program	Addresses gaps in data provided by other monitoring agencies and addresses questions in specific basins and waterbody segments that are associated with determinations of waterbody impairment for the TMDL Program.	All surface waters based on the schedule in the watershed management cycle

Table 1c. Summary of FDEP's Site Specific (Tier III) Monitoring Programs

Program	***Summary***	***Resources Addressed***
Intensive Surveys for TMDLs	Provides detailed, time-limited investigations of the conditions of specific surface waters that are identified as impaired.	Specific surface waters identified as impaired
Water Quality Standards Development	Develops, evaluates, and revises new and existing surface water quality standards. Carries out monitoring to determine concentrations to protect aquatic life and human health.	Surface water Ground water
Site-Specific Alternative Criteria	Develops moderating provisions unique to a waterbody that does not meet particular water quality criteria, due to natural background conditions or human-induced conditions that cannot be controlled or abated.	Surface waters to which particular ambient water quality criteria may not be applicable
Fifth-Year Inspections	Achieves and maintains compliance through sound environmental monitoring and permitting practices.	Surface waters that receive point source discharges

Figure 1. Tiers of the Integrated Water Resources Monitoring (IWRM) Network



During the watershed management cycle, data are collected, analyzed, and reviewed for different program needs ***(Figure 2).*** ***Table 2*** provides an example of a timeline for the TMDL basin's rotation cycle, and the relationship with the 2004-2008 Status Network Tier I monitoring cycle.

Basin rotation refers to the 5 year process that FDEP adopted to evaluate surface waters throughout the state. A total of 29 basins were established to cover the entire state, and of these, a subset (grouping) of 5 or 6 basins is evaluated until the 5 year cycle covering the entire state is completed. Then, the rotation starts over to allow further assessment of the condition of waters as well as appropriate management actions in the Basin Assessment and Monitoring step, described below.

Tier I Status Monitoring

- Planning and monitoring begins well in advance of Phase 1, usually 1-2 years ahead of the period in which the data is utilized by the TMDL program. This allows selecting an appropriate monitoring design, selection of indicators, field sample collection, and review of results prior to release to the Florida STORET (**STO**rage and **RET**rieval) database.
- ***Table 3*** lists the basin groups in the statewide rotation. As mentioned, 29 basin groupings were established to cover the entire state.
- In any given year, 5 or 6 basins were actively being sampled, data analyzed, and summarized in basin reports. These results will be in the 305(b) and 303(d) Integrated Report submitted to EPA in 2010.

A new Status Network sampling design initiated in 2009 provides a statewide estimate, and no longer follows a basin rotation. This change in design is covered under a separate *Monitoring Design Document*, which is posted on FDEP's website: http://www.dep.state.fl.us/water/monitoring/index.htm.

Tier II Basin Assessment and Monitoring

The information gathered by the TMDL program through the tiered approach is used and exchanged through the 5-year watershed management cycle that rotates through the 29 TMDL basins. There are five phases in the cycle, as follows:

In Phase 1, or Year 1, a snapshot view of conditions in a basin is obtained to determine the conditions of waters and establish what additional water sampling is required. This incorporates use of Tier I sampling information, as well as other data in STORET.

In Phase 2, or Year 2, additional sampling is carried out to provide adequate data to make a Tier II assessment of condition of the region of interest.

Phase 3 consists of TMDL development activities to model and assess load reductions within that region.

In Phase 4, a Basin Management Action Plan (BMAP) to achieve load reductions in the basin is developed. Activities range from facility discharge modifications to the installation of BMPs.

During Phase 5, or Year 5, the BMAP is implemented.

Figure 2. Sample Basin Rotation Cycle and Phased Approach for the TMDL Program, and Status Monitoring Program 2004-2008.

Basin Group	2003	2004	2005	2006	2007	2008	2009	2010	2011
Group 1	Planning/Monitoring		Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 1	
Group 2		Monitoring		Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	
Group 3			Monitoring		Phase 1	Phase 2	Phase 3	Phase 4	
Group 4				Monitoring		Phase 1	Phase 2	Phase 3	
Group 5					Monitoring/ Analysis		Phase 1	Phase 2	

Table 2. Sample of a Timeline for Status Network Sampling

2003	2004-2008	2010
Planning, Site Selection and Reconnaissance	Sampling	Data Management, Analysis and Reporting

Table 3. Summary of Basins Used Statewide for Tiered Sampling in Support of Basin Assessments (Statewide and for 305[b], 303(d) and TMDL Investigations)

— Empty cell/no basin sampled

	Group 1 Basins	*Group 2 Basins*	*Group 3 Basins*	*Group 4 Basins*	*Group 5 Basins*
Northwest	Ochlockonee–St. Marks	Apalachicola–Chipola	Choctawhatchee–St. Andrew	Pensacola	Perdido
Northeast	Suwannee	Lower St. Johns	—	Nassau–St. Marys	Upper East Coast
Central	Ocklawaha	Middle St. Johns	Upper St. Johns	Kissimmee River	Indian River Lagoon
Southwest	Tampa Bay	Tampa Bay Tributaries	Sarasota Bay–Peace–Myakka	Withlacoochee	Springs Coast
South	Everglades West Coast	Charlotte Harbor	Caloosahatchee	Fisheating Creek	Florida Keys
Southeast	Lake Okeechobee	St. Lucie–Loxahatchee	Lake Worth Lagoon–Palm Beach Coast	Southeast Coast–Biscayne Bay	Everglades

Florida Monitoring Council Formation

According to Florida Administrative Code (F.A.C.), Rule 62-40, FDEP is responsible for coordinating monitoring activities at state, regional, and local governmental levels to improve the quality of monitoring data and information, as well as to reduce costs. FDEP is taking a lead role in the Florida Water Resources Monitoring Council (FWRMC) to achieve these goals. The council was established in October of 2006. The FWRMC enhances communication and information exchange about monitoring throughout the state and increases FDEP's ability to detect problems and incorporate local efforts not associated with FDEP monitoring programs.

With participation from diverse sectors of Florida's monitoring community, workshops have been conducted throughout the state, resulting in an action plan, completed December 2008. The Monitoring council website is: http://www.dep.state.fl.us/coastal/WaterMonitoringCouncil/, and the plan can be found at: http://www.dep.state.fl.us/coastal/WaterMonitoringCouncil/files/Action_Plan.pdf. The action plan addresses major components of metadata standards, data management, increased communication with monitoring entities, and better interaction with marine/estuarine monitoring entities.

Innovative Monitoring and Assessment Tools

Florida has developed biological indices to characterize the condition of surface waters and has adopted these indices for use in water resource assessments in all three monitoring tiers. These new indicators integrate the biological responses from land use in a basin and can provide a measure of resource health.

A macroinvertebrate-based index is used as part of the Tier I characterizations of rivers and streams throughout the state. Florida has also launched a lake condition characterization employing plant community (macrophytes) composition (Lake Vegetation Index, or LVI). Using transects and a visual survey, the results can be compiled for a rapid assessment of lake condition.

A multi-assemblage biological assessment tool, the Wetland Condition Index, has been developed for freshwater wetland systems for the Office of Submerged Lands and Environmental Resources Program in FDEP's Division of Water Resources Management. This tool is being used to refine FDEP's rapid wetland assessment methodology in the permitting/mitigation arena and to assess the effectiveness of wetland restoration projects.

Florida has also developed geochemical and biological based tools to measure the quality of sediment in marine and freshwater systems. Sediments have been collected from a statistical sampling of lake resources in the state (2004-2008) as part of the Tier I Status Network. The data is compared with thresholds developed to measure naturally occurring concentrations of metals, and a biological-based tool is used to estimate levels of potentially toxic contaminants in the sediments. Future sediment sampling will concentrate on supporting other FDEP programs; specifically, the mercury program to provide data in support of developing the mercury TMDL.

Resource Limitations

Due to resource constraints, FDEP continues to be unable to expand its ambient monitoring capacity to freshwater wetland systems and marine and coastal environments. However, the Florida Fish and Wildlife Conservation Commission (FWCC) and a variety of local environmental agencies monitor marine and coastal surface waters, fisheries, and biological communities.

The Trend surface water monitoring network currently covers 76 monitoring sites at rivers and streams, and at 47 ground water sites. No lakes are included in the surface water Trend monitoring program, due to fiscal and logistical constraints. Determination of loading is essential to better measure the condition of lentic waters. To that end, FDEP has contracted with USGS for monitoring gauging stations on rivers and streams in the trend network. However, there are several Trend river and stream stations that do not have gauges, and FDEP is exploring how best to obtain state funding so that gauges could be established at the remaining sites to allow calculation of loading, important to the TMDL Program and other programs at FDEP.

The probabilistic design has many benefits; nonetheless, the extent of water resources and the size of the state limit the collection of a comprehensive number of samples to represent every basin or watershed. Dedicated funding from state and federal sources is not guaranteed. Furthermore, ongoing resource and logistical limitations compound the issue.

Seasonality may affect some water quality indicators; subsequently the 2009 design of the statewide Status monitoring program will collect surface water samples in opposing seasons. It has been determined that ground water does not exhibit seasonality, therefore allowing collection of a representative sample at any time of the year. Surface water analytes do change: for example, temperature, dissolved oxygen, pH, and plant and bacteriological communities. The question to be answered is whether the proportion of waters that meet or do not meet WQ criteria changes. Initial examination of the data from special studies suggests that the proportion does not shift significantly. Future studies will be conducted in the design of the monitoring program beginning in 2009.

SECTION B: TIER I MONITORING

Chapter 4: Status Network

Recent guidance from the U.S. Environmental Protection Agency (EPA) describes the requirements for water quality assessment, listing, and reporting under Sections 303(d) and 305(b) of the Clean Water Act (CWA) (*2002 Integrated Water Quality Monitoring and Assessment Report Guidance*, November 19, 2001, available at http://www.epa.gov/owow/tmdl/2002wqma.html). It is fiscally and logistically prohibitive to sample every segment of river or stream, every acre of lake, or each individual well in the state on a regular basis. The effort would entail a census of the entire population every year. In its guidance document, the EPA states that a probabilistic monitoring design is a cost-effective approach in producing a statistical statement of known confidence to describe the aggregate condition of water resources. Florida has adopted a probabilistic approach, called the Status Network.

Monitoring and water quality information obtained from regulatory programs and other outside sources (such as data generated by users incorporated in state and federal databases, including STORET, the EPA's **STO**rage and **RET**rieval database) have historically provided information on 20 to 30 percent of Florida's rivers and streams. Therefore, prior to the establishment of the Status Network, in any two-year cycle of reporting to the EPA, a majority of Florida's waters had not been monitored or completely assessed.

Florida launched the Status Network beginning in January 2000. This monitoring network is designed to assess both surface water and ground water throughout the state. The design provides an estimate of condition, or status, of the state's numerous and diverse water resources. The implementation of the Status Network monitoring enables FDEP to estimate the condition of 100 percent of accessible aquatic resources in the state with a known statistical confidence. Data produced by the Status Network are used to complement traditional CWA 305(b) reporting.

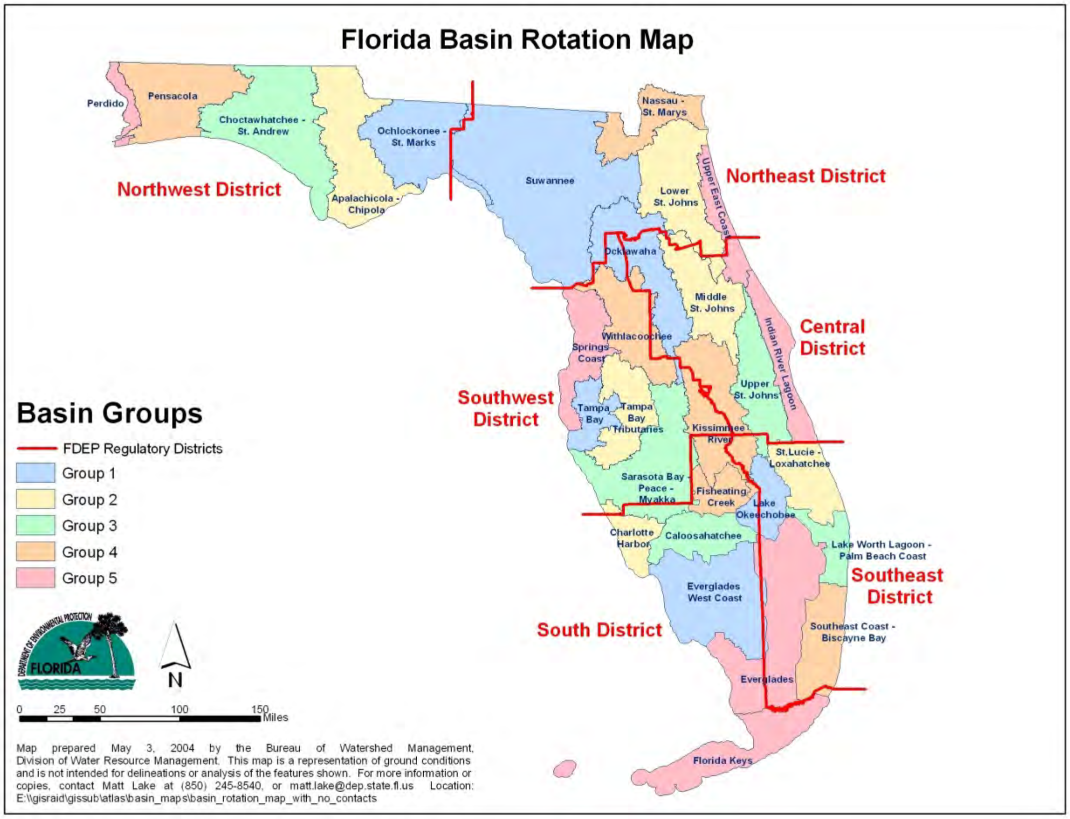
The Status Network design for probabilistic monitoring is based on the EPA's Environmental Monitoring and Assessment Program (EMAP) model. ***Figure 3*** shows the state and the basins used as a foundation for Florida's Status monitoring network during 2004-2008. These basins were selected as the basic reporting unit for the Status monitoring design, as they are used for the TMDL program. This report includes discussion of the Status Network with reference to the rotating TMDL basin design.

Starting 2009, the Status monitoring program was redesigned to provide a statewide annual estimate of water quality condition. A comprehensive document addresses EPA's 10 elements, reflecting the new statewide assessment design. This will be submitted under separate cover, and will be available on the FDEP monitoring website, http://www.dep.state.fl.us/water/monitoring/index.htm.

Monitoring Design

Administratively, Florida is divided into five water management districts (WMDs) and six regional FDEP districts ***(Figure 3).*** The WMDs are statutorily responsible for water quantity issues, while FDEP is statutorily responsible for water quality issues. The geopolitical borders of the WMDs are based on large watershed boundaries. A design to address statewide as well as regional resources was selected, using the probabilistic, or Generalized Random Tessellation Stratified (GRTS) sampling design supported by the EPA's EMAP Program.

Figure 3. Florida Basin Rotation Map for sampling conducted 2004-2008



All stratified random sampling networks use predefined geographic subunits (basins) that together comprise the whole, so that the resulting data can address questions at statewide and specific basin scales. As seen in ***Figure 3,*** and summarized in ***Table 3,*** the state is divided into 29 basins as the foundation for the basin assessments. During the first five-year cycle of the Status Network (January 2004 through December 2008), all basins were sampled in a predetermined sequence, using the same five-year rotation as the TMDL Program. At the end of the five-year cycle, the entire state was sampled. Results will be reported in the 2010 305(b) Integrated Report.

In general, the use of strata in a sampling design enhances the power to detect differences, because it optimizes the design based on the natural variability characteristics of what is being measured. The key to selecting the appropriate strata is the determination of monitoring needs, the availability of data on the distribution of the strata, the availability of data on the spatial variability of indicators of interest in the strata, and the ramifications of multiple strata on sampling size (i.e., reduce sampling size for site-specific monitoring and increase sampling size for ecosystem wide sampling). By using the basins as the selected strata, this strategy represents a graduated subdivision of the base stratum (the state of Florida), so that only the sampling sites need to be determined.

Sampling in the Status Network from 2000 to 2008 occurred 1 to 2 years ahead of the TMDL rotation. This schedule provided both recently collected data from the region of interest and an estimate of condition for 4 surface water resources (small streams, rivers, small lakes, and large lakes) and 2 ground water resources (confined and unconfined aquifers) from each of the 29 basins. Results are provided annually to FDEP's Watershed Assessment Section through STORET.

Some limitations are inherent in the GRTS sample design, due to the geography of the state. Not all resources can be sampled in all basins, depending on how the basins are delineated and whether specific resources are actually present. Portions of Florida do not support all the "typical" waters used in the sampling design. For example, there are few, if any, true small lakes in the southern portions of the state. Watersheds may split the tributaries to an estuary from the upland contributing portion, leaving no stream miles on the freshwater side of the two watersheds.

As in any monitoring program, the placement of sites and the total number of sites are based on the assessment questions. Since many of the Tier I monitoring questions require assessments for "all" of Florida's fresh waters, then an element of the sampling design must be extractable and thus probabilistic in nature. The use of the term "probabilistic" infers that the sites are representative and not biased. Therefore, the use of random selections is adopted from a list (list frame) of resources available to sample from each population. The specific protocol for the selection of sample sites for each resource type (e.g., small lakes, low-order streams, etc.) is somewhat different. Some resources are selected as points, while others are line features, and still others are based on area. The base for the state map showing water resources is the re-leveled National Hydrography dataset (rNHD). The following section on **Geographic Design** discusses the selection of the sites for the 2004-2008 sampling design.

Geographic Design

Location information for point-feature sites (e.g., wells, small lakes) and electronic representations of all other water resources were sent in a geographic information system (GIS) file with associated metadata to the EPA in Corvallis, Oregon. Thirty random samples and a 5-time oversample, for a total of 180 possible sites, were selected from each resource in each basin. The oversample was required because of the high probability of possible sampling problems, such as landowner refusals, dry resources, accessibility, possible GIS errors, and other sampling challenges routinely associated with random versus fixed station sampling designs.

The 180 potential sample sites were placed into a database and accessed by samplers in an Internet-based application called Oracle Generalized Water Information System (OGWIS). The application allowed samplers to review selected sites using an Arc Interactive Mapping System (ArcIMS). Initial reconnaissance was conducted to determine whether the site represents the correct resource, whether additional information was needed from the field to determine whether the site met the definition of the population being sampled, or even help determine the easiest access for collecting samples at the site. These sites were sampled in the same order in which they were generated.

Water Resource Types

In order to sample many different occurrences of water systematically across the state, Florida's waters are subdivided into "resources." Each resource constitutes a readily identifiable occurrence of a water of interest for the purposes of management. Each of these resources is considered state waters; therefore have applicable water quality criteria. In addition, the scale of a waterbody has an effect on sampling strategy and, in many cases, on the management of resources, so the resources have been subdivided to facilitate sampling and resource evaluation. The following resources are monitored as part of the Status Network:

Ground water (confined and unconfined aquifers),

Lakes (1 to 10 hectares and over 10 hectares), and

Rivers and streams (including canals).

Ground Water

Ground water includes those portions of Florida's aquifers that have the potential for supplying potable water or affecting the quality of currently potable water as it was defined in 1998. Florida has three major aquifer systems, all of which are sampled: the surficial aquifer system (SAS), the intermediate aquifer system (IAS), and the Floridan aquifer system (FAS).

The ground water resource is subdivided into two target populations for the purposes of sampling and resource characterization: (1) unconfined aquifers and (2) confined aquifers. Typically, the SAS, which is unconfined and near the land surface, can be readily affected by human activities. Because of this vulnerability to contamination, the SAS is randomly sampled where present. In areas where the SAS is not present and either the IAS or the FAS is unconfined, these aquifers are sampled as part of the unconfined-aquifer target population.

The confined-aquifer target population includes confined portions of either the IAS and the FAS, depending on which is the most heavily used as a source of public water supply. The rationale for sampling a confined-aquifer target population is that pumping for municipal supply typically involves high volumes of water that may induce lateral or upward movement of saline water. Since the effects of saltwater intrusion take many years to reverse, and the resulting degradation of water quality may result in significant and costly changes in water supply systems, the confined IAS and FAS are monitored as part of the Status Network.

Individual wells are selected from a well list frame. The well population consists of wells from the former Ground Water Quality Monitoring Background Network or Very Intense Study Area (VISA) Network, a Florida Department of Health (FDOH) private well survey cosponsored by FDEP, the WMDs' and counties' saltwater intrusion networks, upgradient monitoring wells associated with FDEP-permitted facilities, U.S. Geological Survey (USGS) monitoring wells, and other wells nominated by the regional WMDs. The Background Network wells avoided heavily industrialized areas, areas of known or suspected ground water contamination, and coastal areas with saltwater intrusion. VISA wells were specifically selected in areas of suspected contamination, including agricultural, residential, and industrialized areas.

Most wells available for sampling in urbanized areas are associated with facilities permitted by FDEP. Each permitted facility has several wells purposefully placed to detect and evaluate a known or suspected contaminant plume, in addition to a "background" well upgradient of the facility. While the compliance wells are heavily biased near sites that may have a potential to detect contaminated ground water, the background wells are located outside the facility's plume and are more likely to detect regional degradation in water quality. Only background wells from the facilities are considered for sampling in the monitoring network.

Lakes

Lakes for the 2004-2008 survey were subdivided into two groups: (1) small lakes between 1 and 10 hectares and (2) large lakes over 10 hectares. This differentiation on the basis of size was intended to accommodate different sampling strategies and methods and to allow better representation of the resource. The size of large lakes would have skewed selection and caused small lakes to be under-represented in the sample design, had all lakes been in one category. Small lakes were randomly sampled from a list frame and selected as a "point feature" (1 lake per selection), while a grid was overlaid on large lakes, and samples randomly chosen from the entire area of large lakes.

The protocol for site selection for small lakes (1 to 10 hectares in surface area) was based on the rNHD 1:100,000 scale. All lakes less than 10 hectares in size are associated with latitude-longitude coordinates for the center of the lake. A list frame was developed for each basin, and 30 random samples were selected in each basin. An oversample of small lakes was randomly selected, in case some of the original selections were dry or otherwise could not be sampled.

The selections of large lakes (a surface area greater than 10 hectares) were also based on available coverage from the rNHD 1:1000:000 scale. A grid resulting in hexagonal spatial units was overlaid on the reporting area, so that approximately 30 hexagons contained large lakes or portions of large lakes. A random location was identified in each hexagon.

Rivers, Streams, and Canals

In earlier investigations, perennial rivers were originally subdivided into two water resources based on stream order. Because inconsistencies in GIS coverage caused problems with this stream selection process, the coverage was revised for incorporation into the Status Network. This coverage utilizes the newest NHD information. The resource was divided into "large rivers" and "small streams" based on the GIS coverage that better estimated the major rivers of the state, with subsequent review by WMD project managers. Once the "large rivers" coverage was determined, the remaining rivers on the 1:100,000 scale were deemed "small streams." In order to sample rivers (including most canals) and streams randomly, each waterbody was broken into one-meter stream lengths. The segments in each category were placed in the list frame and randomly selected.

