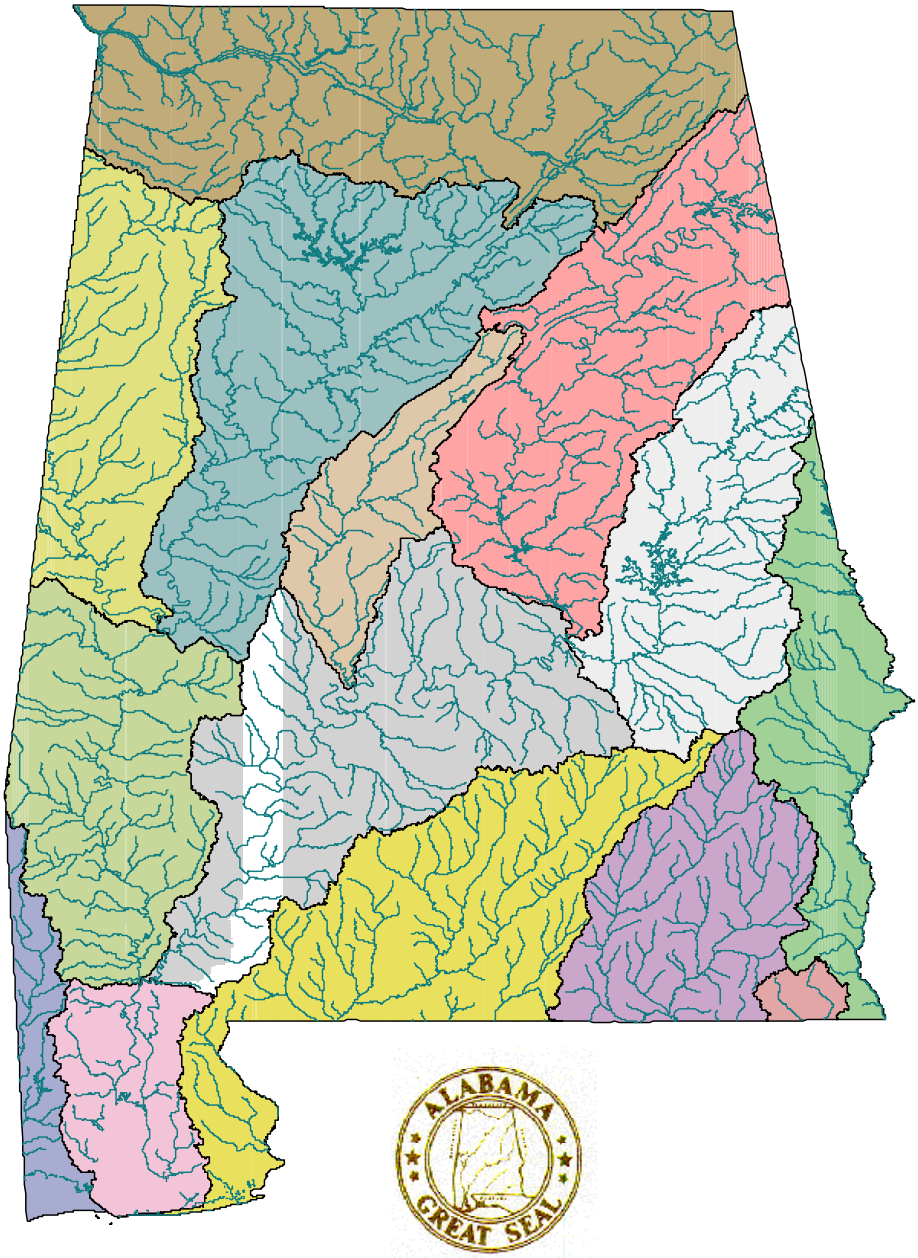
State of Alabama
Water Quality Monitoring Strategy