Sampling Schedule

In the 2004-2008 design of the Status network, a maximum of 30 random samples was collected every year from each of the resources in 5 to 6 basins around the state. Approximately 150 - 180 samples were collected for each resource: over 900 samples were collected each year for all resources, in addition to quality assurance samples. The indicator list used, which consists of both chemical and biological parameters, is discussed in the next section on **Core and Supplemental Water Quality Indicators**.

The same sampling and analytical methodologies were used for all of the basins. This enabled FDEP to compare the conditions of Basin A with those of Basin B, compare Basin A with Basin A over time, and assess issues of statewide concern consistently. For example, FDEP will be able to answer questions of statewide concern such as (1) "What are the concentrations of nitrate in Florida's ground waters?", and (2), using Trend network information, "Are nitrate concentrations increasing over time?"

Some indicators in surface water may exhibit large intra-annual variability (i.e., they are seasonal). Generally, monitoring programs do not have the monetary resources to characterize this variability, or to assess ambient conditions in all seasons for "all" resources (i.e., all of Florida's fresh waters). Therefore, sampling was limited to a confined portion of the year (index period). Sampling for the Status Network occurred during different index periods (12 weeks) for each resource type ***(Figure 4).***

In addition to early studies to answer the question of whether there are significant changes in water quality as a result of the seasonality, the 2009 network design will incorporate repeat stations. Samples will be collected from the same stations in lakes, rivers and streams, but in different seasons. Results will be compared to determine whether the proportional estimate of condition of selected indicators is significantly different.

Figure 4. Status Network Index Periods for 2004-2008
Samples collected per basin (5 or 6 basins each year)

STATUS NETWORK SAMPLING INDEX PERIODS

N = North Florida (NWFWMD, SR-DEP), P = Peninsular Florida (Alachua County, SJRWMD, SW-DEP, SF-PG, SF-PSL)

Month	Confined Aquifer		Unconfined Aquifer		Small Streams		Large Rivers		Small Lakes		Large Lakes	
	N	P	N	P	N	P	N	P	N	P	N	P
Jan	Primary	Primary										
Feb	Primary	Primary										
Mar	Primary	Primary							Primary			
Apr				Primary	Primary				Primary			
May				Primary	Primary			Primary	Overflow			
Jun			Primary	Overflow	Overflow			Primary			Primary	
Jul			Primary				Primary	Overflow		Primary	Primary	
Aug			Overflow			Primary	Primary			Primary	Overflow	
Sep						Primary	Overflow			Overflow		
Oct						Overflow						Primary
Nov												Primary
Dec												Overflow

Primary Index Period   Overflow Index Period

* Total does not include QA samples
— Dashed line indicates current Contract Period Start/Finish   Revised 12/06

Core and Supplemental Water Quality Indicators

While most monitoring has historically focused on water chemistry, FDEP's Integrated Water Resources Monitoring (IWRM) Program includes water chemistry and biological and physical indicators that integrate ecological conditions over time. These indicators provide more scientific and meaningful information on the condition of a watershed.

The Status Network analyte list is routinely reviewed, and updated as necessary. The analytes collected during the 2004-2008 timeframe are found in ***Tables 4a-f.*** The analyte list included measures of biological condition in rivers and streams and, in lakes, the condition of plant communities and sediment chemistry. Analytes with primary drinking water standards were added to measure the condition of our aquifers. Because the resources sampled are state waters, water quality (WQ) standards apply, and can be used as a measure of water quality condition.

The Status Network analytes provide information about the chemical and biological status of surface water and ground water, including the suitability of the water for human and aquatic life use. These values can be used as a gauge of condition based on the WQ standard or guidance value. The design estimates the percent of a resource that may exceed or be within some range of an analytical measurement, with known error. Some analytes are not associated with a water quality use or standard, and are designed simply to evaluate the chemical composition of water.

All indicators used have been tested and validated for use in Florida, and serve to summarize and condense data from multiple metrics into meaningful results to resource managers. FDEP has developed bioassessment procedures that more directly assess whether aquatic life use support is being maintained. Bioassessment tools for rivers and streams (the Stream Condition Index [SCI] and BioReconnaissance [BioRecon]) and small lakes (the Lake Vegetation Index) are completed and being implemented in many FDEP monitoring programs. The results are currently being used in the basin assessments. The wetland tools are under study, but not yet implemented. Additionally, an estuarine biological tool that is applicable statewide has not yet been developed.

Surface waters sampled in the Status Network are designated as Classes I and III under Florida Surface Water Quality Standards (Chapter 62-302, Florida Administrative Code [F.A.C.]). Class I criteria protect potable water supply use, and Class III criteria protect recreation and aquatic life uses. Many of the analytes sampled in the Status Network have numeric surface water quality standards to protect one or more of these uses ***(Table 5).*** Additionally, ground water standards and guidance values used to measure compliance are listed below.

The candidate lists of indicators to be measured as part of the Status Network were derived from multiple discussions with the participating agencies and consist of core measurements used to evaluate water quality. It is cost-prohibitive to fully analyze water resources for every potential contaminant. Instead, key indicator contaminants and those with WQ standards serve to assess the general suitability of water resources for their designated uses.

Table 4a. Status Network core and supplemental indicators for field measurements. This is a three column table with column one listing the indicators, column two listing the analytical method numbers, and column three listing sampled resources

Field Measurement Indicators	Analysis Method	Resources
pH	Method 150.1	Lakes, Streams/Rivers, Aquifers
Temperature	Method 170.1	Lakes, Streams/Rivers, Aquifers
Specific Conductance	Method 120.1	Lakes, Streams/Rivers, Aquifers
Dissolved Oxygen	Method 360.1	Lakes, Streams/Rivers, Aquifers
Turbidity	SOP FT 1600	Aquifers
Secchi Depth	Welch (1948); EPA 620/R-97/001	Lakes, Streams/Rivers
Total Depth	Manual/electronic measuring device	Lakes, Streams/Rivers
Sample Depth	Manual/electronic measuring device	Lakes, Streams/Rivers
Micro Land Use	Sampling manual (01/09), Section 4	Aquifers
Depth to Water	Steel tape and/or chalk	Aquifers

Table 4b. Status Network core and supplemental indicators for biological and microbiological indicators. This is a three column table with column one listing the indicators, column two listing the analytical method numbers, and column three listing sampled resources

Biological/Microbiological Indicators	Analysis Method	Resources
Chlorophyll *a*	SM 10200 H (modified)	Lakes, Streams/Rivers
Biological Community (SCI)	SM 10500 C (modified)	Streams/Rivers
Algal Growth Potential[1]	Method 9-78-018 (modified)	Small Lakes
Phytoplankton	SM 10200 F.1; 10200 F.2	Lakes
Habitat Assessment	SOP FT 3000	Streams/Rivers
Lake Vegetation Index	SOP FS 7220	Small Lakes
Total Coliform	SM 9222B	Aquifers
Fecal Coliform	SM 9222D	Lakes, Streams/Rivers, Aquifers
Enterococci	EPA 1600[2]	Lakes, Streams/Rivers

[1] Dropped in 2005; [2] 2004-2007 SM 9230C;

Table 4c. Status Network core and supplemental indicators for organic and nutrient indicators. This is a three column table with column one listing the indicators, column two listing the analytical method numbers, and column three listing sampled resources

Organic/Nutrient Indicators	Analysis Method	Resources
Nitrate + Nitrite	Method 353.2	Lakes, Streams/Rivers, Aquifers
Ammonia	Method 350.1	Lakes, Streams/Rivers, Aquifers
Total Kjeldahl Nitrogen	Method 351.2	Lakes, Streams/Rivers, Aquifers
Phosphorus	Method 365.1/365.4	Lakes, Streams/Rivers, Aquifers

Table 4d. Status Network core and supplemental indicators for major ion indicators. This is a three column table with column one listing the indicators, column two listing the analytical method numbers, and column three listing sampled resources

Major Ion Indicators	Analysis Method	Resources
Chloride	Method 300	Aquifers
Sulfate	Method 300	Aquifers
Fluoride	Method 340.2	Aquifers
Calcium	Method 200.7	Aquifers
Magnesium	Method 200.7	Aquifers
Sodium	Method 200.7	Aquifers

Table 4e. Status Network core and supplemental indicators for metal indicators. This is a three column table with column one listing the indicators, column two listing the analytical method numbers, and column three listing sampled resources

Metal Indicators	Analysis Method	Resources
Aluminum, Arsenic, Calcium, Cadmium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Sodium, Zinc	Method 200.7/200.8	Aquifers

Table 4f. Status Network core and supplemental indicators for physical property indicators. This is a three column table with column one listing the indicators, column two listing the analytical method numbers, and column three listing sampled resources

Physical Property Indicators	Analysis Method	Resources
Alkalinity	Method 310.1	Aquifers
Turbidity (Lab)	Method 180.1	Lakes, Streams/Rivers, Aquifers
Specific Conductance (Lab)[3]	Method 120.1	Lakes, Streams/Rivers, Aquifers
Color	Method 110.2	Lakes, Streams/Rivers, Aquifers
Total Dissolved Solids	Method 160.2	Aquifers

[3] Added in 2006

All samples are unfiltered unless stated. All methods, unless otherwise stated, are based on *EPA 600, Methods for Chemical Analysis of Water and Wastes*.

During 2000-2004 of the Status Network, aquifer samples were generally filtered to mitigate well construction factors, and the analytes were measured as dissolved constituents. This was changed for the 2004-2008 cycle to measuring total constituents in order to reflect more closely the actual conditions for drinking water and to be consistent with standards. Likewise, the indicator lists for surface water resources are designed to detect the major threats to surface water quality, such as eutrophication and habitat loss.

Table 5. Status Monitoring Network indicators with water quality criteria/thresholds. This is a two column table where column one is a list of the indicators and the second column is a list of water quality criteria/thresholds.

Primary Indicator/Index for Potable Water Supply (Ground Water)	Criterion/Threshold
Fluoride	≤4 mg/L
Arsenic	≤10 µg/L
Cadmium	≤5 µg/L
Chromium	≤100 µg/L
Lead	≤15 µg/L
Nitrate-Nitrite	≤10 mg/L
Sodium	≤160 mg/L
Total Coliform Bacteria (#/100mL)	≤4
Secondary Indicator/Index for Potable Water Supply (Ground Water)	**Criterion/Threshold**
Aluminum	≤0.2 mg/L
Chloride	≤250 mg/L
Fluoride	≤2 mg/L
Manganese	≤0.05 mg/L
pH	≥6, ≤8.5 su
Sulfate	≤250 mg/L
Total Dissolved Solids	≤500 mg/L
Zinc	≤5 mg/L

Microbiological Indicator/Index for Recreation Use (Surface Water)	Criterion/Threshold
Fecal Coliform Bacteria	< 400 colonies/100mL
Physical/Other Indicators/Index for Aquatic Life Use (Surface Water)	**Criterion/Threshold**
Dissolved Oxygen	≥ 5 mg/L
pH	≥ 6, ≤ 8.5 su
Unionized Ammonia	≤ 0.02 mg/L
Alkalinity	≥20 mg/L
Fluoride	≤10 mg/L
Specific Conductance	≤1,275 or 50% above background
Turbidity	≤29 NTU above background
Chlorophyll *a**	≤ 20 µg/L
TSI*	Color ≤ 40 PCUs, then TSI ≤ 40 Color > 40 PCUs, then TSI ≤ 60

mL – milliliters; mg/L – milligrams per liter; µg/L – micrograms per liter; PCUs – platinum cobalt units; su – standard units; NTU – nephelometric turbidity units.

* Both TSI and chlorophyll *a* are not criteria, but thresholds used to estimate the impairment of state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer the verification of impairment, as defined in Rule 62-303, F.A.C.

The water quality criteria and thresholds are derived from Section 62-302.530, F.A.C., Criteria for Surface Water Classifications; Rule 62-550, F.A.C., Drinking Water Standards; Rule 62-303, F.A.C., Identification of Impaired Surface Waters; and Section 62-520.420, F.A.C., Standards for Class G-I and Class G-II Ground Water.

Quality Assurance

In a multi-agency, statewide program, it is essential to have a centralized quality assurance (QA) program to ensure that data are properly and consistently collected. The QA Program for the Status Network is coordinated by the Quality Assurance Officer (QAO) with the cooperation of FDEP staff and QA officers at the sampling agencies and analytical laboratories. However, QA is considered to be the responsibility of everyone associated with sampling, monitoring, and data analysis.

The QAO coordinates and oversees data quality activities, monitoring adherence to company policies and procedures and corrective actions. He or she has the authority to recommend and implement immediate corrective measures to refine and assure compliance with state standard operating procedures. The QAO's responsibilities are as follows:

Reviews quality control data to determine if data are acceptable;

Performs annual systems audits to ensure compliance with all QA plans and standard operating procedures (SOPs);

Distributes the results of internal and external audits to management and all affected individuals;

Oversees responses to internal and external audits;

Oversees and recommends corrective actions as a result of the audits;

Verifies the implementation of corrective action;

Oversees the administration of performance audits;

Coordinates the preparation of QA reports to management;

Coordinates and oversees the preparation of QA manuals;

Reviews new or proposed procedures to determine appropriate use; also reviews associated method validation information;

Reviews, in writing, initiated corrective actions to assure effectiveness, and recommends additional measures if necessary.

A Sampling Manual based on FDEP's SOPs was developed for the Status Network. This was incorporated into the contracts with all participating agencies. The SOPs require each agency to have a quality system to achieve the following:

Identify, implement and promote QA policies and procedures that will produce data of a known and verifiable quality;

Create and/or identify and follow SOPs for all activities, both technical and administrative;

Monitor adherence to the established policies, procedures, and written SOPs;

Establish and use procedures for continual improvement through both corrective and preventive action policies; and

Monitor the quality of the organization's product.

Any updates or changes to the protocols are communicated through project management meetings, statewide meetings, an Internet Web site, and training classes. The classes are conducted by FDEP staff and focus on program-specific sampling requirements. The training has been expanded to include aquatic habitat assessment, periphyton collection (for 2009 and beyond) and sediment sampling.

The accuracy of field measurements is assessed through internal FDEP field reference sample programs. Field samplers test meter calibrations by checking blind reference samples every 5 to 10 sites and call in the results to the QAO before sampling.

Equipment blanks are collected at a rate of 20 percent. This allows staff to monitor the on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions. Sample data are qualified if detections are found in blanks at levels above the sample results.

All samples are analyzed at FDEP's Bureau of Laboratories. The lab has consistently scored high compared with other environmental labs in the nation in performance reviews by the USGS and the EPA. It is one of the few facilities in the country able to perform ultra low-level metals analyses. In addition to its internal quality assurance/quality control (QA/QC) procedures, FDEP's Watershed Monitoring Section submits blind analytical samples to the lab for analysis. The results have been consistently within expectations.

There are programmatic, logistical limitations involved with analysis, as well. Meeting the published holding times for some key indicators (e.g., orthophosphate, total coliform, and fecal coliform) has routinely been a problem in past monitoring efforts and will likely continue to be a problem. However, a number of reviewers of the lists have supported including these indicators; they are likely to be of semi-qualitative utility, despite their shortcomings of not meeting the holding times.

Data Management

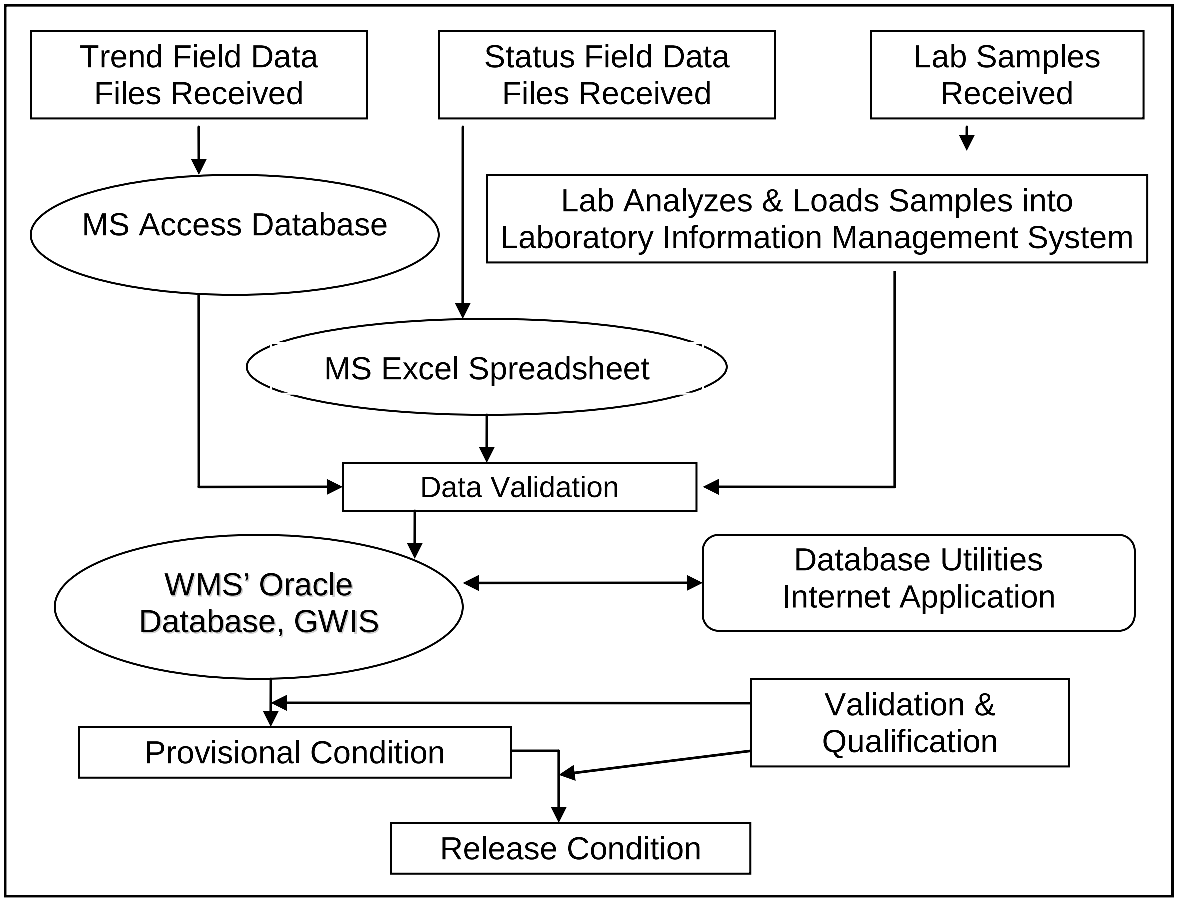
The smooth and timely flow of water quality data from sample collectors and analytical agencies to data analysts is a high priority. The data flow path ***(Figure 5)*** begins with FDEP's Watershed Monitoring Section. Assisted by cooperating federal, state, and county agencies, sample locations are selected, monitoring parameters and frequencies determined, and sample collection and analysis coordinated. This information is communicated electronically to the sampling agencies before sampling commences.

Results of data collected in the field are computerized at the sampling agency, using an FDEP-written field data-entry program. This customized software ensures a common data exchange format, facilitating the flow of data from the field. The data-entry software, which is based on existing software currently in use, includes data entry verification and additional data entry capability.

Water quality samples are tracked from the field to the lab via Access Automated DAta Management (AADAM) software. Files containing analytical data are transferred to FDEP staff using an Internet ftp site, where they are processed and merged with corresponding field data, and linked to the corresponding site data. Computerized accuracy and completeness checks are run, in addition to a variety of other QA checks, including water quality checks and extreme value checks. FDEP project managers manually check each data file, using the results from the computerized reviews to identify any obvious random or systematic errors.

After the preliminary data review for a project is completed, a copy of the project file is transferred to the sampling agency for further review. Also, notifications required by FDEP's Division of Water Facilities are generated automatically and sent to FDOH, specific FDEP/WMD programs, and property owners. After project data have been reviewed, the data are considered "release quality" and made available to the public. All data collected are uploaded to STORET annually. Periodically, data are uploaded to an in-house Oracle database version of the Generalized Water Information System (GWIS) that is available to FDEP staff.

Figure 5. Data Flow Path



Data Analysis/Assessment

In analyzing data from the Status Network, FDEP staff examine the variability in the results to determine the reason for differences in water quality in the basins studied. For example, the Trophic State Index (TSI) varied widely among reporting units of the state when the results of the monitoring network were compared in the 2004 305(b) report. Further efforts could focus on determining if there is an underlying reason for lakes not meeting the TSI threshold, or help focus efforts on addressing problem areas. Following up these results, using Tier II and III investigations, could be accomplished through a new investigation or the use of available data (e.g., investigating other lakes in the region, or examining geographic coverages such as land use), as a reasonable next step.

The design of the Status Network used the TMDL basins as the basic "building block" or reporting unit (2004-2008), with a state summary after the 5 year rotation. As long as the number of samples in each basin was about 30, the statistical inference of uncertainty is approximately 10 percent for each basin. Because of the consistency in the design of the Status Network, the results from basins can be combined to draw conclusions about larger geographic units, including the state and multiple resources, such as all streams. The data can also be post stratified, or subdivided, according to sample sets corresponding with smaller geographic units, land uses, or resource subdivisions. If the number of samples in a different spatial framework is significantly below 30, however, the uncertainty is greater than 10 percent.

The probabilistic design of the Status Network permits FDEP to answer many water resource–related questions with an unbiased, rigorous data set, and to place statistically sound confidence limits on the answers to these questions. This design, in part, is dictated by the questions addressed. Addressing questions is a three-step process. First, the monitoring must be accomplished following standardized protocols for data acquisition. Second, the larger, "parent" population from which the sample data were collected must be characterized in order to describe statistically the magnitude and variability of the distributions of indicators used to evaluate the water resource. This step is termed "population characterization." Finally, the distributions are used to draw inferences about the overall status of the resource (the parent population) in question. This last step is termed "statistical inference."

Population Characterization

To measure or characterize the overall distribution of the data for an indicator, one starts with a sample question, such as, "What is the distribution of nitrates in low-order streams in Florida?"

A cumulative distribution function (CDF) is created to describe the overall variability of the indicator. A CDF ***(Figure 6)*** shows the values of the indicator on the horizontal axis and the percentage of the samples (and by inference the overall population) less than or equal to each value on the vertical axis. The CDF is a fundamental tool for characterizing the population of an indicator.