Alabama Department of Environmental Management
June 19, 2012

State of Alabama

Water Quality Monitoring Strategy

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INTRODUCTION

In 2003, the U.S. EPA released *Elements of a State Water Monitoring and Assessment Program*. The purpose of this document was to outline basic recommended components for monitoring programs performed by states receiving Clean Water Act (CWA) §106 funds. States are required to develop a formal written monitoring strategy that addresses ten broad categories: Monitoring Strategy, Objectives, Design, Water Quality Indicators, Quality Assurance, Data Management, Data Analysis and Assessment, Reporting, Programmatic Evaluation, and Support Planning. Each state's monitoring strategy document should describe how each state is currently incorporating the "Ten Elements" recommendations in their monitoring programs, identify elements not sufficiently addressed, and outline a ten-year timeline for full implementation of these missing elements. The desired effect of the "Ten Elements" is the development and implementation of more comprehensive monitoring strategies by each state and enhanced comparability of data and assessments on a national scale.

In the following document, the Alabama Department of Environmental Management (ADEM) presents an updated overview of how its monitoring programs address the "Ten Elements" recommendations, following the initial version in 2005. These are presented in Sections I-X. Section XI provides a timeline of relevant past, current, and future monitoring activities and the date, or projected date, of incorporation into monitoring programs. Section XII provides more detailed information for each of the individual component monitoring programs in each of these categories.

ADEM's first monitoring strategy was developed in 1997. Originally entitled 'ADEM's Strategy for Sampling Environmental Indicators of Surface Water Quality Status' or '*ASSESS'*, the strategy was implemented on a five-year rotational cycle. An integral part of *ASSESS* was a thorough review of the Strategy at the end of each monitoring cycle. As part of ADEM's Monitoring Strategy review process, personnel from ADEM's Field Operations Division, Water Division and Office of Education and Outreach met in 2004 to review results from ADEM's first five-year monitoring cycle. The purpose of the meeting was to conduct a comprehensive review of ADEM surface water quality monitoring programs, to include identification of data needs not met by

ASSESS, and discussion of potential changes to the monitoring design that could address these needs. Based on these identified needs and recommendations, the Monitoring Strategy was revised, updated, and implemented in 2005. This second comprehensive review, revision, and update was repeated in 2011-2012, having been delayed one year by extensive tasks required by the Deepwater Horizon oil spill to the Gulf of Mexico in 2010.

This Monitoring Strategy is intended to be the next step in an ongoing, iterative planning process. The Strategy sets forth a plan to address the "Ten Elements", but reassessments of initiatives, needs, and resources must be made on a regular basis. ADEM's Monitoring Strategy is implemented on a five-year monitoring cycle and an in-depth review of the Strategy is completed at the end of each five-year cycle. Annual coordination/planning meetings are conducted internally that include staff involved in monitoring, criteria/standards, permitting, and education/outreach. Annual status reports are provided to USEPA Region 4 to document progress towards ADEM's monitoring goals.

This strategy document will enable ADEM to build on its existing monitoring capabilities and to address all state waters over time, including wetlands. ADEM views each 5-year Monitoring Strategy as an opportunity for long-term planning and to that end, includes discussion of future initiatives and a timeline, that address incremental improvements necessary to incorporate requirements outlined in *Elements of a State Water Monitoring and Assessment Program* and to satisfy monitoring goals and requirements pursuant to the Alabama Water Pollution Control Act (AWPCA), the Alabama Environmental Management Act (AEMA), and the federal Clean Water Act (CWA).

I. MONITORING PROGRAM STRATEGY

The ADEM has maintained a surface water quality monitoring program since 1974, but did not develop a coordinated monitoring strategy until 1997, with the publication of **A**DEM's **S**trategy for **S**ampling **E**nvironmental Indicators of **S**urface Water Quality **S**tatus or "*ASSESS*". This document was developed in an effort to focus and document the Department's surface water quality monitoring mission. The strategy was updated in 2005 with the 2003 EPA *Elements of a State Water Monitoring and Assessment Program* as the basic framework. The Strategy outlined quality assurance plans, data management, data analysis, reporting, program review, and overall resource needs. The objectives and design of the Strategy are summarized in the Monitoring Objectives and Monitoring Design sections of this document.