Population descriptors are the measures most often used to describe a population. For example, the median of a population is a measurement of the magnitude of the center of a distribution. Since many environmental indicator distributions are not symmetrical about the average, other population descriptors, which are not sensitive to the symmetry of the distribution, will be used. These include the following:

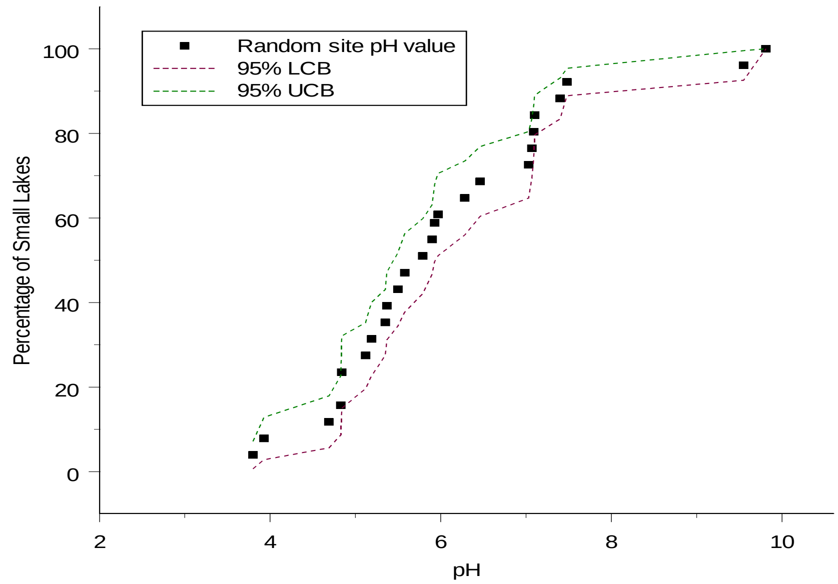
Median*—This is defined as the 50th percentile of the CDF. Half of the values of the indicator fall below this value.*

Percentiles*—The 10th, 25th, 75th, 90th, and other percentiles can be used to describe what proportion of the resource has an indicator less than the percentile.*

Range*—The total range of values for an indicator is a measure of its variability.*

Measure*—This demonstrates whether an indicator has changed since the last sampling event.*

Figure 6. Example of Cumulative Distribution Function



Nonparametric statistical tests are used to compare the median and CDFs over time to determine if statistically significant changes have occurred. Nonparametric tests make no assumptions about the symmetry of indicator distributions and are the most appropriate tests for comparing population descriptors and CDFs over time, or comparing different sampling units. The tests used include the chi-square test and the Mann-Whitney two-sample test. All statistical tests are considered significant at a 95 percent probability.

A summary index that uses terminology—"attaining" and "not attaining"—was developed to allow an overall summary of the quality of the resource in a sampling unit. The summary index is based on the number of sample sites that have "attaining" and "not attaining" sample indices, can be used to communicate the overall quality of a resource. The number of "attaining," and "not attaining" sample index assignments is compared over time using a chi-square contingency table. This quantifies statistically any change (improvement or deterioration of the resource) of the resource index.

Statistical Inference

Population characterization facilitates a description of the condition of a resource. To evaluate the quality of a resource in the state or an individual basin, it is necessary to transition from samples to the parent population. The need for this transition is the primary reason for the random sample design of the Status Network. By randomly sampling each resource, it can be assumed that all segments of the resource have an equal probability of being sampled and, therefore, the sample set is an adequate measure of the resource in a basin. The third step in evaluating the resource is to use the populations of indicators and indices to draw conclusions about the entire basin and resource.

Many of the statewide environmental issues can be directly addressed by the inference of data collected in the Status Network. Indicators that directly address statewide issues include biological integrity and productivity, stream and lake acidity, thermal pollution, dissolved oxygen (DO) in streams and lakes, nitrates, phosphates, saltwater intrusion, and coliform bacteria. Many important indicators cannot be assessed in the Status Network because of a lack of financial resources. However, some of these key indicators are being addressed in the basin assessments and the regulatory/compliance networks (Tiers II and III).

Many questions about the state's water quality can be addressed at the scale of basins or larger areas, including the state as a whole. The Trend Network is used to monitor time-dependent change on a high-frequency (i.e., monthly) basis for surface water, and quarterly/monthly for ground water.

Knowing whether the amount of minimally affected water in a resource is increasing or decreasing is a critical management tool. Surface water and ground water data collected before the IWRM network was implemented vary in whether they can be used in this comparison. Data from the 1991–1997 Background Network (a sub-network of FDEP's old Ground Water Quality Monitoring Network) have been used for the comparison for ground water. The existing reference sites are being used for surface water, where applicable. In the absence of appropriate existing, pre-IWRM network data, the initial Status Network sampling round is being used to identify minimally affected areas by studying the CDFs for each indicator and comparing them with existing data. The proportion (area or stream length) of the resource identified as minimally affected in previous assessments from the Status Network will provide a baseline for future sampling.

The use of the sample and resource indices allows inferences to be made about the amount of a resource affected by human activities. Since the samples are random and the Status Network is not designed to assess specific sites, it will be necessary to conduct basin- or site-specific assessments to identify and confirm whether specific areas are affected.

As mentioned, some indicators in the Status Network have water quality standards. For example, there is a standard for fecal coliform, and a healthy system should not contain significant numbers of these organisms. Through an analysis of the CDF for fecal coliform, the Status Network can be used to address the proportion of the resource that contains coliform counts higher than the standards. All anthropogenic constituents present in Florida waters are not being sampled in the Status Network, due to cost considerations. The indicator list ***(Tables 4a-f)*** has been selected to detect stress to a resource, but not necessarily to identify the cause of this stress.

The percentage and/or number of kilometers/hectares of a resource that do not support the natural ecosystem are being addressed by examining the indices assigned to the resource. CDFs of indicators and indices can be used to identify the probable causes of this failure to support the designated use adequately.

Statistical comparisons of previous and current Status Network indicator and index CDFs will provide an answer to the question of why a water resource is failing to support the designated use adequately. The answer is an important evaluation tool for managing resource outcomes. Trend analyses of medians and percentiles can also be used to identify long-term changes in overall water quality.

Data Quality Objectives—Uncertainty Levels

Uncertainty criteria must be defined and agreed on in order to select a monitoring design with the appropriate power to address the assessment questions. For example, one assessment criterion might be that all status or "health" assessments have 95 percent confidence intervals of 10 percent, such that an assessment of lake chemistry with contaminant concentrations greater than criteria A would be X% ± 10% (e.g., 35 ± 10% of all Florida's fresh waters). This type of uncertainty pertains to probabilistic statements. Site-specific assessments also will require uncertainty criteria, primarily at the level of discrimination often referred to as p-level. For example, the uncertainty level for distinction between affected and reference sites might be a 95 percent chance of discerning a difference, if a difference exists between the sites.

Reporting

An important goal for the Status Network is to characterize comprehensively the quality of all surface waters and ground waters, specifically to (1) determine the condition of the state's water resources and whether those resources support water quality thresholds and (2) define changes in quality. Historically, the state has only been able to assess a percentage of its total surface waters based on the availability of data. The dilemma is that not every waterbody or aquifer-foot can be individually sampled and assessed under the current monitoring strategy.

As briefly discussed in the earlier section on core and supplemental water quality indicators, Florida incorporates EPA's broad goals into five classes of surface waters designated by their most beneficial use, as follows:

> *Class I —Potable water supply;*
> *Class II —Shellfish propagation and harvesting;*
> *Class III —Recreation and well-balanced population of fish and wildlife;*
> *Class IV—Agricultural water supply; and*
> *Class V—Navigation, utility, and industrial use.*

Class III waters include recreational activities such as fishing, fish consumption, swimming, boating, and protection of aquatic life. Within Class III, Florida does not distinguish between secondary contact (e.g., boating) and primary contact (e.g., swimming).

The probabilistic sampling program allows the total miles or areas of attainment or nonattainment for water quality thresholds to be estimated, with separate assessments for rivers, lakes, and ground water. Probability-type monitoring can make water quality statements for larger geographic areas nested into each other, rather than for a waterbody, which is the current limitation. In contrast, 305(b) reporting from other programs defines a waterbody as an approximate five-square-mile area or watershed. Currently, total miles of attainment are calculated by summing up the individual five-square-mile waterbodies across the state. The data are displayed by hydrologic unit code (HUC), but this is an assessment of individual waterbody quality and not of the

HUC. Since individual waterbodies are not representative of any other waterbody, the results cannot be extrapolated between them.

Probability-type monitoring can provide unbiased estimates by HUC, basin, and region, and for the entire state. This monitoring can be used to provide 100 percent coverage of Florida's water resources, thus meeting the long-term 305(b) goal for comprehensive resource characterization. The EPA and the 305(b) Consistency Work Group continues to develop guidance for data integration. The efforts of the Status Network to integrate its surface water and ground water monitoring efforts fit into the guidance of the Work Group.

Probability-based sampling is most appropriate for the evaluation of Class III fresh waters and Class II and III marine waters, specifically for aquatic life support and recreational use support assessments. These are by far the greatest number of miles of waters in the state and the least likely to be sampled adequately in a targeted program.

Unfortunately, a probability-based design cannot answer questions about changes in individual waterbodies or regulatory changes that affect only a localized area; nor can it address whether an individual waterbody is impaired and should be placed on the 303(d) list. It can, however, provide reference water quality for an area or region of the state. The assessment of targeted sampling can be used to identify specific waterbodies and causes for nonsupport. Targeted sampling is needed to address these issues.

Class I and Class IV waters are best covered under a targeted approach that addresses their usability as drinking water supply and agricultural water supply, respectively, since there are a relatively small number of Class I and Class IV surface waters, and their objectives are more narrowly defined.

Schedule of Reporting

Status Network reports for the rotating basin sampling can be found on FDEP's website: http://www.dep.state.fl.us/water/monitoring/basins.htm. These are available to the public, and other interested agencies/programs/individuals. These are produced for each TMDL basin. Future reports will be annual, with an emphasis on statewide reporting.

Every two years, results can be incorporated into FDEP's 305(b) Integrated Report to the EPA. A statewide assessment for results from 2004-2008 is in preparation in anticipation of the 2010 305(b) submittal.

Periodically, as data are generated from the Status Network, assessments of a variety of types (independent of 305[b] assessments) are generated. As these miscellaneous reports are generated, they are distributed to programs within FDEP, other state agencies, the WMDs, local governments, and the public as needed. For example, a report on the status of the water resources in the St. Johns River Water Management District (SJRWMD) will be generated periodically and sent to the SJRWMD for review. Once approved, the final report will be sent to the SJRWMD headquarters and distributed to local governments in northeast Florida and to the general public.

Programmatic Evaluation

Florida, in consultation with the EPA, provides a review of each aspect of its monitoring program to determine how well the program serves its water quality decision needs for state waters. The EPA and FDEP QA plans and audits are used in evaluating the monitoring program to determine how well each of the elements is addressed and how to incorporate needed changes and additions into future monitoring cycles.

Chapter 5: Temporal Variability (Trend) Network

The Temporal Variability or Trend Network (http://www.dep.state.fl.us/water/monitoring/trend.htm), which consists of a surface water network and a ground water network, complements the Status Network. Samples are collected monthly at surface water fixed stations throughout the state. The Trend Network is intended to associate Tier I, II, and III sampling results with seasonal climatic changes (i.e., sampling occurring during wet or dry hydrographic periods), estimate general basin wide loading at the hydrologic unit code (HUC) level for sampled indicators, and make the best temporal estimates of population parameters for sampled indicators (e.g., means, variances, etc.).

Monitoring Design

The Trend Network was designed to achieve the following:

Determine the existence of trends in water quality,

If trends exist, determine the most likely causes of the trends,

Correlate the results of the probabilistic sampling of the Status Network with seasonal hydrological variations,

Estimate the temporal variances of sampled analytes, and

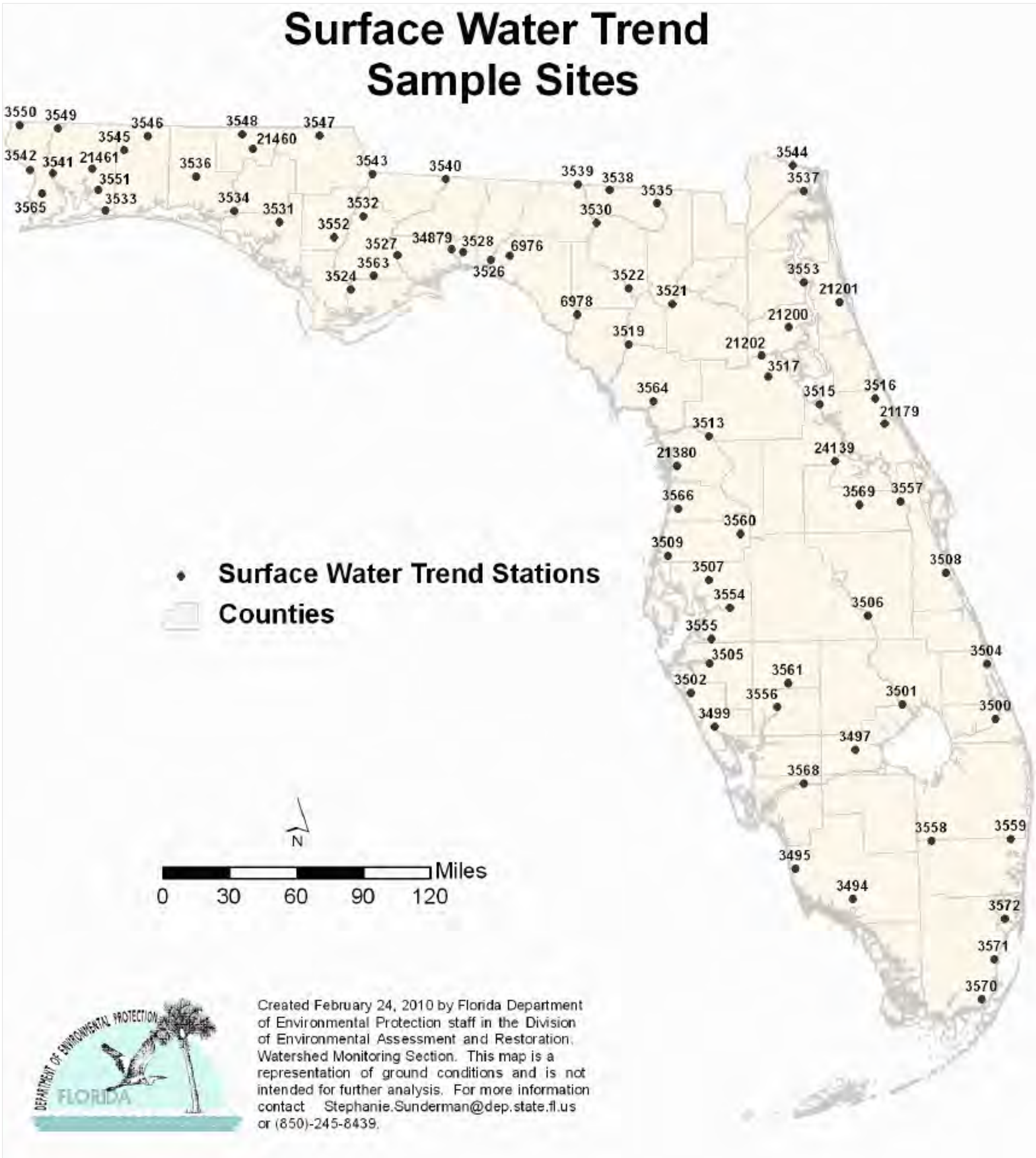
Provide information to managers, legislators, agencies, and the public.

Surface Water Temporal Variability (Trend) Network

The Surface Water Temporal Variability (SWTV, or Trend) Network consists of fixed location sites that are sampled monthly ***(Figure 7).*** Most of the SWTV stations are non-tidal high-order rivers, and some are at or near existing gauging stations. The sites, which are usually located at the lower end of a basin, enable FDEP to obtain biological assessments and chemistry, discharge, and loading data at a point that integrates the land use activities of the watershed. Some SWTV sites are also located at or near the Florida state boundary with Alabama and Georgia. These stations are used to obtain chemistry and loading data for major streams entering Florida.

Data from SWTV sites are used to assist in evaluating temporal variability in Florida's surface water resources. They are also used to determine trends over time at each site. SWTV sites are not designed to monitor point sources of pollution, since Trend sites are located away from known outfalls or other regulated point sources. The SWTV sites are sampled by staff at the Florida Department of Environmental Protection (FDEP) and by two of the state's five water management district (WMDs); samples are analyzed in FDEP's Central Laboratory. Each site is sampled monthly for physical, chemical, and biological analytes.

Figure 7. Surface Water Temporal Variability Sites

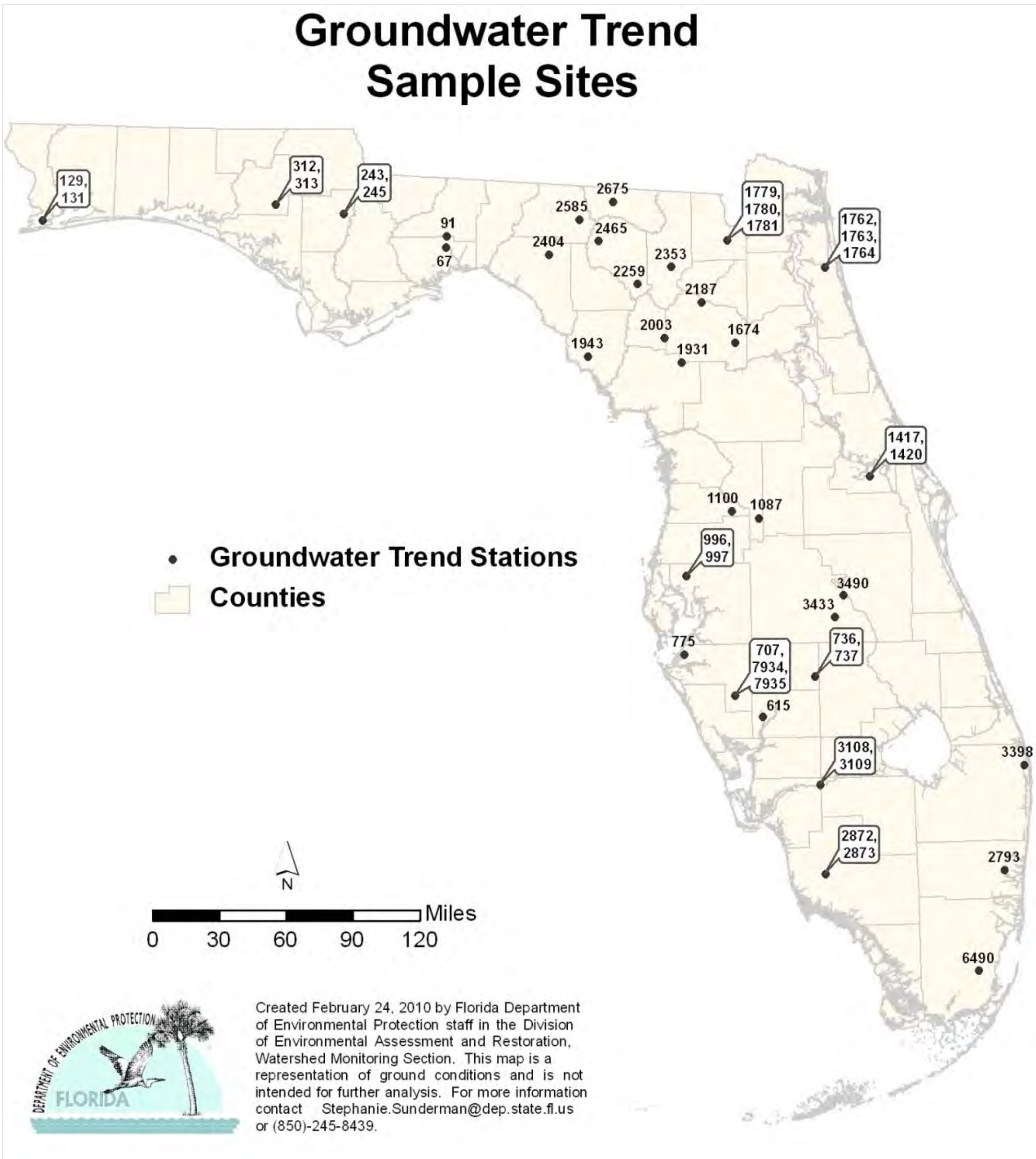


Ground Water Temporal Variability (Trend) Network

The Ground Water Temporal Variability (GWTV, or Tend)) Network consists of 46 fixed location sites ***(Figure 8)*** that are used to obtain chemistry and field analyte data in confined and unconfined aquifers. These data are used to quantify temporal variability in ground water resources and to help determine whether the Status Network samples are collected during wet or dry periods.

As with the SWTV Network, GWTV sites were sampled by staff at FDEP and two of the five WMDs, with the samples analyzed in FDEP's Central Laboratory. Water samples are collected quarterly at all wells in the GWTV Network. Field analytes are also measured monthly at the unconfined-aquifer sites. A micro-land use form is completed annually.

Figure 8. Ground Water Temporal Variability Sites



Core and Supplemental Water Quality Indicators

The analytes and indicators sampled though the Trend Network ***(Tables 6a-f)*** provide chemical and biological information on water quality. These values are used to gauge changes in water quality over time. Some of the analytes are based on a standard or guidance value, while others are designed simply to evaluate the chemical composition of water.

Table 6a. Trend Network field measurement indicators. This is a four column table with column one listing indicators, column two listing analytical method numbers, column three indicates sampling regime for Surface waters and column four indicates sampling regime for Ground waters.

Field Measurement Indicators	Analysis Method	Surface Water	Ground Water
pH	Method 150.1	X	X
Temperature	Method 170.1	X	X
Specific Conductance/Salinity	Method 120.1	X	X
Dissolved Oxygen	Method 360.1	X	X
Turbidity	SOP FT 1600	N/A	X
Secchi Depth	Welch (1948); EPA 620/R-97/001	X	N/A
Total Depth	Manual/electronic measuring device	X	N/A
Sample Depth	Manual/electronic measuring device	X	N/A
Depth to Water	Steel tape and/or chalk	N/A	X

Table 6b. Trend Network biological and microbiological indicators. This is a four column table with column one listing indicators, column two listing analytical method numbers, column three indicates sampling regime for Surface waters and column four indicates sampling regime for Ground waters.

Biological/Microbiological Indicators	Analysis Method	Surface Water	Ground Water
Chlorophyll *a*	SM 10200 H (modified)	T	N/A
Biological Community (SCI)	SM 10500 C (modified)	X*	N/A
Habitat Assessment	SOP FT 3000	X*	N/A
Total Coliform	SM 9222B	N/A	T
Fecal Coliform	SM 9222D	T	T
Enterococci	EPA 1600[1]	T	N/A

[1] 2004-2007 SM 9230C

Table 6c. Trend Network organic and nutrient indicators. This is a four column table with column one listing indicators, column two listing analytical method numbers, column three indicates sampling regime for Surface waters and column four indicates sampling regime for Ground waters.

Organic/Nutrient Indicators	Analysis Method	Surface Water	Ground Water
Total Organic Carbon	Method 415.1	T	T
Nitrate + Nitrite	Method 353.2	T	D/T*[2]
Ammonia	Method 350.1	T	D/T*[2]
Total Kjeldahl Nitrogen	Method 351.2	T	D/T*[2]
Phosphorus	Method 365.1/365.4	T	D/T*[2]
Orthophosphate	Method 365.1	D[3]	D

[2] Total analysis added annually in 2008; [3] Dropped in 2008;

Table 6d. Trend Network major ion indicators. This is a four column table with column one listing indicators, column two listing analytical method numbers, column three indicates sampling regime for Surface waters and column four indicates sampling regime for Ground waters.

Major Ion Indicators	Analysis Method	Surface Water	Ground Water
Chloride	Method 300	T	D/T*[2]
Sulfate	Method 300	T	D/T*[2]
Fluoride	Method 340.2	T	D/T*[2]
Calcium	Method 200.7	T	D/T*

Magnesium	Method 200.7	T	D/T*
Sodium	Method 200.7	T	D/T*
Potassium	Method 200.7	T	D/T*[2]

[2] Total analysis added annually in 2008

Table 6e. Trend Network metal indicators. This is a four column table with column one listing indicators, column two listing analytical method numbers, column three indicates sampling regime for Surface waters and column four indicates sampling regime for Ground waters.

Metal Indicators	Analysis Method	Surface Water	Ground Water
Aluminum, Arsenic, Calcium, Cadmium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Sodium, Zinc	Method 200.7/200.8	T*[2]	T*

[2] Total analysis added annually in 2008

Table 6f. Trend Network physical property indicators. This is a four column table with column one listing indicators, column two listing analytical method numbers, column three indicates sampling regime for Surface waters and column four indicates sampling regime for Ground waters.

Physical Property Indicators	Analysis Method	Surface Water	Ground Water
Alkalinity	Method 310.1	T	D/T*[2]
Turbidity (Lab)	Method 180.1	T	T
Specific Conductance (Lab)	Method 120.1	T	D/T*[2]
Color	Method 100.2	T	T
Total Suspended Solids	Method 160.1	T	T
Total Dissolved Solids	Method 160.2	T	T

[2] Total analysis added annually in 2008
T = Total sample (unfiltered sample); D = Dissolved sample (filtered sample); X = Other sample or measurement
N/A – Not applicable.
* Collected once a year per site.
All methods, unless otherwise stated, are based on *EPA 600, Methods for Chemical Analysis of Water and Wastes.*

Quality Assurance

In a multiagency, statewide program, it is essential to have a centralized quality assurance (QA) program to ensure that data are properly and consistently collected. The QA Program for the Status Network is coordinated by the Quality Assurance Officer (QAO) with the cooperation of FDEP staff and QA officers at the sampling agencies and analytical laboratories. However, QA is considered to be the responsibility of everyone associated with sampling, monitoring, and data analysis.

The QAO coordinates and oversees data quality activities, monitoring adherence to company policies and procedures and corrective actions. He or she has the authority to recommend and implement immediate corrective measures, without going through chains of command. The QAO's responsibilities are as follows:

Reviews quality control data to determine if data are acceptable;

Performs annual systems audits to ensure compliance with all QA plans and standard operating procedures (SOPs);

Distributes the results of internal and external audits to management and all affected individuals;

Oversees responses to internal and external audits;

Oversees and recommends corrective actions as a result of the audits;

Verifies the implementation of corrective action;

Oversees the administration of performance audits;

Coordinates the preparation of QA reports to management;

Coordinates and oversees the preparation of QA manuals;

Reviews new or proposed procedures to determine appropriate use; also reviews associated method validation information;

Reviews, in writing, initiated corrective actions to assure effectiveness, and recommends additional measures if necessary.

A Sampling Manual based on FDEP's SOPs has been developed for the Status and Trend Networks. This is incorporated into the contracts with all participating agencies. The SOPs require each agency to have a quality system to achieve the following:

1. *Identify, implement, and promote QA policies and procedures that produce data of a known and verifiable quality;*
2. *Create and/or identify and follow SOPs for all activities, both technical and administrative;*
3. *Monitor adherence to the established policies, procedures, and written SOPs;*
4. *Establish and use procedures for continual improvement through both corrective and preventive action policies; and*
5. *Monitor the quality of the organization's product.*

Any updates or changes to the protocols are communicated through project management meetings, two statewide meetings per year, an Internet Web site, and training classes. The classes, which are conducted by FDEP staff, focus on program-specific sampling requirements. The training has been expanded to include bioassessment and sediment sampling techniques.

The accuracy of field measurements is assessed through internal FDEP field reference sample programs. Field samplers test meter calibrations by checking blind reference samples every 5 to 10 sites and call in the results to the QAO before sampling.

Equipment blanks are collected at a rate of 20 percent. This allows staff to monitor the on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water. Problems are indicated by the presence of contaminants found in blanks at levels above the sample results.

All samples are analyzed at FDEP's Bureau of Laboratories. The lab has consistently scored high compared with other environmental labs in the nation in performance reviews by the U.S. Geological Survey (USGS) and the EPA. It is one of the few facilities in the country able to perform ultra low-level metals analyses. In addition to its internal quality assurance/quality control (QA/QC) procedures, FDEP's Watershed Monitoring Section submits blind analytical samples to the lab for analysis. The results have been consistently within expectations.

Data Management

The smooth and timely flow of water quality data from sample collectors and analytical agencies to data analysts is a high priority. The data flow path for the Trend Network is similar to that of the Status Network ***(Figure 5)***

Data collected in the field are computerized at the sampling agency, using an FDEP-written, field data-entry program. This customized software ensured a common data exchange format, facilitating the flow of data from the field. The data-entry software is based on existing software currently in use and includes data entry verification and additional data entry capability.

Water quality samples are tracked from the field to the lab via Access Automated DAta Management (AADAM) software. Files containing analytical data are transferred to FDEP staff using an Internet ftp site, where they are processed and merged with corresponding field data, and linked to the corresponding site data. Computerized accuracy and completeness checks are automatically run, in addition to a variety of other QA checks, including water quality checks and extreme value checks. FDEP manually checks each data file, using results from the computerized reviews to identify any obvious random or systematic errors.

After the preliminary data review for a project is completed, a copy of the project file is transferred to the sampling agency for further review. Notifications required by FDEP are generated automatically and sent to the Florida Department of Health (FDOH), specific FDEP/WMD programs, and property owners. After project data are reviewed, the data is considered “release quality” and made available to the public. All data collected are uploaded to STORET. Periodically, data are uploaded to an in-house Oracle database version of the Generalized Water Information System (GWIS) that is available to FDEP staff.

Data Analysis/Assessment

The Trend Network is specifically designed to provide important information about long-term trends in state water quality. The statistical tests used by this trend-monitoring program require adequate data over a long period of record for meaningful analysis. Because the program was initiated in 2000, data are recently available for analysis, which is underway. A report of ground water trend results is under review for publication, and surface water trend analysis is underway. The results of these investigations of surface water and ground water trends will be presented in future 305(b) reports. Tier II and III investigations of these results, through a new investigation or the use of available data (such as investigating other rivers or aquifers in the region, or examining geographic coverages such as land use), are a reasonable next step.

Preliminary GWTV Data Analysis Protocols

Preliminary protocols have been developed for the GWTV Network, as some data from previous programs can be incorporated for trend analysis. This information is presented below. Protocols are being developed for the SWTV Network will follow a similar format.

Parent and Target Populations

For confined ground water, the parent population is defined as the water from wells tapping confined aquifers of the state that are generally considered potable. Confined aquifers are sufficiently conductive (permeable) to yield economically significant quantities of water to wells. Confined aquifers are bounded above and below by beds of distinctly lower hydraulic conductivities than the aquifers themselves. All confined ground water has the potential to become contaminated, either by land use or by pumping activities.

The target population included the water from all wells tapping the confined aquifers of the state, with two exclusions. The first is ground water that lies directly within or beneath a permitted facility’s zone of discharge (ZOD) (Subsection 62-22.200(23), Florida Administrative Code [F.A.C.]). The second is water influenced by deep well injection (Class I and II wells). FDEP’s Underground Injection Control Program monitors these waters.

The parent population of unconfined ground water is defined as water from wells tapping unconfined aquifers that are generally considered potable. Unconfined aquifers are sufficiently conductive to yield economically significant quantities of water to wells and springs. Unconfined aquifers contain water that has a free water table, i.e., water that is not confined under pressure beneath relatively impermeable beds.

Missing Values, Duplicate Data, and Censored Data

Missing values result from samples that were never collected due to some restriction during the sampling effort. Suppose that 12 monthly samples were scheduled to be collected from an unconfined-aquifer well in a given year but for a variety of reasons, only 10 were actually collected. Thus, there would be 2 missing samples and 2 missing values for each indicator sampled. For the statistical analyses of Trend Network data, unless stated otherwise, missing values are treated as if they were never collected. For example, if only 10 samples were collected, then descriptive statistics are based on 10 samples, instead of 12.

Because of the minimum detection level of analytical laboratories, environmental data are often censored. That is, the distribution is truncated at its lower end. For the statistical analyses, all data reported as “below detection level” (BDL) are arbitrarily that of the detection level. In addition, it should be noted that for a given analyte, over the period of record, the laboratory detection level varies. Therefore, it should be understood that when preparing descriptive statistics, the minimum level is often the lowest detection level of the laboratory over the period of record for Trend Network sampling.

Information Goals

Goal 1. Statistically describe the analytes/indicators.

A descriptive statistics table is prepared with data from each Trend site ***(Table 7).*** The table labels the analyte (or indicator); the measurement unit; the number of samples collected; the number of samples with concentrations below the laboratory detection level (BDL); the minimum value; the first, second and third quartiles; and the maximum value. The first, second, and third quartiles (Q1, Q2, and Q3) correspond to the 25^{th}, 50^{th} (median), and 75^{th} percentiles, respectively. Note that for a given analyte, the reported minimum concentration value in the table mostly reflects the minimum detection level reported by the analytical laboratory.

Table 7. Example of Descriptive Statistics for GWTV Network Wells

Analyte	Measurement Unit	Number of Samples	Number of BDLs	Minimum Value	Q1 Value	Median Value	Q3 Value	Maximum Value
NO3	mg/L	30	7	0.05	0.09	1.00	2.00	10.30
o-PO4	mg/L	29	4	0.05	0.10	0.10	0.15	1.30

NO3 – nitrate; o-PO4 – ortho-phosphate; mg/L – milligrams per liter

Goal 2. Determine if seasonality exists in the time series data.

For each set of data, for the period of record, seasonality was determined by conducting a Kruskal-Wallis (K-W) test. As it turns out, data from the wells and springs have generally been collected either monthly or quarterly for the period of record. For this reason, seasonality tests were conducted on monthly and quarterly data, whichever was applicable. For quarterly sampling, the quarters are as follows: (1) December–February, (2) March–May, (3) June–August, and (4) September–November.

The K-W test compares the distribution of two or more populations by indirectly comparing their mean or their median values. If only two populations are compared, the test is equivalent to a Mann-Whitney (M-W) test. Consider a situation in which one wants to determine if two populations have the same distributions. For the M-W test, the null hypothesis is that the distributions of the two populations are the same, while the alternate hypothesis is that they are not. The two samples are combined into a single sample ordered from smallest to highest. Each observation is then assigned a rank, without regard to which sample it originally came from. The sum of the ranks assigned to those values from one of the populations is generated. If the rank sum of the corresponding population is very small (or very large), this is an indication that the values from one population tends to be smaller (or larger) than the values from the other. If so, the distributions of the two populations are not equal. It should be noted that if the rank sums of the two populations are not equal, neither are their medians.

The K-W test compares the distribution of more than two populations (e.g., seasons). For this report, each test is two-sided. The null hypothesis is that the median concentration of an analyte sampled in any season is equal to the median of the remaining seasons. The alternate hypothesis is that the median concentration for at least one season is not equal to the remaining seasons. The α level is preset at 0.05. For monthly data sets, tests are conducted assuming that each month is a season. For quarterly data, tests are conducted assuming that each quarter is a season.

If seasonal cycles are present, the effects of the seasonal cycles are removed. The procedure is discussed in the following section on Goal 3.

Goal 3. Determine if linear time series trends exist. If yes, determine the slopes.

During the conceptual phases of this monitoring network, there was a concern that a linear trend in a time series might be found for one period, while another trend might be found for a different period. For example, suppose an upward trend was found for the first half of a time series, while a downward trend was found for the second half, or vice versa. Detectable trends are dependent on the period for which they are analyzed.

For ***nonseasonalized*** data (data sets with no seasons), the existence of upward or downward linear trends in the data is determined. At each water resource, for each analyte, a Mann-Kendall (M-K) statistical test for a monotonic linear trend is conducted. The M-K test is a very useful procedure, because missing values are allowed. In addition, data reported as trace or BDL can be used by assigning them a common value that is smaller than, or equal to, the smallest measured value in the data set. For this report, BDLs are assigned an arbitrary value equal to the lowest detection level for the period of record.

The M-K tests for a linear temporal trend in nonparametric data. It does not depend on an assumption of a particular underlying distribution. The test identifies correlations in data by temporally ranking the data and then determining the number of times the concentration goes up or down compared with the previous time step. It only uses the relative magnitudes of the data, rather than their measured values. For this application, each test is two-sided. The null hypothesis is that there is no monotonic linear slope in the concentration. The alternate hypothesis is that there is a slope. The α level is 0.05.

If seasonal cycles are present in the data, they are deseasonalized by subtracting the mean of the corresponding season from each datum and then adding the overall average back to the original datum. For example, suppose 10 years of quarterly data are collected at a site for chloride. The overall mean of the data is 1.0, while the mean of the winter quarter is 0.2 milligrams per liter (mg/L). Suppose a concentration for a winter quarter sample is 1.2 mg/L. In mg/L, the corresponding transformed, deseasonalized datum becomes the following:

***x* = 1.2 (original) – 0.2 mg/L (winter mean) + 1.0 (overall mean) = 2.0 (transformed)**

Once all data have been transformed, an M-K test is performed on the deseasonalized data. As before, the null hypothesis is that there is no slope in the concentration of an analyte over the timeline. The alternate hypothesis is that there is a slope. The α level is 0.05.

If a trend exists, its corresponding slope is determined using a Sen-Slope (S-S) estimator. The method measures the median difference between successive concentration observations over the time series.

In addition to the S-S estimator, a time series plot of the data is produced. Time is plotted on the horizontal axis, while concentrations are plotted on the vertical axis. Smoothing procedures make visual inspections of time series plots easier to interpret. For this reason, Loess smoothing is used on the time series curve. This is a tri-cube kernel technique used on the nearest 50 percent of the data in order to produce an estimated predicted value for a corresponding observed data point on, for example, a timeline.

Goal 4. Determine the spatial, depth, land use, or other related relationships for wells with detectable trends.

For each water resource for which a trend is detected, the location of the station on a map is plotted for each analyte. Visual estimates are made about whether clusters of stations exist. If clusters do exist, M-K tests for homogeneity ($M\text{-}K_h$) of stations are conducted, since when data are collected at several stations in a region, there may be interest in making a regional statement about trends. A general statement about the presence or absence of monotonic trends is meaningful if the trends at all the stations are in the same direction.

The $M\text{-}K_h$ procedure estimates whether two or more stations display homogeneous trends. For these data, the test is two-sided. The null hypothesis is that there is homogeneity in trends among the stations in question. The alternate is that homogeneity does not exist. The α level is preset at 0.05.

In addition to visual detections of clusters, other types of possible associations are checked. Relationships with geomorphology, land use, and depth are evaluated. For example, if several wells located in the same geomorphic region display positive trends, homogeneity tests for those wells are conducted. The same procedure is used as needed for land uses, well depths, and other possible relationships.

Goal 5. Discuss probable causes and, if trends are believed to be human induced, discuss possible solutions.

A table can be generated for data displaying a trend. ***Table 8*** provides a sample. The table includes the station (well or spring) with a trend, the tests on which the results were based, the time segment for which the trend is identified, the analyte with a trend, the direction of the trend, and the p-value of the corresponding test.

Table 8. Sample Results of Time Series Statistical Tests for Wells
(Only analytes displaying a significant difference are displayed.)
M-K = Mann-Kendall, S-K= Seasonal Kendall (Total comparisons = 110) (α = 0.05)

Station	Test	Time Segment	Analyte	Direction	P-Value
SR Well 10	M-K M-K	A	Water level NO3	Down Up	0.003 0.001
SR Well 10	M-K	B	Water level	Down	0.021
SR Well 10	M-K	C	NO3	Up	0.001
SW Well 5	S-K	B, winter	Total dissolved solids (TDS)	Up	0.020
SW Well 5	S-K	C, winter	TDS	Down	0.024

The stations and analytes that display homogeneity in trends are displayed in a separate table. For each trend, possible reasons as to why the analyte has a trend can be discussed. If homogeneity in trends exists for a group of stations, the plausible reasons for the homogeneity are noted. If the trend is believed to be human induced, plausible solutions to the problem are discussed.

Goal 6. Compare analyte concentrations collected during the Status Network sampling index period with the overall 12-month cycle based on the Trend Network period of record.

One of the objectives of the Status Network is to sample a basin once during a sampling cycle and make a statement about the overall water quality in that basin. The basin was sampled during a two- or three-month index period during one year of a sampling cycle.

The index period time frames were established by consensus among a group of scientists from across the state. Specific data were not used in the decision. Since the network sampling began, however, more and more individuals have expressed concern that the index period may not actually represent a time when a resource is in a stable condition.

Questions such as these are being addressed both qualitatively and quantitatively.
For each analyte, the minimum value, Q1, Q2, Q3, maximum value, inter-quartile range (Q3 through Q1), and the range are included in a table. In addition, box-plots of the two sets of data are plotted side by side for qualitative comparisons.

Quantitative comparisons are also conducted. For (1) and (2), median values of the different distributions are compared using the M-W test. In addition, a Conover test is used to determine whether the variances are equal. The test is a nonparametric test that is analogous to an M-W test, in that it is based on ranks. Recall that for the M-W test, the two samples are combined into a single ordered sample, from the smallest to the highest. Each observation is assigned a rank, without regard to which sample it came from.

The Conover test is slightly different. First, the Sample 1 mean is subtracted from each observation in Sample 1. Then the Sample 2 mean is subtracted from each observation in Sample 2. The absolute values of both samples are combined into a single ordered sample from smallest to highest. Each value is assigned a rank, without regard to which sample it came from. The sum of the ranks assigned to those values from one of the samples is then generated. If the rank sum of the corresponding population is too small (or too large), then there is an indication that the value from one population tends to be smaller (or larger) than the value from the other. If so, the variances of the two populations are not equal. Each test is two-sided and the α level is 0.05. The null hypothesis for the first test is that the dispersions (variances) of the two populations are equal. The null hypothesis for the second test is that the dispersions of the two populations are equal; while the alternate hypothesis is that the dispersions are not equal. A two-sided test with an α level of 0.05 is used for each test.

Finally, a Kolmogorov-Smirnov (K-S) test is also used to compare the populations mentioned in (1) and (2). The test compares the cumulative frequency distributions of the two populations and locates the greatest deviation between the two distributions. If the maximum deviation exceeds a critical value, then the two distributions are not considered to be equal. The null hypothesis is that the distributions are equal; while the alternate hypothesis is that the distributions are not equal. A two-sided test with an α level equal to 0.05 is used.

Goal 7. Summarize the major water quality issues and recommend sampling strategies.

Using the information generated from Goals 1 through 6, as well as other information generated as necessary, the major water quality issues for each and Trend Network station is summarized. This will also lead to recommendations regarding future sampling of surface or ground water resources. Of interest, a study using the above approach has concluded that seasonality does not exist in groundwater, thus samples could be collected during any time of the year. This complementary information helps in the development of future monitoring designs.

Reporting

The results of all laboratory analyses are available on FDEP's ORACLE database. The interpretative results of all resource analyses are periodically presented in reports prepared as data sufficiency requirements are met.

The interpretative reports are being currently prepared for FDEP's technical and management-level staff. They describe the overall trend of each sampled site. The reports include suggestions to management regarding possible action steps needed to mitigate violations of designated use criteria, if detected.

For example, if the value of the concentration of a compound is at or above the state's maximum contaminant level in a GWTV well, FDEP's Watershed Monitoring Section notifies the property owner and the FDOH. FDOH determines whether it will resample the well. Internal FDEP programs are also informed, if necessary.

Programmatic Evaluation

Florida, in consultation with the EPA, reviews each aspect of its monitoring program to determine how well the program serves its water quality decision needs for all state waters. Audits are used in evaluating the monitoring program to determine how well each of the elements is addressed and how to incorporate needed changes and additions into future monitoring cycles.

SECTION C: TIER II MONITORING

Chapter 6: Springs Initiative

Since the 1970s, scientists have observed declining water quality in many Florida springs. In many cases, this decline is related to increased nutrient levels. Contaminants that reach ground water and flow to springs often stem from agricultural and residential fertilizer applications, urban stormwater runoff, and human wastewater from septic tanks and spray fields. The Florida Department of Environmental Protection's (FDEP) Ground Water Protection Section is currently performing water quality assessments to identify specific contaminants that may affect first-magnitude spring systems in the state.

Between 1950 and 2000, Florida's human population grew fivefold. The state's population continues to increase, and it is estimated that another fivefold increase will occur by 2025, when the number of residents will exceed 20 million. An unavoidable rise in water use and extensive land use changes have accompanied, and will continue to accompany, this growth. During the 20th century, reductions in flow were noted for many Florida's springs. As a result of incompatible land use practices in vulnerable areas, along with increasing ground water withdrawals, some springs have poor water quality or decreased flows.

Recognizing the declining condition of the state's springs, the Secretary of FDEP directed the formation of a multiple agency Florida Springs Task Force to recommend strategies for protecting and restoring Florida's springs. The task force's report, *Florida's Springs: Strategies for Protection and Restoration,* identifies current problems in Florida's spring systems and a series of recommended "Action Steps." The report is available at http://www.dep.state.fl.us/springs/reports/FloridaSpringsReport.pdf.

Early in 2001, the Florida Springs Task Force II was formed to guide the implementation of these "Action Steps." During the same year, the Florida legislature, with the support of the Governor and the Secretary of FDEP, allocated approximately $2.5 million to fund the Florida Springs Initiative, which began the process of protecting and restoring Florida's springs. Funding was continued in 2002, 2003, and 2004, with a total of approximately $9.9 million appropriated. In 2002–2003, approximately $7.5 million was spent in three broad areas: research and monitoring, landowner assistance, and educational outreach. Continuous funding has enabled the state to pursue protection efforts that focus on identifying in greater detail ground water spring basins and associated land uses and threats, carrying out continued research and monitoring, and developing educational programs.

Monitoring Design

The Florida Springs Initiative is a state-funded program designed in part to achieve the following goals:

Stop the degradation of water quality and the loss of spring flow;

Begin restoring the state's springs to their former health; and

Enhance the understanding of Florida's springs.

As a part of the Springs Initiative, water quality measurements are being collected from selected springs throughout the state. There are two parts to this effort: a baseline measurement and ongoing monitoring. A one-time expanded list of inorganic and metals analytes at all selected springs will provide information for the Florida Geological Survey (FGS) *Springs of Florida* update. Quarterly monitoring, using a basic list of analytes, will be carried out at selected springs as part of a long-term investigation of the health of springs under state or federal ownership. Additional analytes may be added to this list as necessary.

Since the investigation focuses on the quality of the water as it first enters the spring system, samples will be collected at the spring vent, where the discharge enters the system. Other water quality sampling efforts overseen by FDEP's Bureau of Laboratories focus on the biological health of spring systems; the latter are addressing the surface water component, which is separate from the Springs Initiative.