ADEM's current Monitoring Strategy is a coordinated monitoring approach designed to characterize water quality, to identify impacts from a variety of sources, and to provide a systematic and integrated framework for gathering necessary information to support the decision-making process. The monitoring strategy is currently comprised of four programs that, together, will address all surface waters over time. The programs are defined by wadeability and waterbody type: wadeable rivers and streams (RSMP), nonwadeable rivers and reservoirs (RRMP), coastal waters (CWMP), and wetlands (WMP). Each program incorporates specific protocols and methodologies to ensure that monitoring activities provide the highest quality information and make the most efficient use of available resources. The protocols and methods used in each program correspond with the minimum data requirements for each waterbody type in Alabama's Listing and Assessment Methodology. The overall strategy is implemented on a 5-year rotation by basin and incorporates a combination of targeted, probabilistic, and long-term monitoring stations to meet state monitoring goals and objectives.

II. MONITORING OBJECTIVES

The objectives of ADEM's Monitoring Strategy are consistent with the federal Clean Water Act (CWA), as well as Alabama's statutory and regulatory monitoring requirements and data needs. They are applicable to all waters of the state including wadeable rivers and streams, nonwadeable rivers and reservoirs/lakes, estuaries, coastal waters, wetlands, and groundwater. The objectives of ADEM's Monitoring Strategy can be described in six broad categories:

1) Determine water quality standards attainment;
2) Identify impaired waters;
3) Identify high-quality waters;
4) Identify causes and sources of water quality impairments;
5) Support management decisions;
6) Evaluate program effectiveness;
7) Estimate overall water quality;
8) Estimate water quality trends; and,
9) Establish, review, and revise water quality standards.

A brief description of each of these broad objectives follows.

1. Determine water quality standards attainment

A goal of the CWA is the attainment and maintenance of *fishable/swimmable* waters. To reach this goal, Alabama has defined seven designated uses for all surface waters and criteria intended to protect these uses. Designated uses are listed in ADEM regulations at 335-6-11 and the criteria are found in 335-6-10.

All Alabama waters are assigned to one or more designated uses. The assigned use(s) include the highest quality use that the waterbody segment can reasonably be expected to achieve. Attainment of water quality standards is determined by comparing collected data to both the numeric and narrative criteria established for its highest use classification. These data include physical, chemical, and biological data. The data are used to place each monitored location into one of five categories, with category 1

"Fully Supporting" all use classification criteria and category 5 "Not Supporting" one or more use classification criteria.

Monitoring is conducted to assess attainment of water quality standards within specific waterbodies or waterbody segments. The assessment process is described more fully in Section VII. Data Analysis/Assessment.

2. Identify impaired waters

ADEM's monitoring strategy is designed to identify waterbodies or waterbody segments that do not meet their use classification criteria. Stream segments most at risk for impairment based on landuse and other factors are selected as probabilistic monitoring sites. Sites identified as concerns by stakeholders, volunteer organizations, or other state and federal agencies are also prioritized for monitoring. ADEM's monitoring strategy meets the Department's minimum data requirements to fully assess each monitoring location, generally within one year of sampling. Additional data are collected as needed to help determine the cause(s) and source(s) of impairment.

3. Identify high-quality waters

The ADEM monitors a network of least-impaired ecoregional reference reaches throughout the state. Data collected from these high-quality waters are used to define site classes and to establish a basis of comparison to apply narrative criteria on an ecoregional basis. Candidate reference reaches are sampled as probabilistic monitoring sites. Additional high-quality waters identified by stakeholders, volunteer organizations, or other state and federal agencies are also prioritized for monitoring.

4. Identify the cause(s) and source(s) of water quality impairments

ADEM's monitoring strategy is designed to identify waterbodies or waterbody segments that do not meet their use classification criteria. The monitoring strategy meets ADEM's minimum data requirements to fully assess each monitoring location, generally within one year of sampling. Additional data are collected as needed to help determine the cause(s) and source(s) of impairment. Waterbodies or segments where a

cause and/or source of impairment cannot be determined are prioritized for further monitoring.