The Florida Springs Water Quality Monitoring Network is a fixed station network consisting of 43 freshwater spring vents, 9 subaquatic conduits (accessed via wells), 2 coastal submarine spring vents, and 1 river rise, for a total of 55 discrete sampling locations ***(Table 9).*** These sampling stations are located within first- and second-magnitude springs, in karst regions stretching from the Florida Panhandle to central Florida ***(Figure 9).***

Nonconduit water quality samples are collected from the bottom of spring vents outside the overhead environment; for regulatory purposes, these are considered to be surface water samples. Surface water quality standards are applied when analyzing the sample results, based on the designated use of spring-run waters at each location. Subaquatic conduits are accessed through sampling tubes installed in wells drilled from the land surface into specific cave locations. Ground water quality standards are applied to the results from these sites. FGS field staff sample the core analytes quarterly (January, April, July, and October) and biannually (April and October) for trace metals.

The continuous gauging of many spring runs and some conduit sites is performed through agreements with the U.S. Geological Survey (USGS) ***(Table 10).*** The FGS collects additional discharge measurements whenever a water quality sample is collected. Northwest Florida Water Management District (NWFWMD) staff assist in this effort whenever the FGS collects water quality samples in the Panhandle region of Florida.

Most conduit sites also include dedicated flow measurement equipment. For example, dedicated current meters are deployed in several locations in the Wakulla Spring cave.

In addition to water quality and discharge measurements, FDEP Bureau of Laboratories staff perform quarterly to biannual bioassessments in selected spring runs. These investigations include assessments of riparian zone health, habitat description, biological sampling, and limited water quality sampling.

Table 9. First- and Second-Magnitude Spring Monitoring Sites

Spring Name	County	Type
Alexander Springs	Lake	Spring
Apopka (Gourdneck) Spring	Lake	Spring
Blue Spring (Jackson)	Jackson	Spring
Blue Spring (Lafayette)	Lafayette	Spring
Blue Spring (Madison)	Madison	Spring
Blue Spring (Volusia)	Volusia	Spring
Cypress Spring	Washington	Spring
Devil's Ear / Devils Eye / July Spring System	Gilchrist	Spring
Juniper Spring	Marion	Spring
Fanning Springs	Levy	Spring
Lithia Springs Major	Hillsborough	Spring
Marion Salt Springs	Marion	Spring
Morrison Spring	Walton	Spring
De Leon Springs	Volusia	Spring
Rock Springs	Orange	Spring
Silver Glen Springs	Marion	Spring
St. Marks Spring	Leon	River Rise
Troy Spring	Lafayette	Spring
Weeki Wachee	Hernando	Spring
Wekiwa Springs	Orange	Spring
Chassahowitzka Springs Group	Citrus	Spring
Chassahowitzka Main	Citrus	Spring
Chassahowitzka #1	Citrus	Spring
Gainer Springs Group	Bay	Spring
Gainer #1C	Bay	Spring
Gainer #2	Bay	Spring
Gainer #3	Bay	Spring
Homosassa Springs Group	Citrus	Spring
Homosassa #1	Citrus	Spring
Homosassa #2	Citrus	Spring
Homosassa #3	Citrus	Spring
Ichetucknee Springs Group	Suwannee	Spring
Ichetucknee Spring Main	Suwannee	Spring
Mission Spring Vent	Columbia	Spring
Mill Pond Spring	Columbia	Spring
Kings Bay Springs Group	Citrus	Spring
Hunter Spring	Citrus	Spring
Tarpon Hole Spring	Citrus	Spring

Spring Name	County	Type
Manatee Spring	Levy	Spring
Manatee Spring	Levy	Spring
Manatee- Blue Water Tunnel	Levy	Conduit
Manatee - Sewer Tunnel	Levy	Conduit
Manatee - Main Tunnel	Levy	Conduit
Rainbow Springs Group	Marion	Spring
Rainbow Bubbling Spring	Marion	Spring
Rainbow #1	Marion	Spring
Rainbow #4	Marion	Spring
Rainbow #6	Marion	Spring
Silver Springs Group	Marion	Spring
Main	Marion	Spring
Reception Hall	Marion	Spring
Blue Grotto	Marion	Spring
Spring Creek Springs Group	Wakulla	Submarine Spring
Spring Creek Rise (Spring #1)	Wakulla	Submarine Spring
Spring Creek Rise (Spring #2)	Wakulla	Submarine Spring
Wacissa Springs Group	Jefferson	Spring
Big Spring	Jefferson	Spring
Wacissa Head/Spring #2	Jefferson	Spring
Wakulla Spring	Wakulla	Spring
Wakulla Spring	Wakulla	Spring
Wakulla Tubing A/D-Tunnel	Wakulla	Conduit
Wakulla Tubing A/K-Tunnel	Wakulla	Conduit
Wakulla Tubing B-Tunnel	Wakulla	Conduit
Wakulla Tubing C-Tunnel	Wakulla	Conduit
Wakulla Tubing D-Tunnel	Wakulla	Conduit
Wakulla Tubing K-Tunnel	Wakulla	Conduit

Figure 9. Springs Initiative Sampling Sites

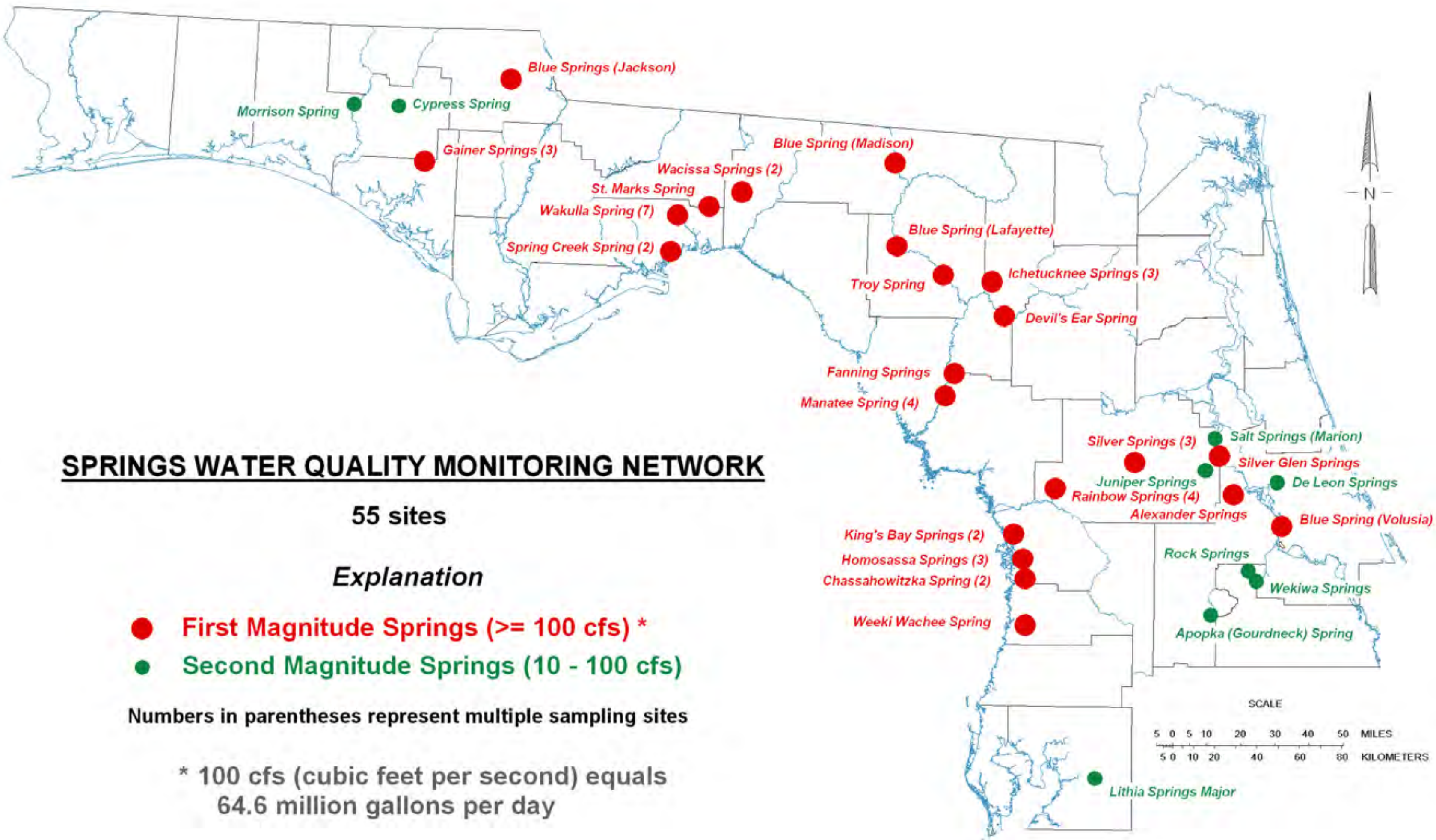


Table 10. U.S. Geological Survey First- and Second-Magnitude Spring Gauging Sites in Florida

Proposed Springs	County	Measurements/Comments
Blue Spring	Jackson	Includes additional measurements
Blue Springs	Volusia	Continuous stage; includes AVM
Chassahowitzka Springs Group	Citrus	Remove velocity meter and operate this site as a regression site with supplemental measurements
Fanning Spring	Levy	Continuous stage; includes AVM and DCP
Homosassa Springs Group	Citrus	Remove velocity meter and operate this site as a regression site with supplemental measurements
Ichetucknee River at U.S. 27	Suwannee	Stage-Discharge site; no DCP
Ichetucknee Head Spring	Suwannee	Stage-Discharge site; no DCP; includes Outreach Signpost
Blue Hole Spring	Suwannee	Stage-Discharge site; no DCP; includes Outreach Signpost
Cedar Head Spring	Suwannee	Stage-Discharge site; no DCP
Devil's Eye Spring	Suwannee	Stage-Discharge site; no DCP
Mission Springs Group	Suwannee	Stage-Discharge site; no DCP, includes 7 measurements at Fig Spring
Mill Pond Spring	Suwannee	Stage-Discharge site; no DCP
Ichetucknee River above Dampier's Landing	Suwannee	Stage-Discharge site; no DCP
Coffee Spring	Suwannee	7 measurements/year
King’s Bay Springs Group	Citrus	Continue collecting velocity meter and ADCP measurements, improve rating, compute discharge
Little Fanning Spring	Levy	7 measurements/year included in cost of Fanning gage
Manatee Spring	Levy	Continuous stage; includes AVM and DCP
Rainbow Springs Group	Marion	Continuous stage
Silver Glen Spring	Marion	Ott AVW with two transducers; stage at current locations; index velocity flow determination
Silver Springs	Marion	Stage-Discharge site
Troy Spring	Lafayette	Continuous stage; includes AVM, well, and DCP
Wakulla Springs	Wakulla	Procure Campbell instruments, coordinate program writing, QA velocity data, rate flow for main vent, and display on NWISWeb
Weeki Wachee Main Spring	Hernando	Continue collecting velocity meter and ADCP measurements, improve rating, compute

		discharge w/ADCP; index velocity

Core and Supplemental Water Quality Indicators

Table 11 lists the core chemical and field analytes collected at each station; these are similar to those collected for the ground water portion of the Status and Trend Networks. In addition to core analytes, an extended list of supplemental analytes is collected on a multiyear, rotating basis; currently, trace metals are being sampled.

Disparities between ground water and surface water quality standards are problematic when analyzing the results from spring vents and conduits, particularly for nutrient concentrations. Differences in water chemistry and biology between spring runs and other Florida streams are also prompting a re-evaluation of the tools used in performing spring assessments. FDEP has created a Nutrient Advisory Committee to investigate and make recommendations for the development of quantitative nutrient criteria to help address these issues.

Quality Assurance

During sampling, staff must adhere to the requirements set forth in Rule 62-160, Florida Administrative Code (F.A.C.), and in the document *Requirements for Field and Analytical Work performed for the Department of Environmental Protection under Contract* (DEP-QA-002/02, April 15, 2002). This document lists specific procedures for sampling at springs that may not be directly addressed in the FDEP document, *Standard Operating Procedures for Field Activities* (DEP-SOP-001/01, February 1, 2004). If a sampling agency wants to deviate from a standard procedure, the nonstandard procedure must be submitted for review and approval in accordance with FA 2000 of FDEP's standard operating procedures (SOPs). FDEP must approve the procedure before use.

Water quality sampling procedures are outlined in the document *Springs Initiative Monitoring Standard Operating Procedure*. All water quality samples collected through this effort are analyzed by FDEP's laboratory, a National Environmental Laboratory Accreditation Program (NELAP)-certified facility.

The accuracy of field measurements is assessed through internal and field reference sample programs. Field samplers test meter calibrations by checking blind pH and conductance reference samples every 5 to 10 sites. The sampler reports the results to FDEP's quality assurance (QA) Officer or Project Manager by fax, telephone, or email. The results are evaluated quickly, and a satisfactory, marginal, or unsatisfactory rating is provided. If the results are unsatisfactory or marginal, a follow-up reference sample is analyzed. Typical reasons for poor performance on field reference samples include dirty probes, low batteries, contaminated standards, faulty meters, and occasionally analyst error. If unsatisfactory results are not resolved before actual field measurements are taken, the field measurements must be qualified with the appropriate qualifier code for the failed parameter.

Table 11. Springs Initiative Core and Supplemental Indicators

Core Indicators	Filtered/total/other
Calcium	D, T
Magnesium	D, T
Sodium	D, T
Potassium	D, T
Chloride	D, T
Sulfate	D, T
Fluoride	D, T
Alkalinity as CaCO3	D, T
Nitrate + Nitrite	D, T
Ammonia	D, T
Kjeldahl Nitrogen	D, T
Total Phosphorus	D, T
Orthophosphate	D
Specific Conductance	D
Organic Carbon	T
Dissolved Solids	T
Suspended Solids	T
Turbidity	T
Color	T
Total Coliform	T
Fecal Coliform	T
Enterococci	T
Water Temperature	X
pH	X
Specific Conductance/Salinity	X
Dissolved Oxygen	X
Secchi Depth	X*
Estimated Sample Depth	X
Stage	X*
Discharge	X*

Extended Indicators	Filtered/total/other
Aluminum	D, T
Arsenic	D, T
Barium	D, T
Boron	D, T
Cadmium	D, T
Cobalt	D, T
Chromium	D, T
Copper	D, T
Iron	D, T
Manganese	D, T
Nickel	D, T
Lead	D, T
Selenium	D, T
Tin	D, T
Strontium	D, T
Zinc	D, T

T = Total sample
D = Dissolved or filtered sample
X = Field measurement
* = Measurement collected whenever possible

An equipment or field blank sample is collected after approximately every 5 samples. Equipment blanks test the cleanliness or purity of the sampling equipment and containers, preservatives, and analyte-free water and water containers, in addition to sampling methods and laboratory methods. The equipment blank is collected by running analyte-free water through all equipment used to collect actual samples. All procedures should be the same as for an actual sample.

Field blanks must be taken in cases where the only sampling equipment is the sample container. They should also be collected if analytes are detected at high levels in equipment blanks, in order to better isolate the contamination source. These blanks will aid in determining if the contamination results from water that is not analyte-free, a dirty water container, or fouled acid preservatives. Field blanks consist of filling on site a suite of sample containers with analyte-free water from the water container, preserving the appropriate containers with the necessary acid preservative, sealing the containers, documenting them as quality assurance samples/field blanks, and shipping them to the laboratory, as is done with actual field samples. The custody and field sheets must indicate that a field blank sample was collected.

Adherence to standard field protocols is verified by periodic internal and external field audits of sampling agencies. These field audits are carried out by Springs Initiative staff, working with FDEP's Bureau of Laboratories QA Section staff. The accuracy of field measurements is assessed through internal (FDEP) and external (U.S. Geological Survey [USGS]) field reference sample programs. Formalized procedures for computerized and manual data review, developed for the Status Network, are also applied to Springs project data.

Data Management

Water quality samples are tracked from the field to the lab via FDEP's Access Automated DAta Management (AADAM) software. Analytical results are provided electronically using the FDEP Laboratory Information Management System (LIMS) to staff in FDEP's Watershed Monitoring Section, where they are processed and merged with corresponding field data, and linked to the corresponding site data. Computerized accuracy and completeness checks are automatically run, in addition to a variety of other QA checks, water quality checks, and extreme value checks. FDEP staff manually check each data file, using results from the computerized reviews to identify any obvious random or systematic errors.

After the data undergo a preliminary review, a copy of the project file is transferred to the FGS (sampling agency) for review. After the review is completed, the data are considered "release quality," ready to be made available to FDEP staff and the general public. All data collected are uploaded to STORET annually. Periodically, data are uploaded to FDEP's Oracle-based Generalized Water Information System (OGWIS) that is available to FDEP staff. Hydroport, a user-friendly ground water quality data retrieval and analysis tool currently in beta testing, will soon be used to serve up these data online through the Ground Water Protection Section's Web site at: http://www.dep.state.fl.us/water/groundwater/index.htm.

Data Analysis/Assessment

Springs water quality and discharge data will be analyzed statistically to determine long-term trends. Very few water quality data exist for Florida springs prior to 2001. Significant statewide spring sampling took place on three prior occasions: 1947, 1972–73, and 1985, with some additional limited sampling done in 1924, 1956, and 1966–68. The USGS has collected flow data for a few of the more prominent springs since the 1930s.

Staff of the Hydrogeology Program at FGS have performed preliminary water quality trend analysis using historical springs data and available post-2000 data. Trend analysis of recent springs data began during 2004. The statistical analysis of trends in data collected beginning in late 2001 has been hampered by insufficient data. This is due in part to the short period of collection and the approximately six-month lag between data collection and release.

The analysis of specific analytes will be used in some instances to estimate the proportion of source waters (recent surface water vs. primary ground water) contributing to total spring flow. More involved analyses will be used to relate discharge volume to water quality. A springs ground water quality index has been proposed to rank and compare water quality between individual spring vents and between spring systems.

Initially, springs data will be analyzed based on a comparison with applicable water quality standards. For ground water (such as conduit well samples), U.S. Environmental Protection Agency (EPA) primary and secondary drinking water standards apply, as do FDEP ground water guidance concentrations. All other spring samples (vent, submarine spring, river rise) will be compared with the designated use of a specific waterbody.

Reporting

All field measurements and water quality data collected through the quarterly Springs Network are housed in OGWIS. From here, data are periodically uploaded to Florida STORET and are also exported to Hydroport, an innovative ground water quality data retrieval and analysis tool. When released, Hydroport will be used to serve up data to users via the Internet at http://floridagroundwater.dep.state.fl.us/.

FGS Bulletin 66, *Springs of Florida,* September 2004, is a compendium of information on the 700-plus known springs of the state; it includes photos, site descriptions, discharge, and locational information on the most significant springs. Water quality samples were collected during site visits to springs from 2001 to 2003. The report includes the results of this sampling effort, along with data collected for publication in earlier FGS spring surveys published in 1947 and 1977.

Ecosummaries, biological assessments performed quarterly to biannually in several of Florida's larger spring runs, are available online from FDEP at http://www.dep.state.fl.us/labs/cgi-bin/reports/results.asp. All spring water quality data are made available for use in Florida's Section 305(b) water quality report, submitted biannually to the EPA.

Programmatic Evaluation

FDEP's Florida Springs Water Quality Monitoring Network (FSWQMN) was developed by an advisory team made up of Florida Springs Initiative staff, assisted by staff from the FDEP's Watershed Monitoring Section, FDEP's Bureau of Laboratories, and the FGS Hydrogeology Program and Geological Investigations Section. To the greatest extent possible, efforts were made to incorporate this network into the rotating watershed management cycle used by the Status Network and TMDL Programs, while maintaining the goals set forth by the Florida Springs Task Force.

Third-party programmatic evaluation of the FSWQMN has not yet been commissioned, as the overall monitoring effort has been under way for less than 3 years. An external program audit is tentatively planned for Year 5. Much of this network is a product of work and procedures developed for the FDEP Watershed Monitoring Section's Temporal Variability (Trend) Network.

Chapter 7: Total Maximum Daily Load Strategic Monitoring Program

Monitoring Design

The Total Maximum Daily Load (TMDL) Program's Strategic Monitoring Program assesses the health of surface waters by conducting watershed-based monitoring activities as part of the Tier II component of the Florida Department of Environmental Protection's (FDEP) Integrated Water Resources Monitoring (IWRM) strategy. The Strategic Monitoring Program is driven by strategic monitoring plans (SMPs) carried out by FDEP's district offices. The goal of the SMP is to assure that all waterbody identification numbers (WBIDs) on the 1998 Consent Decree list, and secondarily the planning list, have sufficient data to be assessed using the Impaired Waters Rule (IWR) methodology. This chapter describes the process by which the SMPs are designed and developed, and provides some background information.

As discussed earlier in this report, the state's major hydrologic basins are divided into 5 basin groups, and these basins are grouped within the jurisdictional boundaries of each FDEP district. Each basin is sampled on a 5-year, staggered, rotating schedule. Group 1 monitoring was initiated in 2001, Group 2 in 2002, and so on; this process will continue until the first cycle has been completed for all 5 basin groups. In 2006, the second cycle of TMDL monitoring will resume, starting with Group 1. ***Table 3*** in Chapter 3 lists the basin rotation schedule.

Within each basin, the watersheds and waterbodies are divided into sampling units, and a WBID has been assigned to each unit. WBIDs are discrete hydrological segments or drainage areas. Sampling may occur anywhere in a WBID following the procedures in Rule 62-303, Florida Administrative Code (F.A.C.) (the Impaired Waters Rule, or IWR, for surface waters). Data deficiencies, additional data requirements, and data gaps are determined from the IWR data runs. The results are pooled and assigned to the specific WBID from which they were collected. This information is then used to prepare the SMPs that identify specific monitoring needs. The SMPs are developed for each basin, using the information gathered from the latest IWR STORET data run and other sources, usually in September preceding a basin's sampling year. The SMP sets forth the water bodies and number of samples for each parameter that are needed to allow assessment using the IWR process.

Because of limited resources, monitoring must be prioritized so that the most important data needs are addressed first. These priorities are determined based on the U.S. Environmental Protection Agency's (EPA) TMDL categories for identifying data needs and the need for TMDL development (from the most to the least important), as follows:

Any WBID on the 1998 303(d) list of impaired waters,

Potentially impaired waters for which additional data are needed (this includes those WBIDS identified by the IWR) (Planning list - EPA Category 3c), *Waters where the verified impaired threshold has been met, but monitoring must be maintained (EPA Category 3d),*

Waters with insufficient data (EPA Category 3b), and

Waters with no data (EPA Category 3a).

Tracking for monitoring success in each individual WBID is carried out quarterly; this include updates on monitoring success from each of the sampling entities. The information is needed to refine and modify the SMP to ensure that the monitoring produces data that are useful and robust enough for TMDL evaluations and assessments.

Core and Supplemental Water Quality Indicators

The parameters collected are those for which FDEP has water quality standards or other key indicators of condition, as listed in Rule 62-302, F.A.C. Parameters that are selected for SMP sampling are used to produce the 303(d) list, and the additional parameters as determined by evaluations using the IWR. In some instances, supplemental indicators are used—for example, when core parameters indicate impairment but a pollutant cannot be identified, or to screen for a specific pollutant. Indicators may be physical/habitat, chemical/toxicological, and biological/ecological where appropriate and useful in assessing impairment.