5. Support management decisions

Alabama's monitoring strategy is designed to meet Alabama's statutory and regulatory monitoring requirements and data needs. It provides technically sound data and information for the development and implementation of Total Maximum Daily Loads (TMDLs), Waste Load Allocations (WLAs), and Watershed Management Plans (WMPs), as well as permit compliance and enforcement.

6. Evaluate program effectiveness

Specific and intensive monitoring is conducted to determine if permits are within appropriate limits, if TMDL changes have been effective, if non-point source control practices have resulted in improvements, etc.

7. Estimate overall water quality

The ADEM implemented its probabilistic monitoring of wadeable flowing watersheds in 2005. The sites are located at the downstream-most wadeable pour points of randomly-selected watersheds that reflect both overall water quality conditions within a basin group, as well as the complete gradient of potential human disturbances. They are sampled in accordance with ADEM's five year rotating basin cycle. Overall water quality can be reported statewide or by basin group.

8. Estimate water quality trends

Long term trends in water quality can be estimated for any of ADEM's fixed monitoring locations, including its intensive and compliance sampling stations sampled as part of its Rivers and Reservoirs Program and Coastal Waters Monitoring Program. Included in these Programs are 103 long-term ambient trend sites that are sampled to identify trends in water quality statewide and to provide data for the development of TMDLs and water quality criteria.

9. Establish, review, and revise water quality standards

Data collected as part of ADEM's Monitoring Strategy are used to develop and refine use classifications and water quality standards. The data are used to determine designated uses that can be supported or attained and for the establishment of criteria to protect existing designated uses. A primary goal of ADEM's Monitoring Strategy is developing a comprehensive dataset that can be used to develop biological, nutrient, and sediment criteria.

III. MONITORING DESIGN

ADEM's current monitoring strategy is a coordinated monitoring approach designed to characterize water quality, to identify impacts from a variety of sources, and to provide a systematic and integrated framework for gathering necessary information to support the decision-making process. The monitoring strategy is currently comprised of four programs that, together, will address all surface waters over time. The programs are defined by waterbody type, tidal influence, and wadeability: Rivers and Streams Monitoring Program (RSMP), wadeable rivers and streams; Rivers and Reservoirs Monitoring Program (RRMP), nonwadeable rivers and reservoirs; Coastal Waters Monitoring Program (CWMP), waters in the coastal area; and, the Wetlands Monitoring Program (WMP). The objectives and monitoring design of each program is summarized in Section XII. The key aspects of ADEM's overall strategy are described below.

Basin Rotation

Since 1996, ADEM's monitoring strategy has been implemented on a 5-year rotation by basin. This approach has improved monitoring coverage within each river basin, improved spatial detail of water quality assessments, and increased the total stream miles monitored during each rotation.

While most surface water monitoring is conducted within the targeted river basin, more frequent monitoring is conducted within priority watersheds or at priority stations identified by ADEM's Water Quality Branch (WQB), NPS Unit, or Field Operations Division (FOD) (see Organizational Chart, p. 15). This type of intensive monitoring is necessary to evaluate trends in water quality at specific locations.

Ecoregions

Ecoregions are used to define relatively homogeneous geographic areas that define the patterns and composition of biotic and abiotic characteristics (Wiken 1986, Omernik 1987, 1995). These characteristics include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. Data are collected from least-impaired

reference reaches in each ecoregion to help define site classes. These data also serve as the basis of comparison with other waterbodies within the same region.

Site Selection

In very general terms, ADEM's Monitoring Strategy incorporates a combination of long-term fixed, targeted, and probabilistic monitoring locations:

- The ADEM has established **long-term, fixed monitoring sites** that became part of the RSMP, RRMP, and CWMP. They are permanent monitoring locations established to identify long-term trend in water quality, develop TMDLs and water quality standards, and establish regional "reference" conditions for comparison with other similar waterbodies.
- **Probabilistic sites** are sampled as part of ADEM's RSMP in accordance with ADEM's 5-year rotating basin cycle. Currently, they are located at the downstream-most pour points of randomly-selected watersheds that reflect both overall water quality conditions within a basin group, as well as a gradient in watershed conditions.