Quality Assurance

In a multiagency, statewide monitoring program, it is essential to have Quality Assurance (QA) protocols that ensure all data are properly collected. All SMP data are collected in accordance with FDEP's QA Rule, Rule 62-160, F.A.C. Methods for all analyses are on file at the FDEP Central Laboratory in Tallahassee and are available at http://www.floridadep.org/labs/sop/index.htm and/or http://www.floridadep.org/labs/qa/index.htm.

All samplers, including FDEP and non-FDEP staff, who collect data for the SMP undergo training to ensure that the data are collected using correct sampling procedures. All samplers also participate in continued sampling audits to ensure their continuing competence and proficiency in following the standard operating procedures (SOPs) and other sampling requirements.

The collection of additional quality assurance elements for the monitoring data is identified in FDEP's guidance document, *Data Quality Assurance Elements for Identification of Impaired Surface Waters* (FDEP EAS 01-01, April 2001). These additional elements apply to all samples collected after June 10, 2003.

All of the Chemistry Section laboratory analysis capabilities and procedures are certified by the National Environmental Laboratory Accreditation Program (NELAP) through the Florida Department of Health (FDOH) under Certification Number E31780. The *Quality Manual for the State of Florida* (FDEP Central Chemistry Laboratory) contains further information on these capabilities. Many of the Biology Section laboratory analysis capabilities and procedures are certified by FDOH under Certification Number E31780.

The FDEP *Quality Manual for Biology Section* contains additional information on these capabilities.

The Biology Section laboratory capabilities not addressed by NELAP are invertebrate taxonomic identification, algal taxonomic identification, algal growth potential, limiting nutrient determination, and sediment grain size analysis. SOPs for these procedures are available on FDEP's Web site at http://www.floridadep.org/labs/sop/index.htm.

Habitat Assessment

Anyone performing or leading a habitat assessment must have passed a Habitat Assessment Performance Test for that type of system (e.g., stream) when the field work is carried out. Habitat Assessment Performance Test results are documented and maintained by the Bureau of Assessment and Restoration Support's (BARS) Standards and Assessment Section (SAS). FT 3000 describes the criteria for passing a Habitat Assessment Performance Test. The testing is conducted at a minimum of four sites per year at sites selected by FDEP staff.

Aquatic Macroinvertebrate Sampling

Anyone performing or leading macroinvertebrate community sampling using a dipnet for a Stream Condition Index (SCI, FS 7420), Biological Reconnaissance (BioRecon, FS 7410), or Lake Condition Index (LCI, FS 7460) determination must have passed a Biology Field Audit for that type of sampling at the time of the field work. FA 4200 outlines the criteria for passing a Biology Field Audit. The audit results are documented and maintained by the Standards and Assessment Section.

Data Management

Data collected by FDEP's districts for the SMPs are loaded into the master Florida STORET database, which is FDEP's implementation of the EPA's STORET database for TMDL-generated data. Data collected by all other agencies for the SMPs are loaded into the originating agency's copy of STORET, and then FDEP is provided with an Oracle export file for appending to Florida STORET. Biology data such as SCI results are loaded to FDEP's Statewide Biological Database (SBIO). This data-loading process is ongoing throughout the year but may peak just before a quarterly data run, as described in the next section.

Data Analysis/Assessment

Before chemical and physical data are assessed quarterly, they are first analyzed and subjected to a number of quality checks in which the data are partitioned into good quality, unknown quality, and bad quality. To the extent possible, blatant errors are corrected, and every attempt is made to reinsert them into the dataset.

A quarterly assessment of SMP data (also called "data runs") for a given basin is then performed in conjunction with other stakeholder-generated data from Florida STORET and other sources by a computer program containing a statistical procedure that interprets the IWR. Biological data (i.e., SCI data) in the SBIO database are also considered in the quarterly basin assessment process. Management input is added where appropriate. The process eventually leads to updates to waters on previous Planning and Verified Lists, as well as revisions to SMPs where indicated. Generally, data of unknown quality go directly into the Planning List assessment, while good data go into the Verified List assessment. Bad data are rejected from the assessment runs.

Reporting

Assessment results in the form of the Planning and Verified Lists are used for quarterly updates, not only to determine which waterbodies are impaired but also for the following:

To assess the overall coverage of monitoring data,

To assess the completeness of specific WBID requirements,

To track monitoring success throughout the year,

To assess the health of surface waters,

To model waterbodies to determine their assimilative capacity (TMDLs), and

To track the success of the TMDL Program over time.

SMP data assessment reports are also used in the annual Water Quality Status Reports and Water Quality Assessment Reports as part of the implementation of the watershed management approach.

Programmatic Evaluation

FDEP provides for internal evaluation of the TMDL SMP between its various sections and its six district offices. The watershed stakeholders in each basin are also an essential part of the monitoring process, and they provide additional input to refine and modify the monitoring strategy. This process will provide the necessary evaluations to determine the best possible monitoring strategy for FDEP's TMDL Program.

SECTION D: TIER III MONITORING

Chapter 8: Intensive Surveys for Total Maximum Daily Loads

Monitoring Design

The Florida Department of Environmental Protection's (FDEP) Watershed Assessment Section (WAS) is the lead group conducting intensive surveys in support of the development of total maximum daily loads (TMDLs). Intensive surveys provide a detailed, time-limited investigation of the condition of specific surface resources that are identified as impaired (i.e., not meeting their designated use for one or more parameters). WAS staff carry out a preliminary evaluation based on existing data in STORET and other databases that are readily available to FDEP. Staff then contacts local resources to assist in performing a field reconnaissance. Once the survey is complete, the WAS survey manager prepares a written plan of study (POS), which provides a detailed plan for the survey. The POS clearly identifies the location of one or more fixed stations to be sampled on one or more occasions during the survey. The survey plan may call for discrete grab sampling, continuous monitoring, or some combination of the two.

The intensive survey plan also identifies the resources required to successfully secure the data needed to support the TMDL effort. While the demands for each intensive survey vary, the plan may include the number of people or teams required, the skills needed by those participating in the survey, essential and optional equipment for conducting the survey, and the laboratory allocation reserved for sample processing. A list of equipment needs identifies the number and types of vehicles required (based on the number of participants, the type of terrain anticipated, and the amount of field equipment to be transported) and the number and types of monitoring equipment (e.g., field meters) necessary to capture the type and quantity of data identified in the POS.

Core and Supplemental Water Quality Indicators

The state's monitoring programs select core indicators to represent each applicable designated use, in addition to supplemental indicators selected according to site-specific or project-specific criteria. Core indicators for each water resource type can be physical/habitat, chemical/toxicological, and biological/ecological, as appropriate; these can be used routinely to assess the attainment of applicable water quality standards throughout the state. Supplemental indicators are used when there is a reasonable expectation that a specific pollutant may be present in a watershed, when core indicators indicate impairment, or to support a special study such as screening for potential pollutants of concern.

The intensive surveys generally focus on gathering the data necessary to address a very specific water quality problem (e.g., nutrients, coliforms, or metals). Thus, the core water quality indicators included in any one intensive survey are linked to the water quality problem being studied. The WAS survey planners rely on their knowledge of what is needed to support calibrating and validating a water quality model to determine those parameters to be sampled. ***Table 12*** lists the typical analytes gathered for rivers, streams, lakes, estuaries, and coastal waters.

Table 12. Typical Analytes for TMDL Intensive Surveys

Laboratory Analytes
Alkalinity
Nitrate + Nitrite
Ammonia
Kjeldahl Nitrogen
Phosphorus
Orthophosphate
Suspended Solids
Turbidity
Color
Fecal Coliform
Total Coliform
Chlorophyll *a*
Algal Growth Potential
Phytoplankton

Field Analytes
Water Temperature
pH
Specific Conductance
Salinity
Dissolved Oxygen
Secchi Depth
Total Depth
Sample Depth
Flow/Current Speed
Land Surface Elevation (LSE)
Depth to Water (from LSE)
Land Use

As needed, WAS will work cooperatively with other parts of FDEP to gather supplemental data (e.g., with the Biology Section for habitat assessments) or with groups outside the agency (e.g., with the U.S. Geological Survey [USGS] for long-term flow station, or the U.S. Environmental Protection Agency [EPA] for reaeration studies). These intensive data are usually collected on at least two different occasions, once under a low-flow condition and the other under wet weather or a high-flow condition.

Quality Assurance

In a multiagency, statewide program, it is essential to have a centralized quality assurance (QA) program to ensure that data are properly and consistently collected. FDEP staff, with the cooperation of project QA officers at the sampling agencies and analytical laboratories, coordinate the QA Program for the Status Network. The QA program consists of several related efforts.

First, a QA rule was cooperatively developed for FDEP and made known to all participating agencies. The QA Rule (Rule 62-160, Florida Administrative Code [F.A.C.]) requires all staff involved in monitoring to adhere to FDEP's adopted standard operating procedures (SOPs), which describe standardized protocols for sampling, analysis, and data reporting.

Second, WAS has developed its own SOP manual to cover procedures that are not addressed by FDEP's agency wide SOPs. The manual discusses procedures relating to activities such as conducting re-aeration studies and making flow measurements using a variety of flow-measuring devices.

Third, data quality assessment tools were developed to evaluate the effectiveness of the agency wide QA Plan; FDEP also provides training classes. These tools include systems and performance audits of sampling agencies and analytical laboratories. Adherence to standard field protocols is verified by regular internal and external field audits. The accuracy of field measurements is assessed through internal (FDEP) and external (USGS) field reference sample programs. Systems evaluations of analytical laboratories are conducted through a contract with FDEP's Bureau of Laboratories, Quality Assurance Section. Fourth, formalized procedures for computerized and manual data review were developed.

Data Management

WAS uses an accessible electronic data system for recording water quality and quality information. The water chemistry data are provided directly in electronic format for entry into FDEP's water quality database (Florida STORET), and metered parameters are entered manually, with an independent review provided by the project manager. Florida will continue to upload its data to the national STORET database at least annually. Alternatively, these data are available to other agencies and the public by request.

Data Analysis/Assessment

WAS compiles summary reports of all intensive surveys, including maps, detailed site descriptions, sampling frequencies, parameter lists, and reviewed water quality and quantity results. Data from the surveys are used in water quality and watershed models to develop TMDLs for individual waterbodies. FDEP prepares draft versions of the TMDL reports, circulates them among interested stakeholders, and solicits comments. These reports contain a more detailed evaluation of the watershed in which the intensive survey was conducted. The data are presented in graphical or tabular form, including a display of the results of any parametric or nonparametric tools applied to the data sets gathered. If any data are rejected, they must be identified, and a rationale for the rejection of the data must be provided. Upon completion of the TMDL evaluation, a final report is prepared and submitted to the EPA for review.

Reporting

WAS's intensive survey data sets are not typically useful to the Section 303(d) activities, and even less so to the 305(b) activities, because intensive surveys are by definition "intensive." Therefore, the data gathered provide very detailed information about a limited area for a brief period (e.g., one to four days). While these data sets are very useful for calibrating and validating water quality models, the data are generally consolidated for reporting purposes, as the quantity of data gathered in these surveys should not be overweighted in evaluating a waterbody's water quality over the long term.

Programmatic Evaluation

WAS staff communicate regularly with EPA Region 4 staff in Atlanta and EPA field staff in Athens, Georgia, on issues relating to gathering water quality data. WAS staff and EPA Athens staff routinely (one to two times per year) participate in cooperative water quality surveys conducted in Florida. These joint activities provide an opportunity for cross-training and evaluating sampling procedures.

Chapter 9: Water Quality Standards Monitoring

The Florida Department of Environmental Protection's (FDEP) Standards and Assessments Section (SAS) is charged with developing, evaluating, and revising new and existing surface water quality standards. These standards comprise the designated use (functional classification) of a waterbody, the numeric and narrative criteria protective of the use, the antidegradation policy, and any moderating provisions (e.g., mixing zones, variances, and site-specific alternative criteria [SSACs]). In developing or revising water quality criteria, any necessary monitoring must be of sufficient quality to result in the adoption of scientifically valid and defensible concentrations sufficient to protect aquatic life and human health. It is not anticipated that implementation of the antidegradation policy will require monitoring. Chapter 10 discusses monitoring for the establishment of moderating provisions.

Monitoring Design

Because developing and revising water quality criteria is a process unique to a waterbody's designated use (e.g., human health protection or aquatic life protection) and a particular parameter, the monitoring design is also specific and unique.

Core and Supplemental Water Quality Indicators

The core and supplemental water quality indicators are based on the criterion being developed or revised.

Quality Assurance

FDEP's quality assurance requirements for analytical laboratories and field activities are codified in Chapter 62-160, Florida Administrative Code (F.A.C.), Quality Assurance (the QA Rule), and in FDEP standard operating procedures (SOPs), which have been incorporated by reference into the QA Rule. Methods for all analyses are on file at FDEP's Central Laboratory in Tallahassee and are available at http://www.floridadep.org/labs/sop/index.htm and/or http://www.floridadep.org/labs/qa/index.htm.

All of the Chemistry Section laboratory analysis capabilities and procedures are certified by the National Environmental Laboratory Accreditation Program (NELAP) through the Florida Department of Health (FDOH) under Certification Number E31780. The FDEP Central Laboratory's *Quality Manual for the State of Florida* provides further information on these capabilities. Many of the Biology Section's laboratory analysis capabilities and procedures are certified by FDOH under Certification Number E31780. FDEP's *Quality Manual for Biology Section* contains further information on these capabilities.

The Biology Section laboratory capabilities not addressed by NELAP are invertebrate taxonomic identification, algal taxonomic identification, algal growth potential, limiting nutrient determination, and sediment grain size analysis. SOPs for these procedures are available on FDEP's Web site at http://www.floridadep.org/labs/sop/index.htm.

Habitat Assessment

Anyone performing or leading a habitat assessment must have passed a Habitat Assessment Performance Test for that type of system (e.g., stream) when the field work is carried out. Habitat Assessment Performance Test results are documented and maintained by the Bureau of Assessment and Restoration Support's (BARS) Standards and Assessment Section (SAS). FT 3000 describes the criteria for passing a Habitat Assessment Performance Test. The testing is conducted at a minimum of four sites per year at sites selected by FDEP staff.

Aquatic Macroinvertebrate Sampling

Anyone performing or leading macroinvertebrate community sampling using a dipnet for a Stream Condition Index (SCI, FS 7420), Biological Reconnaissance (BioRecon, FS 7410), or Lake Condition Index (LCI, FS 7460) determination must have passed a Biology Field Audit for that type of sampling at the time of the field work. FA 4200 outlines the criteria for passing a Biology Field Audit. The audit results are documented and maintained by the Standards and Assessment Section.

Data Management

When a water quality standards sampling event is planned, it is scheduled in the Laboratory Information Management System (LIMS). LIMS generates a Request Identification (RQ ID) number for the sampling, which is linked to each sample bottle requested for the event. LIMS generates sample submittal forms using this information. Field and laboratory data stored in LIMS are linked to that sampling event's RQ number. The data are recorded and stored by unique location/date identifiers.

Logbooks used by FDEP's Bureau of Laboratories are maintained using a Document Control System, which is used to control what logbooks are used when and to keep up with document version numbers, revision dates, etc. FDEP uses many field sheets from FD 9000. Reports produced by the agency are submitted to the person requesting the report. Text reports are posted or linked on FDEP's Web site. Draft reports are reviewed by a supervisor before they are finalized. Reports produced by the FDEP are public record unless the data are restricted as part of a criminal investigation.

Chemistry Section data reduction, validation, and reporting policies and procedures are described in Section 12.0 of the FDEP Central Laboratory's *Quality Manual for the State of Florida* under FDOH Certification Number E31780.

Biology Section data reduction, validation, and reporting policies and procedures are described in Section 12.0 of FDEP's *Quality Manual for Biology Section* under FDOH Certification Number E31780. All bureau data are handled to ensure data integrity from field to laboratory to reporting.

All data generated by the Bureau of Laboratories are verified before being entered into LIMS. The data must be checked by designated staff before being considered "complete."

Each sample collected and/or analyzed has a unique identifier on the sample container. This identifier includes a label on the sample container with the site and/or project name, sample collection date, collector's initials or name, and test type. The label may also include the RQ number for the event, a bar code for electronic uploading of sample information; the sample collection time for certain tests, and/or replicate number. This information is linked to each unique sample analysis result for each event-location-date-test-replicate combination in LIMS and/or the Statewide Biological Database (SBio).

Data Analysis and Assessment

Data analysis and assessment are based on the needs of each criterion. Depending on the complexity of the criterion, the analysis and assessment may be equally complex.

Reporting

The development of a criterion must follow the procedures established by the EPA, and the criteria are not considered final until approved by the EPA.

Programmatic Evaluation

As required by the Federal Water Pollution Control Act, at least every three years each state must hold public hearings to review applicable water quality standards. This process is commonly referred to as Triennial Review.

Chapter 10: Site-Specific Alternative Criteria

Chapters 62-302 and 62-4, Florida Administrative Code (F.A.C.), allow for the development of moderating provisions for Florida's surface water quality standards. These provisions include site-specific alternative criteria (SSACs), mixing zones, and temporary changes (e.g., use attainability analyses or variances). In the case of SSACs, Section 62-302.800, F.A.C., states that a waterbody or portion thereof may not meet a particular ambient water quality criterion specified for its classification, due to natural background conditions or human-induced conditions that cannot be controlled or abated. Each SSAC is unique to the parameter as well as the waterbody, and must be adopted by the Florida Department of Environmental Protection (FDEP) following the requirements set out by rule.

Monitoring Design

The development of each moderating provision is unique to a waterbody and parameter; therefore, the monitoring design is also unique to each moderating provision. However, the evaluation must contain a minimum amount of information, including the existing water quality of the parameter of concern; spatial, seasonal, and diurnal variations; other parameters or conditions that may affect the parameter; and existing biology, including variations that may be affected by the parameter of concern.

Core and Supplemental Water Quality Indicators

The core and supplemental water quality indicators are based on the moderating provision being developed.

Quality Assurance

FDEP's quality assurance requirements for analytical laboratories and field activities are codified in Chapter 62-160, F.A.C., Quality Assurance (QA Rule) and in FDEP standard operating procedures (SOPs), which have been incorporated by reference in the QA Rule. Methods for all analyses are on file at FDEP's Central Laboratory in Tallahassee and are available at http://www.floridadep.org/labs/sop/index.htm and/or http://www.floridadep.org/labs/qa/index.htm.

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Habitat Assessment

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Aquatic Macroinvertebrate Sampling

Anyone performing or leading macroinvertebrate community sampling using a dipnet for a Stream Condition Index (SCI, FS 7420) or a Biological Reconnaissance (BioRecon, FS 7410)determination must have passed a Biology Field Audit for that type of sampling at the time of the field work. FA 4200 outlines the criteria for passing a Biology Field Audit. The audit results are documented and maintained by the Standards and Assessment Section.

Data Management

When a water quality standards sampling event is planned, it is scheduled in the Laboratory Information Management System (LIMS). LIMS generates a Request Identification (RQ ID) number for the sampling, which is linked to each sample bottle requested for the event. LIMS generates sample submittal forms using this information. Field and laboratory data stored in LIMS are linked to that sampling event's RQ number. The data are recorded and stored by unique location/date identifiers.

Logbooks used by FDEP's Bureau of Laboratories are maintained using a Document Control System, which is used to control what logbooks are used when and to keep up with document version numbers, revision dates, etc. FDEP uses many field sheets from FD 9000. Reports produced by the agency are submitted to the person requesting the report. Text reports are posted or linked on FDEP's Web site. Draft reports are reviewed by a supervisor before they are finalized. Reports produced by the FDEP are public record unless the data are restricted as part of a criminal investigation.

Chemistry Section data reduction, validation, and reporting policies and procedures are described in Section 12.0 of the FDEP Central Chemistry Laboratory's *Quality Manual for the State of Florida* under FDOH Certification Number E31780.

Biology Section data reduction, validation, and reporting policies and procedures are described in Section 12.0 of FDEP's *Quality Manual for Biology Section* under FDOH Certification Number E31780. All bureau data are handled to ensure data integrity from field to laboratory to reporting.

All data generated by the Bureau of Laboratories are verified before being entered into LIMS. The data must be checked by designated staff before being considered "complete."

Each sample collected and/or analyzed by FDEP has a unique identifier on the sample container. This identifier includes a label on the sample container with the site and/or project name, sample collection date, collector's initials or name, and test type. The label may also include the RQ number for the event, a bar code for electronic uploading of sample information; the sample collection times for certain tests, and/or replicate number. This information is linked to each unique sample analysis result for each event-location-date-test-replicate combination in LIMS and/or the Statewide Biological Database (SBio).

Data Analysis/Assessment

Data analysis and assessment vary with each moderating provision. Depending on the complexity of the provision, the analysis and assessment may be equally complex. For example, with the Everglades SSAC for dissolved oxygen (DO), a single-value criterion did not adequately account for the wide natural daily (diel) fluctuations observed in the marsh. The SSAC provided a mechanism to account for the major factors (e.g., time of day and season) influencing natural background DO variation in the Everglades. Therefore, the recommended SSAC was based on an algorithm that uses sample collection time and water temperature to model the observed natural sinusoidal diel cycle and seasonal variability.

Reporting

The development of an SSAC must follow the procedures defined in Section 62-302.800, F.A.C.; Chapter 62-4, F.A.C.; and Chapter 120, Florida Statutes (F.S.). Each completed and adopted SSAC is listed in the Surface Water Quality Standards Rule (Chapter 62-302, F.A.C.).

Programmatic Evaluation

As required by the Federal Water Pollution Control Act, at least every three years each state must hold public hearings to review applicable water quality standards. This process is commonly referred to as Triennial Review. Since moderating provisions are part of the water quality standards, they are also subject to the Triennial Review process.

Chapter 11: Fifth-Year Inspection Program

The Florida Department of Environmental Protection's (FDEP) Wastewater Compliance Evaluation Section has developed a comprehensive compliance strategy to help achieve and maintain compliance with permit conditions through sound environmental monitoring and permitting practices. This strategy, known as the Fifth-Year Inspection (FYI), uses various inspection and sampling techniques to determine a facility's chemical and biological impacts on the receiving waters at the time of permit renewal. This information can then be used to make critical permitting decisions that may result in permit modifications or plant changes that would improve effluent and receiving water quality. These surveys support the state's water quality management objectives.

Monitoring Design

Facilities with a National Pollutant Discharge Elimination System (NPDES) permit are required to renew their permit every five years. As part of the renewal process, FDEP performs an FYI to determine compliance with permit limits and the appropriate water quality standards for the waterbody. In addition to analyzing for the pollutants specified in the permit, the program uses an upstream/downstream comparison, or gradient approach, to assess the impacts of point source discharges on the receiving waters compared with background conditions for the receiving waterbody.

For freshwater FYIs, a standard suite of water samples is collected from the facility outfall for chemical and toxicological analysis. Water and biological samples are also collected from the receiving waterbody below the point of discharge (test site), and compared with samples collected from the receiving waterbody above the discharge point (control site). FDEP then attempts to determine if the facility's effluent is violating water quality criteria or impairing the biological communities in the receiving water.

For marine FYIs, chemical and biological comparisons are made along a gradient of effluent exposure. Exposure to effluent is estimated using effluent rhodamine dye measurements during incoming and outgoing tides. The dye plume is tracked using a fluorometer and/or a multiprobe meter. An initial dye concentration of 100 parts per billion (ppb) is injected into the effluent stream at the NPDES sampling point. The background fluorescence of the waterbody is determined and subtracted from subsequent readings. Stations are located at points where the dye (and effluent) concentrations are approximately halved. A total of six stations, with three replicate Ponars per station, are located along the gradient, with two stations acting as control sites. Core sediment samples are also collected at all stations for determining grain size and percent organic content.

Core and Supplemental Water Quality Indicators

Table 13 lists the analytes for a standard FYI. Additional analyses may be performed, depending on particular permitting requirements or issues of concern not addressed in the standard protocol.

Chemical Analyses of Effluent

The effluent samples are analyzed for nutrients, metals, organic constituents (base, neutral, and acid extractables), and pesticides following FDEP's standard operating procedures (SOPs). The results from these analyses are then compared with water quality criteria (Rule 62-302, Florida Administrative Code [F.A.C.]) and facility permit limits.

Toxicity Bioassays

Toxicity bioassays are performed following FDEP's SOPs, which are based on U.S. Environmental Protection Agency (EPA) methods.

Effluents considered to be fresh water (less than 1 part per thousand [ppt] salinity based on temperature and conductivity) are tested with a freshwater invertebrate, the water flea *(Ceriodaphnia dubia),* and a freshwater fish, the bannerfin shiner *(Cyprinella leedsi).*

Effluents considered to be salt water (greater than 1 ppt salinity based on temperature and conductivity) are tested with a saltwater invertebrate, the mysid shrimp *(Americamysis bahia),* and a saltwater fish, the Atlantic silverside *(Menidia beryllina).*

These tests may be performed following the permit toxicity testing requirements or as 48-hour acute screening tests. The failure of toxicity testing may constitute a violation of Subsections 62-302.520(21) and 62-302.530(62), F.A.C., and/or facility permit limits.

Bacteriological Testing

The effluent and water from control and test sites are analyzed for the presence and concentration of total and fecal coliform bacteria following FDEP's SOPs MB1_0 and MB1_1. High levels of fecal or total coliform bacteria may constitute a violation of Subsections 62-302.530(6) and 62-302.530(7), F.A.C., and/or facility permit limits.

Habitat Assessment

Habitat assessment is used to evaluate the physical structure and extent of disturbance in a waterbody. The control site and test site are selected in an attempt to maximize the similarity between the two sites' habitat assessment scores. This is done so that differences in the bioassessments may be attributed to the facility, rather than physical differences between the two sampling locations.

The habitat asessment has 8 aspects, which are ranked with 20 possible points for each aspect (Quality Assurance [QA] Rule, SOP FT 3100). The habitat assessment score includes the types and amounts of benthic substrates, water velocity, the amount of sand or silt accumulation, the extent of artificial channelization, bank stability, and riparian zone width and vegetation type. All scores are summed to yield an overall habitat assessment score.

Algal Growth Potential

Samples of effluent and water from the control and test sites are autoclaved, filtered (0.45 micrometers [μm]), inoculated with the unicellular green alga, *Pseudokirchneriella subcapitata* (formerly *Selenastrum capricornutum*), and incubated for 14 days (FDEP SOP TA08_05). The algal growth potential (AGP) value is the peak growth of the alga within that 14-day period, recorded as milligrams of dry weight per liter (mg dry weight/L. An AGP above 5.0 mg dry weight/L represents a "problem" threshold for fresh receiving waters, implying nutrient enrichment. High AGP values may constitute one line of evidence for violation of Subsections 62-302.530(47), 62-302.530(48)(a), and/or 62-302.530(48)(b), F.A.C.

The concentration of nutrients in a water sample may be used to calculate the expected yield of AGP under the assumption that other required nutrients (e.g., silicon or micronutrients) are present in excess. The expected amount of production is calculated as 38 times the total soluble inorganic nitrogen (nitrate and nitrite plus ammonia) under nitrogen limitation, or 430 times the orthophosphate (OP) concentration under phosphorus limitation, with an error of ± 20 percent. When the ratio of nitrogen to phosphorus (N:P) is less than 10:1, nitrogen limitation of algal production is likely. When the N:P ratio is 20:1 or greater, phosphorus limitation is likely. For ratios in between, colimitation may occur. The production of lower biomass than expected may suggest algal growth inhibition related to toxic compounds present in the water sample; however, an algal growth inhibition test would be required to confirm this. Algal growth inhibition would be considered a violation of Subsection 62-302.530(62), F.A.C.

Algal Phytoplankton and Periphyton Assemblages

Periphyton is sampled at both control and test sites by incubating glass microscope slides in a standard periphytometer for 28 days (QA Rule, SOP FS7210). Phytoplankton is sampled using a 1-liter grab sample (QA Rule, SOP FS7100). Periphyton and phytoplankton are subsampled and identified to the lowest practical level, usually species (FDEP SOPs AB03, AB03_1, and AB05).

Chlorophyll *a* Content

Chlorophyll *a* content is measured in both phytoplankton and periphyton samples to estimate algal biomass (FDEP SOP BB05). High algal biomass implies nutrient stress and may be a violation of Subsections 62-302.530(47), 62-302.530(48)(a), and/or 62-302.530(48)(b), F.A.C.

Algal Density

Algal density is estimated as the number of natural units per milliliter for phytoplankton samples and the number of natural units per square centimeter for periphyton samples. Although algal density at a single site is highly variable and depends on a number of factors, the comparison of algal density at a control site with algal density at a related test site gives a partial comparison of algal biomass at the two sites.

Algal Taxa Richness

Taxa richness is the number of distinct algal taxa present in a sample. Extreme nutrient enrichment tends to reduce the number of different types of algae present in a sample, because a few tolerant taxa tend to reproduce rapidly and constitute the majority of the cells present. However, moderate nutrient enrichment of nutrient-poor waters may sometimes be correlated with increased algal taxa richness, as the algal community begins to respond to the increased input of nutrients.

Community Composition

Shifts in proportions of the major groups of algae and other organisms downstream of a point source, compared with upstream, control conditions, may indicate the negative effects of a discharge and may constitute violations of Subsections 62-302.530(47), 62-302.530(48)(a), 62-302.530(48)(b), and/or 62-302.530(62), F.A.C.

Shannon-Wiener Diversity Index

This index is specified in Rule 62-302, F.A.C., as a measure of biological integrity. Low diversity scores are undesirable. Where diversity is low, only a few taxa are abundant, compared with an area where many taxa are present, with equitable abundance among taxa. A difference of 25 percent in Shannon-Wiener diversity between results from Hester-Dendy multiplate samplers incubated for 28 days at test and control sites constitutes a violation of Subsection 62-302.530(11), F.A.C. Low diversity scores related to a facility's effluent may constitute violations of Subsections 62-302.530(47), 62-302.530(48)(a), 62-302.530(48)(b), and/or 62-302.530(62), F.A.C.

Benthic Macroinvertebrate Assemblages

Benthic macroinvertebrates are collected using two methods. Quantitative samples are collected from Hester-Dendy multiplate samplers incubated for 28 days (QA Rule, SOP FS7430). Qualitative collections are made using 20 dipnet sweeps (QA Rule, SOP FS7420). Benthic macroinvertebrates are sorted and identified to the lowest practical taxonomic level, usually species (FDEP SOP IZ06).

Macroinvertebrate Taxa Richness

Taxa richness is the number of distinct macroinvertebrate taxa present in a sample. Stress, habitat destruction, and pollution tend to reduce the number of different organisms present. Decreases in taxa richness related to a facility's effluent may constitute violations of Subsections 62-302.530(47), 62-302.530(48)(a), 62-302.530(48)(b), and/or 62-302.530(62), F.A.C.

Percent Contribution of Dominant Taxon

The percent contribution of the dominant taxon is calculated by dividing the number of individuals in the most abundant taxa by the total number of individuals counted. Percent contribution of the dominant taxon tends to increase with increasing perturbation. Increases in the percent contribution of the dominant taxon related to a facility's effluent may constitute violations of Subsections 62-302.530(47), 62-302.530(48)(a), and/or 62-302.530(48)(b), F.A.C.

Florida Index

Some organisms become rare or absent as the intensity or duration of disturbance increases. The Florida Index assigns points to stream-dwelling macroinvertebrates based on their ranked sensitivity to pollution. A site with a high Florida Index score is considered healthy. Decreases in Florida Index points related to a facility's effluent may constitute violations of Subsections 62-302.530(47), 62-302.530(48)(a), 62-302.530(48)(b), and/or 62-302.530(62), F.A.C.

Ephemeroptera/Plecoptera/Trichoptera Taxa

This value is the number of ephemeroptera/plecoptera/trichoptera (EPT) taxa present. More EPT taxa are usually present in unpolluted waters. Decreases in the number of EPT taxa related to a facility's effluent may constitute violations of Subsections 62-302.530(47), 62-302.530(48)(a), 62-302.530(48)(b), and/or 62-302.530(62), F.A.C.

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Functional Feeding Groups

Environmental degradation may differentially affect groups of invertebrates based on how the group feeds (e.g., predators and deposit feeders). In Florida, pollution may be responsible for reducing the numbers of filter feeders and shredders. Changes in the proportions of functional feeding groups related to a facility's effluent may constitute violations of Subsections 62-302.530(47), 62-302.530(48)(a), 62-302.530(48)(b), and/or 62-302.530(62), F.A.C.

Stream Condition Index

The Stream Condition Index (SCI) is a true multi-metric biological index of freshwater stream condition that was developed specifically for Florida's stream and river environments. Using a 20-dip net sweep method (FDEP SOP #FS 7420), the SCI uses 10 metrics of the benthic biological community and aggregates them into a single composite score. With a single SCI score, it is possible to detect 3 categories of biological condition (good, fair, and poor). With 2 samples at a site, it becomes possible to detect 5 categories of condition (excellent, good, fair, poor, and very poor). A decrease in SCI score from the control to the test site may be evidence of degradation related to a facility's effluent. An SCI score of "poor" or "very poor" related to a facility's effluent may constitute violations of Subsections 62-302.530(47), 62-302.530(48)(a), 62-302.530(48)(b), and/or 62-302.530(62), F.A.C.

Table 13. Typical Analytes for a Fifth-Year Inspection

Site	Analysis Group	Component	Units
Effluent	Bio-AGP/LimNut	Algal Growth Potential	mg DryWt/L
Effluent	Bio-Chl-a	Chlorophyll a, Monochromatic, Water	ug/L
Effluent	Bio-Chl-a	Phaeophytin a, Monochromatic, Water	ug/L
Effluent	Bio-Toxicology	Bioassay-Acute-Screen-FW-C.dubia, LC50	LC50
Effluent	Bio-Toxicology	Bioassay-Acute-Screen-FW-Fish, LC50	LC50
Effluent & Blank	BNA-Water	1,2,4,5-Tetrachlorobenzene	ug/L
Effluent & Blank	BNA-Water	1,2,4-Trichlorobenzene	ug/L
Effluent & Blank	BNA-Water	1,2-Dichlorobenzene	ug/L
Effluent & Blank	BNA-Water	1,3,5-Trinitrobenzene	ug/L
Effluent & Blank	BNA-Water	1,3-Dichlorobenzene	ug/L
Effluent & Blank	BNA-Water	1,3-Dinitrobenzene	ug/L
Effluent & Blank	BNA-Water	1,4-Dichlorobenzene	ug/L
Effluent & Blank	BNA-Water	1,4-Naphthoquinone	ug/L
Effluent & Blank	BNA-Water	1-Naphthylamine	ug/L
Effluent & Blank	BNA-Water	2,3,4,6-Tetrachlorophenol	ug/L
Effluent & Blank	BNA-Water	2,4,5-Trichlorophenol	ug/L
Effluent & Blank	BNA-Water	2,4,6-Trichlorophenol	ug/L
Effluent & Blank	BNA-Water	2,4-Dichlorophenol	ug/L
Effluent & Blank	BNA-Water	2,4-Dimethylphenol	ug/L
Effluent & Blank	BNA-Water	2,4-Dinitrophenol	ug/L
Effluent & Blank	BNA-Water	2,4-Dinitrotoluene	ug/L
Effluent & Blank	BNA-Water	2,6-Dichlorophenol	ug/L
Effluent & Blank	BNA-Water	2,6-Dinitrotoluene	ug/L
Effluent & Blank	BNA-Water	2-Acetylaminofluorene	ug/L
Effluent & Blank	BNA-Water	2-Chloronaphthalene	ug/L
Effluent & Blank	BNA-Water	2-Chlorophenol	ug/L
Effluent & Blank	BNA-Water	2-Methyl-4,6-dinitrophenol	ug/L
Effluent & Blank	BNA-Water	2-Methylnaphthalene	ug/L
Effluent & Blank	BNA-Water	2-Naphthylamine	ug/L
Effluent & Blank	BNA-Water	2-Nitroaniline	ug/L
Effluent & Blank	BNA-Water	2-Nitrophenol	ug/L
Effluent & Blank	BNA-Water	2-Picoline	ug/L
Effluent & Blank	BNA-Water	3,3'-Dichlorobenzidine	ug/L
Effluent & Blank	BNA-Water	3,3'-Dimethylbenzidine	ug/L
Effluent & Blank	BNA-Water	3-Methylcholanthrene	ug/L
Effluent & Blank	BNA-Water	3-Nitroaniline	ug/L
Effluent & Blank	BNA-Water	4,4'-DDD	ug/L
Effluent & Blank	BNA-Water	4,4'-DDE	ug/L

Site	Analysis Group	Component	Units
Effluent & Blank	BNA-Water	4,4'-DDT	ug/L
Effluent & Blank	BNA-Water	4-Aminobiphenyl	ug/L
Effluent & Blank	BNA-Water	4-Bromophenyl phenyl ether	ug/L
Effluent & Blank	BNA-Water	4-Chloro-3-methylphenol	ug/L
Effluent & Blank	BNA-Water	4-Chloroaniline	ug/L
Effluent & Blank	BNA-Water	4-Chlorophenyl phenyl ether	ug/L
Effluent & Blank	BNA-Water	4-Nitroaniline	ug/L
Effluent & Blank	BNA-Water	4-Nitrophenol	ug/L
Effluent & Blank	BNA-Water	5-Nitro-o-toluidine	ug/L
Effluent & Blank	BNA-Water	7,12-Dimethylbenz(a)anthracene	ug/L
Effluent & Blank	BNA-Water	Acenaphthene	ug/L
Effluent & Blank	BNA-Water	Acenaphthylene	ug/L
Effluent & Blank	BNA-Water	Acetophenone	ug/L
Effluent & Blank	BNA-Water	Aldrin	ug/L
Effluent & Blank	BNA-Water	Aniline	ug/L
Effluent & Blank	BNA-Water	Anthracene	ug/L
Effluent & Blank	BNA-Water	Azobenzene/1,2-Diphenylhydrazine	ug/L
Effluent & Blank	BNA-Water	Benzidine	ug/L
Effluent & Blank	BNA-Water	Benzo(a)anthracene	ug/L
Effluent & Blank	BNA-Water	Benzo(a)pyrene	ug/L
Effluent & Blank	BNA-Water	Benzo(b)fluoranthene	ug/L
Effluent & Blank	BNA-Water	Benzo(g,h,i)perylene	ug/L
Effluent & Blank	BNA-Water	Benzo(k)fluoranthene	ug/L
Effluent & Blank	BNA-Water	Benzyl alcohol	ug/L
Effluent & Blank	BNA-Water	Bis(2-chloroethoxy)methane	ug/L
Effluent & Blank	BNA-Water	Bis(2-chloroethyl)ether	ug/L
Effluent & Blank	BNA-Water	Bis(2-chloroisopropyl)ether	ug/L
Effluent & Blank	BNA-Water	Bis(2-ethylhexyl)phthalate	ug/L
Effluent & Blank	BNA-Water	Butyl benzyl phthalate	ug/L
Effluent & Blank	BNA-Water	Chrysene	ug/L
Effluent & Blank	BNA-Water	Di-n-butyl phthalate	ug/L
Effluent & Blank	BNA-Water	Di-n-octyl phthalate	ug/L
Effluent & Blank	BNA-Water	Dibenzo(a,h)anthracene	ug/L
Effluent & Blank	BNA-Water	Dibenzofuran	ug/L
Effluent & Blank	BNA-Water	Dieldrin	ug/L
Effluent & Blank	BNA-Water	Diethyl phthalate	ug/L
Effluent & Blank	BNA-Water	Dimethyl phthalate	ug/L
Effluent & Blank	BNA-Water	Dimethylaminoazobenzene	ug/L
Effluent & Blank	BNA-Water	Dinoseb	ug/L
Effluent & Blank	BNA-Water	Diphenylamine	ug/L
Effluent & Blank	BNA-Water	Endosulfan I	ug/L
Effluent & Blank	BNA-Water	Endosulfan II	ug/L
Effluent & Blank	BNA-Water	Endosulfan sulfate	ug/L

Site	Analysis Group	Component	Units
Effluent & Blank	BNA-Water	Endrin	ug/L
Effluent & Blank	BNA-Water	Endrin aldehyde	ug/L
Effluent & Blank	BNA-Water	Ethyl methanesulfonate	ug/L
Effluent & Blank	BNA-Water	Fluoranthene	ug/L
Effluent & Blank	BNA-Water	Fluorene	ug/L
Effluent & Blank	BNA-Water	Heptachlor	ug/L
Effluent & Blank	BNA-Water	Heptachlor epoxide	ug/L
Effluent & Blank	BNA-Water	Hexachlorobenzene	ug/L
Effluent & Blank	BNA-Water	Hexachlorobutadiene	ug/L
Effluent & Blank	BNA-Water	Hexachlorocyclopentadiene	ug/L
Effluent & Blank	BNA-Water	Hexachloroethane	ug/L
Effluent & Blank	BNA-Water	Hexachloropropene	ug/L
Effluent & Blank	BNA-Water	Indeno(1,2,3-cd)pyrene	ug/L
Effluent & Blank	BNA-Water	Isophorone	ug/L
Effluent & Blank	BNA-Water	Isosafrole	ug/L
Effluent & Blank	BNA-Water	Methapyrilene	ug/L
Effluent & Blank	BNA-Water	Methyl methanesulfonate	ug/L
Effluent & Blank	BNA-Water	N-Nitrosodi-n-butylamine	ug/L
Effluent & Blank	BNA-Water	N-Nitrosodi-n-propylamine	ug/L
Effluent & Blank	BNA-Water	N-Nitrosodiethylamine	ug/L
Effluent & Blank	BNA-Water	N-Nitrosodimethylamine	ug/L
Effluent & Blank	BNA-Water	N-Nitrosodiphenylamine	ug/L
Effluent & Blank	BNA-Water	N-Nitrosomethylethylamine	ug/L
Effluent & Blank	BNA-Water	N-Nitrosomorpholine	ug/L
Effluent & Blank	BNA-Water	N-Nitrosopiperidine	ug/L
Effluent & Blank	BNA-Water	N-Nitrosopyrrolidine	ug/L
Effluent & Blank	BNA-Water	Naphthalene	ug/L
Effluent & Blank	BNA-Water	Nitrobenzene	ug/L
Effluent & Blank	BNA-Water	Nitroquinoline-1-oxide	ug/L
Effluent & Blank	BNA-Water	Pentachlorobenzene	ug/L
Effluent & Blank	BNA-Water	Pentachloroethane	ug/L
Effluent & Blank	BNA-Water	Pentachloronitrobenzene	ug/L
Effluent & Blank	BNA-Water	Pentachlorophenol	ug/L
Effluent & Blank	BNA-Water	Phenacetin	ug/L
Effluent & Blank	BNA-Water	Phenanthrene	ug/L
Effluent & Blank	BNA-Water	Phenol	ug/L
Effluent & Blank	BNA-Water	Pyrene	ug/L
Effluent & Blank	BNA-Water	Pyridine	ug/L
Effluent & Blank	BNA-Water	Safrole	ug/L
Effluent & Blank	BNA-Water	alpha-BHC	ug/L
Effluent & Blank	BNA-Water	beta-BHC	ug/L
Effluent & Blank	BNA-Water	delta-BHC	ug/L
Effluent & Blank	BNA-Water	gamma-BHC	ug/L

Site	Analysis Group	Component	Units
Effluent & Blank	BNA-Water	m,p-Cresols	ug/L
Effluent & Blank	BNA-Water	o-Cresol	ug/L
Effluent & Blank	BNA-Water	o-Toluidine	ug/L
Effluent & Blank	GC-Water	Alachlor	ug/L
Effluent & Blank	GC-Water	Ametryn	ug/L
Effluent & Blank	GC-Water	Atrazine	ug/L
Effluent & Blank	GC-Water	Azinphos Methyl	ug/L
Effluent & Blank	GC-Water	Bromacil	ug/L
Effluent & Blank	GC-Water	Butylate	ug/L
Effluent & Blank	GC-Water	Chlorpyrifos Ethyl	ug/L
Effluent & Blank	GC-Water	Chlorpyrifos Methyl	ug/L
Effluent & Blank	GC-Water	Diazinon	ug/L
Effluent & Blank	GC-Water	Ethion	ug/L
Effluent & Blank	GC-Water	Ethoprop	ug/L
Effluent & Blank	GC-Water	Fenamiphos	ug/L
Effluent & Blank	GC-Water	Fonofos	ug/L
Effluent & Blank	GC-Water	Hexazinone	ug/L
Effluent & Blank	GC-Water	Malathion	ug/L
Effluent & Blank	GC-Water	Metalaxyl	ug/L
Effluent & Blank	GC-Water	Metolachlor	ug/L
Effluent & Blank	GC-Water	Metribuzin	ug/L
Effluent & Blank	GC-Water	Mevinphos	ug/L
Effluent & Blank	GC-Water	Naled	ug/L
Effluent & Blank	GC-Water	Norflurazon	ug/L
Effluent & Blank	GC-Water	Parathion Ethyl	ug/L
Effluent & Blank	GC-Water	Parathion Methyl	ug/L
Effluent & Blank	GC-Water	Phorate	ug/L
Effluent & Blank	GC-Water	Prometryn	ug/L
Effluent & Blank	GC-Water	Simazine	ug/L
Effluent & Blank	Metals-Water	Aluminum	ug/L
Effluent & Blank	Metals-Water	Arsenic	ug/L
Effluent & Blank	Metals-Water	Cadmium	ug/L
Effluent & Blank	Metals-Water	Calcium	mg/L
Effluent & Blank	Metals-Water	Chromium	ug/L
Effluent & Blank	Metals-Water	Copper	ug/L
Effluent & Blank	Metals-Water	Iron	ug/L
Effluent & Blank	Metals-Water	Lead	ug/L
Effluent & Blank	Metals-Water	Magnesium	mg/L
Effluent & Blank	Metals-Water	Nickel	ug/L
Effluent & Blank	Metals-Water	Selenium	ug/L
Effluent & Blank	Metals-Water	Silver	ug/L
Effluent & Blank	Metals-Water	Zinc	ug/L
Effluent & Blank	Nutrients-Liquid	Ammonia-N	mg N/L

Site	Analysis Group	Component	Units
Effluent & Blank	Nutrients-Liquid	Color	PCU
Effluent & Blank	Nutrients-Liquid	NO2NO3-N	mg N/L
Effluent & Blank	Nutrients-Liquid	N_KJEL_TOT	mg N/L
Effluent & Blank	Nutrients-Liquid	O-Phosphate-P	mg P/L
Effluent & Blank	Nutrients-Liquid	Organic Carbon	mg C/L
Effluent & Blank	Nutrients-Liquid	TSS	mg/L
Effluent & Blank	Nutrients-Liquid	Total-P	mg P/L
Effluent & Blank	Nutrients-Liquid	Turbidity	NTU
Effluent & Blank	Overflow	Oil and Grease	mg/l
Effluent & Blank	VOC-Water	Bromodichloromethane	ug/L
Effluent & Blank	VOC-Water	Bromoform	ug/L
Effluent & Blank	VOC-Water	Chloroform	ug/L
Effluent & Blank	VOC-Water	Dibromochloromethane	ug/L
Control & Test Sites	Bio-AGP/LimNut	Algal Growth Potential	mg DryWt/ L
Control & Test Sites	Bio-Chl-a	Chlorophyll a, Monochromatic, Periphyton	mg/m2
Control & Test Sites	Bio-Chl-a	Chlorophyll a, Monochromatic, Water	ug/L
Control & Test Sites	Bio-Chl-a	Phaeophytin a, Monochromatic, Periphyton	mg/m2
Control & Test Sites	Bio-Chl-a	Phaeophytin a, Monochromatic, Water	ug/L
Control & Test Sites	Bio-Invertebrates	Macroinvert-FW-Qual-Dipnetx20-# Taxa	# Taxa
Control & Test Sites	Bio-Invertebrates	Macroinvert-FW-Quan-ArtSubstr-# Taxa	# Taxa
Control & Test Sites	Bio-Peri/Phyto	Periphyton-Quantitative-# Diatom Taxa	#Taxa
Control & Test Sites	Bio-Peri/Phyto	Periphyton-Quantitative-# Wet Taxa	#Taxa
Control & Test Sites	Nutrients-Liquid	Ammonia-N	mg N/L
Control & Test Sites	Nutrients-Liquid	NO2NO3-N	mg N/L
Control & Test Sites	Nutrients-Liquid	N_KJEL_TOT	mg N/L
Control & Test Sites	Nutrients-Liquid	O-Phosphate-P	mg P/L
Control & Test Sites	Nutrients-Liquid	Total-P	mg P/L

Quality Assurance

In a multiagency, statewide monitoring program, it is essential to have Quality Assurance (QA) protocols that ensure all data are properly collected. All Fifth-year inspection program data are collected in accordance with FDEP's QA Rule, Rule 62-160, F.A.C. Methods for all analyses are on file at the FDEP Central Laboratory in Tallahassee and are available at http://www.floridadep.org/labs/sop/index.htm and/or http://www.floridadep.org/labs/qa/index.htm.

All samplers, including FDEP and non-FDEP staff, who collect data for the Fifth-year inspection program undergo training to ensure that the data are collected using correct sampling procedures. All samplers also participate in continued sampling audits to ensure their continuing competence and proficiency in following the standard operating procedures (SOPs) and other sampling requirements.

The collection of additional quality assurance elements for the monitoring data is identified in FDEP's guidance document, *Data Quality Assurance Elements for Identification of Impaired Surface Waters* (FDEP EAS 01-01, April 2001). These additional elements apply to all samples collected after June 10, 2003.

All of the Chemistry Section laboratory analysis capabilities and procedures are certified by the National Environmental Laboratory Accreditation Program (NELAP) through the Florida Department of Health (FDOH) under Certification Number E31780. The *Quality Manual for the State of Florida* (FDEP Central Laboratory) contains further information on these capabilities. Many of the Biology Section laboratory analysis capabilities and procedures are certified by FDOH under Certification Number E31780. The FDEP *Quality Manual for Biology Section* contains additional information on these capabilities.

The Biology Section laboratory capabilities not addressed by NELAP are invertebrate taxonomic identification, algal taxonomic identification, algal growth potential, limiting nutrient determination, and sediment grain size analysis. SOPs for these procedures are available on FDEP's Web site at http://www.floridadep.org/labs/sop/index.htm.

Habitat Assessment

Anyone performing or leading a habitat assessment must have passed a Habitat Assessment Performance Test for that type of system (e.g., stream) when the field work is carried out. Habitat Assessment Performance Test results are documented and maintained by the Bureau of Assessment and Restoration Support's (BARS) Standards and Assessment Section (SAS). FT 3000 describes the criteria for passing a Habitat Assessment Performance Test. The testing is conducted at a minimum of four sites per year at sites selected by FDEP staff.

Aquatic Macroinvertebrate Sampling

Anyone performing or leading macroinvertebrate community sampling using a dipnet for a Stream Condition Index (SCI, FS 7420) or a Biological Reconnaissance (BioRecon, FS 7410) determination must have passed a Biology Field Audit for that type of sampling at the time of the field work. FA 4200 outlines the criteria for passing a Biology Field Audit. The audit results are documented and maintained by the Standards and Assessment Section.

Data Management

When a water quality standards sampling event is planned, it is scheduled in the Laboratory Information Management System (LIMS). LIMS generates a Request Identification (RQ ID) number for the sampling, which is linked to each sample bottle requested for the event. LIMS generates sample submittal forms using this information. Field and laboratory data stored in LIMS are linked to that sampling event's RQ number. The data are recorded and stored by unique location/date identifiers.

Logbooks used by FDEP's Bureau of Laboratories are using a Document Control System, which is used to control what logbooks are used when and to keep up with document version numbers, revision dates, etc. FDEP uses many field sheets from FD 9000. Reports produced are submitted to the person requesting the report. Text reports are posted or linked on the FDEP's Web site. Draft reports are reviewed by a supervisor before they are finalized. Reports produced by FDEP are public record unless the data are restricted as part of a criminal investigation.

Chemistry Section data reduction, validation, and reporting policies and procedures are described in Section 12.0 of the FDEP Central Chemistry Laboratory's *Quality Manual for the State of Florida* under FDOH Certification Number E31780.

Biology Section data reduction, validation, and reporting policies and procedures are described in Section 12.0 of FDEP's *Quality Manual for Biology Section* under FDOH Certification Number E31780. All bureau data are handled to ensure data integrity from field to laboratory to reporting.

All data generated by the Bureau of Laboratories are verified before being entered into LIMS. The data must be checked by designated staff before being considered "complete."

Each sample collected and/or analyzed by FDEP has a unique identifier on the sample container. This identifier includes a label on the sample container with the site and/or project name, sample collection date, collector's initials or name, and test type. The label may also include the RQ number for the event, a bar code for electronic uploading of sample information; the sample collection times for certain tests, and/or replicate number. This information is linked to each unique sample analysis result for each event-location-date-test-replicate combination in LIMS and/or the Statewide Biological Database (SBio).

Data Analysis/Assessment

The results of chemical and biological analyses are compared with permit limits and water quality criteria to determine compliance. For biological community–level analyses, statistical comparisons of the proportions of taxa, major groups, or feeding groups are made using 95 percent confidence intervals on proportions. A 95 percent confidence interval is the range of values above and below a given proportion that has a 95 percent chance of containing the true proportion. If the 95 percent confidence intervals for two proportions do not overlap, then the proportion of X in Sample 1 is significantly different from the proportion of X in Sample 2 at $p < 0.05$. A "$p < 0.05$ " level of significance means that there is less than a 5 percent chance that the true proportions in the two samples are the same. All comparisons that are labeled as significant in the text have a probability < 0.05 that the proportions are the same.

Reporting

When all data have been authorized in LIMS, a biological assessment report is generated. Initially, a predraft review meeting involving several senior staff in the Biology Section is held to review the data for accuracy and completeness, and to provide guidance on data interpretation. The report is generated based on the recommendations of the predraft meeting and, once written, is reviewed by an internal editor and the Biology Section Administrator. The report is then sent to an external review committee, which includes the district biologists directly involved in the sampling and representatives of the Wastewater Program. Edits received at this meeting are incorporated, and the report is reviewed a final time by the Biology Section Administrator before being approved for publication.

Programmatic Evaluation

The Wastewater Compliance Evaluation Section and district biologists routinely work with FDEP's Tallahassee biological staff to ensure that all aspects of the program's monitoring design and compliance strategies are being met, and that the reports generated from the FYI surveys meet the needs of the district offices. Training is also provided periodically to keep district biologists up to date on specific sampling methodologies, so that consistency can be maintained throughout the state and the program's goals and objectives can be met.

SECTION E: GENERAL SUPPORT AND INFRASTRUCTURE PLANNING

Chapter 12: Infrastructure Requirements for the Core Monitoring Programs

The Florida Department of Environmental Protection (FDEP) reviews its budget and planning process in detail annually to ensure that the financial and human resource needs of its eight core monitoring programs are met in the coming year. The review process enables FDEP to identify the needs and opportunities for enhanced efficiency in collecting valid, scientifically defensible, and comprehensive water quality data (physical, chemical, and biological). The review process for state funding sources is conducted on a state fiscal year basis, beginning July 1, and the review and budgeting process for federal funding sources follows an October 1 fiscal year. This chapter provides a synopsis, by program area, of the infrastructure requirements for the eight core monitoring programs.

General Laboratory Support

FDEP's Division of Resource Management transfers funds from the Environmental Laboratory Trust Fund, a state funding source, to the Central Laboratory facility to cover laboratory support expenses for all eight core monitoring programs. Specifically, these funds are used by the laboratory for sample analysis, processing, and data entry into FDEP's master laboratory database.

Role of the Watershed Monitoring Section

FDEP's Watershed Monitoring Section (WMS) provides both administrative and technical support primarily to three of the eight core monitoring programs: the Status and Trend Networks, and the Total Maximum Daily Load (TMDL) Program's strategic monitoring. It also supports all of the agency's monitoring programs by supporting the development of new biological monitoring approaches, standards development, and collection of samples for TMDL development. The next section describes the infrastructure details for the Status and Trend networks. Within the TMDL Program, the WMS plays a key technical role in data gathering and monitoring coordination between FDEP's headquarters, district offices, and central laboratory facility.

Role of the STORET Group in the Watershed Data Services Section

For water quality data going into the impaired waters assessments, the Watershed Data Services Section (WDSS) has a dedicated group handling STORET data loading. Currently this group regularly coordinates with approximately 50 data providers in Florida. WDSS also has a group for geographic information system (GIS) analysis and mapping of the results of impaired waters assessments.

Central Laboratory Support

Five temporary Section 106 grant-funded positions in FDEP's central laboratory facility are dedicated to biological and chemical field collection, as well as sample processing for the TMDL and Ambient Monitoring Programs. The WMS administrator coordinates the funding requests for these five positions; they are supervised by staff in the laboratory.

Strategic Monitoring Program Coordination

The WAS Section coordinates sampling needs between FDEP headquarters and the districts. Staff are responsible for developing and tracking the annual strategic monitoring plans for the FDEP districts and ensuring that the data collected are loaded back into the STORET system and evaluated through the impaired waters assessments. This is an ongoing, year-round process that requires constant communication between the Watershed Assessment Section, and the Basin Planning and Coordination Section. The TMDL Strategic Monitoring Program's infrastructure needs for field sampling resources are discussed in the section below on the TMDL Program.

Development of Innovative Monitoring Approaches

Staff in FDEP also provides another Strategic Monitoring Program function relating to new and innovative biological assessment technologies. The Biological Assessment Program's administrative committee performs a central leadership role. The committee is responsible for researching and implementing new bioassessment tools for the Division of Environmental Assessment and Restoration monitoring programs. FDEP's Bureau of Laboratories and its district offices provide in-kind services to support the activities of the Biocriteria Committee.

Ambient Monitoring Program (Status and Trend Networks)

FDEP receives an annual state budget allotment (approx. 1.7M) from the Florida legislature specifically for the Status and Trend Networks. This funding source has been relatively stable over the years, however is subject to cuts if the shortfalls in the state budget do not improve.

The majority of the annual state allotment for ambient monitoring has been budgeted for the Status Network, which collects, analyzes, and reports on over 700 samples per year. For these samples, many more field sites were identified, visited, and evaluated before final selections are made. Therefore, the costs are very high for this type of monitoring program, which uses a random sampling design. In addition, as available, these state funds are set aside to expenses for the Trend network. For example, the program is taking on new initiatives, and plans to fund new gauging stations to complement the surface water Trend monitoring network initiative.

The surface and ground water Trend network consists of fixed stations that are sampled monthly or quarterly. With sites of known location, sampling costs are low compared with those of the Status Network. Only a small portion of the state allotment is used for the Trend Network. To cover the majority of this program's costs, FDEP receives annual grant funding from the CWA Section 604 grant program that is generally prioritized from year to year. To satisfy pass-through requirements, these funds provide mostly for Trend Network contracts with two of the state's five water management districts (WMDs) to obtain surface water trend monitoring samples. Occasionally, when required, some of the annual CWA Section 604 grant work plans describe funding needs to support other division monitoring programs.

The state's $1.7 million allotment and the Section 604 Trend monitoring funds are spent with a focus on Status and Trend Network contracts, field sampling crews and field expenses, and centralized administration of the Ambient Monitoring Program. This includes data management and analysis, geographic information system (GIS) support, report writing, supervision, and clerical support.

In addition to $1.7 million per year allocated to the Ambient Monitoring Program, another legislative allotment (approximately $125,000) is deposited directly into FDEP's Central Laboratory facility for sample processing and analysis to support the Status and Trend Monitoring Programs.

The Status and Trend Networks are implemented primarily by FDEP's Watershed Monitoring Section, in cooperation with district office staff. Total staff resources for this program are as follows:

Administration (program management, contract management, technical assistance, and field sampling supervision, Quality assurance (QA) coordination)—7 permanent full-time employees;

Field sampling—13 temporary positions;

GPS coordinator- 1 temporary position

Data review and recon – 3 temporary positions

Data management—1 temporary position;

Data analysis—2 temporary positions; and

GIS support—1 temporary position.

Although funds are available from the state to support this program, additional funding is required to cover lab expenses for the supplemental indicators analysis.

Florida Springs Initiative

The Springs Initiative receives funding annually to support programs in research and monitoring, educational outreach, and landowner assistance. Currently, about half of the total annual allocation is used to fund current research or monitoring efforts. Continued funding depends on annual allocations proposed by the Governor and approved by the Florida legislature.

The Springs Initiative administrative staff consists of 3.5 full-time equivalent employees. Staff from several other FDEP programs is involved in the initiative in varying degrees, particularly those from the WMDM Section, Florida Geological Survey, Bureau of Laboratories, Ground Water Protection Section, Division of State Lands, Florida Park Service, and Secretary's Office.

A number of other federal, state, and private agencies are involved in the initiative via contracts, grants, or other joint funding agreements. These include four WMDs (Northwest, Suwannee River, St. Johns River, and Southwest Florida), Florida Department of Community Affairs, Florida Fish and Wildlife Conservation Commission, University of Florida, Florida State University, U.S. Geological Survey, Karst Environmental Services, and others.

The *Florida Springs Task Force* is an advisory group made up of representatives of local, state, and federal governmental agencies; universities; environmental advocates; springs-related industries; and the general public. It meets several times per year.

Total Maximum Daily Load Program

Both state and federal funds are required to support the TMDL Program's monitoring needs, which include both strategic monitoring and intensive surveys. Since the passage of the Florida Watershed Restoration Act and the implementation of Florida's watershed management approach in 2000, the legislature has provided varying amounts of funding for the TMDL program. In the first five years of the program, funding varied from approximately $2.2 million to $5 million per year. In fiscal year 2004, the legislature provided $6.6 million, with about half of the funds dedicated to the statewide monitoring effort to help revise Florida's waterbody classification system and the associated ambient water quality standards. In 2005, the Water Protection and Sustainability Trust Fund was established with funding of $50 million per year, with the TMDL program receiving $20 million. The Trust Fund receives its money from documentary stamps which are fees associated with mortgages and other legal documents. Unfortunately, the recent economic slump has dramatically reduced documentary stamps from over $4 billion to less than $2 billion. As a result, the TMDL program has seen its funding reduced to about $10 million per year.

Federal grant sources supporting the TMDL Program include the annual Section 106 grants. Annual Section 106 grant awards to FDEP typically include an allotment for TMDL Program needs. On average, the TMDL Program has been receiving approximately $3 million from the annual Section 106 grant. While these funds are used for all aspects of the TMDL Program, a significant portion are for monitoring support and data management activities.

Staffing for the Strategic Monitoring Program and intensive surveys consists of 11 permanent positions (1 in each of 6 FDEP district offices and 5 at headquarters) and 8 temporary positions (6 in the district offices and 2 at headquarters).

Water Quality Standards Program

The Standards and Assessment Section, in the Bureau of Assessment and Restoration Support has received funding in the past from a special allocation of state funds for a special monitoring project to assist in evaluating and potentially modifying the current dissolved oxygen and nutrient criteria. The staffing resources include three full-time, state-funded positions.

Site-Specific Alternative Criteria

Currently there are no dedicated funds for the development of site-specific alternative criteria (SSACs). Since each SSAC is parameter specific and waterbody specific, resource needs will be determined as needed.

Fifth-Year Inspection Program

FDEP's Wastewater Compliance Evaluation Section evaluates its current and future resource needs annually in order to continue to implement the Fifth-Year Inspection (FYI) compliance strategy. Fifty-three staff support the program: 18 career service positions in FDEP's 6 districts, 11 career service positions in Tallahassee, and 24 temporary positions in Tallahassee.

There are no external funding sources specifically for the FYI Program (i.e., legislative, EPA Section 106, or others).

Chapter 13: Monitoring Program Evaluation and Planning

Within this document the Florida Department of Environmental Protection Division of Environmental Assessment and Restoration has examined its current monitoring program in the context of EPA's *Elements of a State Water Monitoring and Assessment Program.* Florida's Monitoring Strategy is intended to be a critical step in an ongoing, iterative planning process that began many years ago with the establishment of Florida's Integrated Water Resource Monitoring Program. The Strategy will be periodically evaluated and revised, as necessary, to enhance Florida's water quality monitoring and assessment programs.

Currently, Florida's water quality monitoring programs are addressing EPA's ten minimum elements for state monitoring programs. However, enhancements can always be made to improve the state's monitoring programs should additional resources become available. Unfortunately, funding for such program enhancements is beyond the direct control of the Division of Environmental Assessment and Restoration.

1. Ongoing Program Enhancements

- Completion of the conversion of the National Hydrography Dataset (NHD) from 1:100,000 to 1:24,000 and long term maintenance of the data base. Once completed, this new data base will greatly enhance our ability to more accurately located monitoring stations, link data bases, and produce maps showing impairments by stream reaches rather than watersheds.
- Completion of the calibration and adoption of the periphyton Index and the Lake Vegetation Index to provide quantitative biological assessment tools and criteria.
- Data collection and analysis to revise Florida's dissolved oxygen criterion and to develop quantitative nutrient criteria for rivers and lakes. This data will also be useful in assessing the practicality of subdividing Florida's Class III freshwaters which have a designated use as Fishable and Swimmable into subcategories that more accurately reflect their designated uses. Currently, Class III waters include rivers, lakes, spring, wetlands, canals, urban lakes, and urban drainage ditches – all with one set of applicable water quality criteria.
- District LIMS replacement. The current Laboratory Information Management System in nearly all of the FDEP District Offices is woefully outdated and the software is unstable.
- Enhanced software to facilitate data loading into the Florida STORET data base. Monitoring partners are still having difficulty doing batch loading of water quality monitoring data into EPA STORET and into Florida STORET (See WMIS below). Quality assurance elements required by Florida's Impaired Waters Rule cannot be loaded into EPA STORET and many labs do not have the capabilities of loading this information into Florida STORET. Additionally, redesign of Florida STORET is underway.

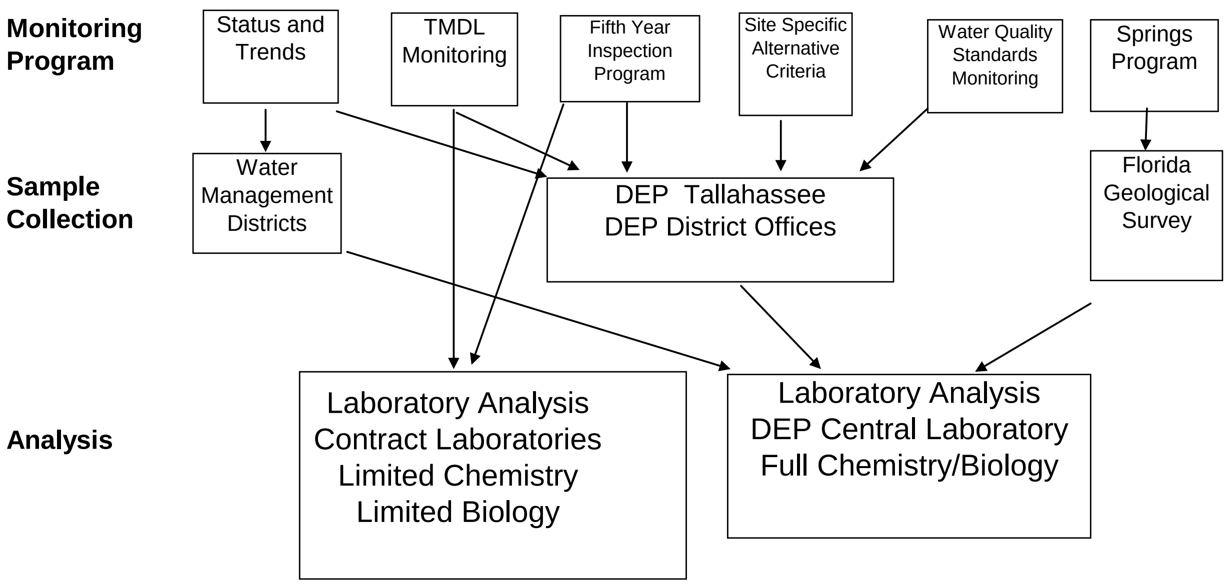
2. Desired Program Enhancement (if funding becomes available)

- Continuation of funding to support statewide monitoring program to report on ambient condition of surface and ground water resources.
- Conversion of existing OPS monitoring positions into career service positions. This would greatly reduce staff turnover by providing staff with benefits including leave, retirement, and medical coverage. This also would increase productivity since less time would be required to train new staff since turnover would be less. This would be vetted through a legislative process.
- Development of an integrated fresh and costal water resource monitoring network.
- Development of wetland monitoring program to evaluate and support criteria development.
- Continued support to allow support of monitoring programs to provide data in support of water and biological criteria development.
- Development, evaluation, and calibration of biological assessment tools for estuarine waters.
- Development, evaluation, and adoption of numerical nutrient criteria for fresh and estuarine waters.
- Continuation of the Florida Water Resources Monitoring Council that will improve the communication, coordination, and cooperation of monitoring entities around the state.

Appendix 1

Flowchart showing relationship between DEP programs, sample collection responsibilities and Laboratory Analysis

Monitoring Program Data Collection and Analysis Generic Org Chart



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