  Approximately 30 probabilistic wetland sites were sampled by ADEM as part of the 2011 National Wetland Condition Assessment and the 2012-2013 Multi-State Assessment of Coastal Plain Wetlands completed by North Carolina, South Carolina, Georgia, and Alabama. The purpose of these projects was, in part, to provide estimates of overall wetland conditions on national and regional scales.

- **Targeted sites** are incorporated into the RSMP, RRMP, and CWMP programs. They are selected by ADEM's WQB, NPS Unit, FOD, other local, state or federal agencies, the Clean Water Partnership of Alabama, or volunteer groups to provide data for use support and assessment, TMDL development, program evaluations, Use Attainability Analyses, or education and outreach. These sites are monitored on a short-term basis (1-5 years). Where possible, targeted sampling is conducted in accordance with ADEM's 5-year basin rotation.

Sampling Protocols

One of the key aspects of ADEM's Monitoring Strategy is to define a given monitoring station as being either wadeable or nonwadeable. This is important because the minimum data requirements for Alabama's Assessment and Listing Methodology vary based on waterbody type and wadeability. The ADEM is currently analyzing biological and water quality data to more precisely define site classes and appropriate sampling protocols based on drainage area, ecoregion, and stream width.

- **Wadeable-Bioassessment (BIO-W)**: A station is classified as wadeable-bio if the 300-foot sampling reach is completely wadeable (~≤ 3 feet) and the 300-foot reaches upstream and downstream of the sampling location are also completely wadeable. This is to help ensure that the reach is representative of the watershed. Bioassessments are conducted using ADEM's wadeable protocols. *In situ* measurements and water quality samples are collected at mid-depth.

- **Wadeable-Water (H20-W)**: A station is classified as wadeable-H20 if water samples can be collected instream, but the sampling reach is not completely wadeable (~≤ 3 feet) or the 300-foot reaches upstream or downstream of the sampling location are not completely wadeable. *In situ* measurements and water quality samples are collected at mid-depth, but it may be necessary to conduct bioassessments using ADEM's non-wadeable protocols.

- **Nonwadeable Bridge Stations (NWG)**: Sub-surface grab samples are collected from a bridge if a nonwadeable station is not accessible by boat. A vertical profile of field parameters (temp., pH, cond., D.O.) is collected. This information is used to document that the stream is well-mixed and collection of a grab sample is appropriate. Once a protocol is established, the protocol used to collect the vertical profile should be consistent (i.e., if a full vertical profile is collected in the spring, a full vertical profile should be collected throughout the sampling period; if *in situ* measurements are measured at surface, mid-, and bottom in the spring, the crew leader should continue to do so throughout the sampling period). By contrast, every attempt should be made to collect water

samples at mid-depth. During the year, if the reach can be waded, water samples should be collected from in stream rather than from the bridge, if it is safe to do so. However, sub-surface grab samples can be collected from the bridge over fast flowing water when conditions are truly non-wadeable or dangerous. Bioassessments are conducted using ADEM's nonwadeable protocols.

- *NWG-Deep*: These stations are ≥ 10 ft. in depth. Full vertical profiles are measured at these stations.
- *NWG-Shallow*: These stations are < 10 ft. in depth. A minimum of 3 measurements are collected at the surface (0.2 m), mid-depth, and the bottom.

- **Nonwadeable Boat Stations (NWB)**: Samples should be collected as photic zone composites. Full vertical profiles should be measured. Nonwadeable stations located in the coastal waters of Alabama (i.e., Mobile Bay, Mississippi Sound, Wolf Bay, etc.) should be sampled the same as non-coastal stations except they will also include salinity as a parameter to be collected with the vertical profile. Bacteriological samples for all nonwadeable stations are collected as surface grabs.

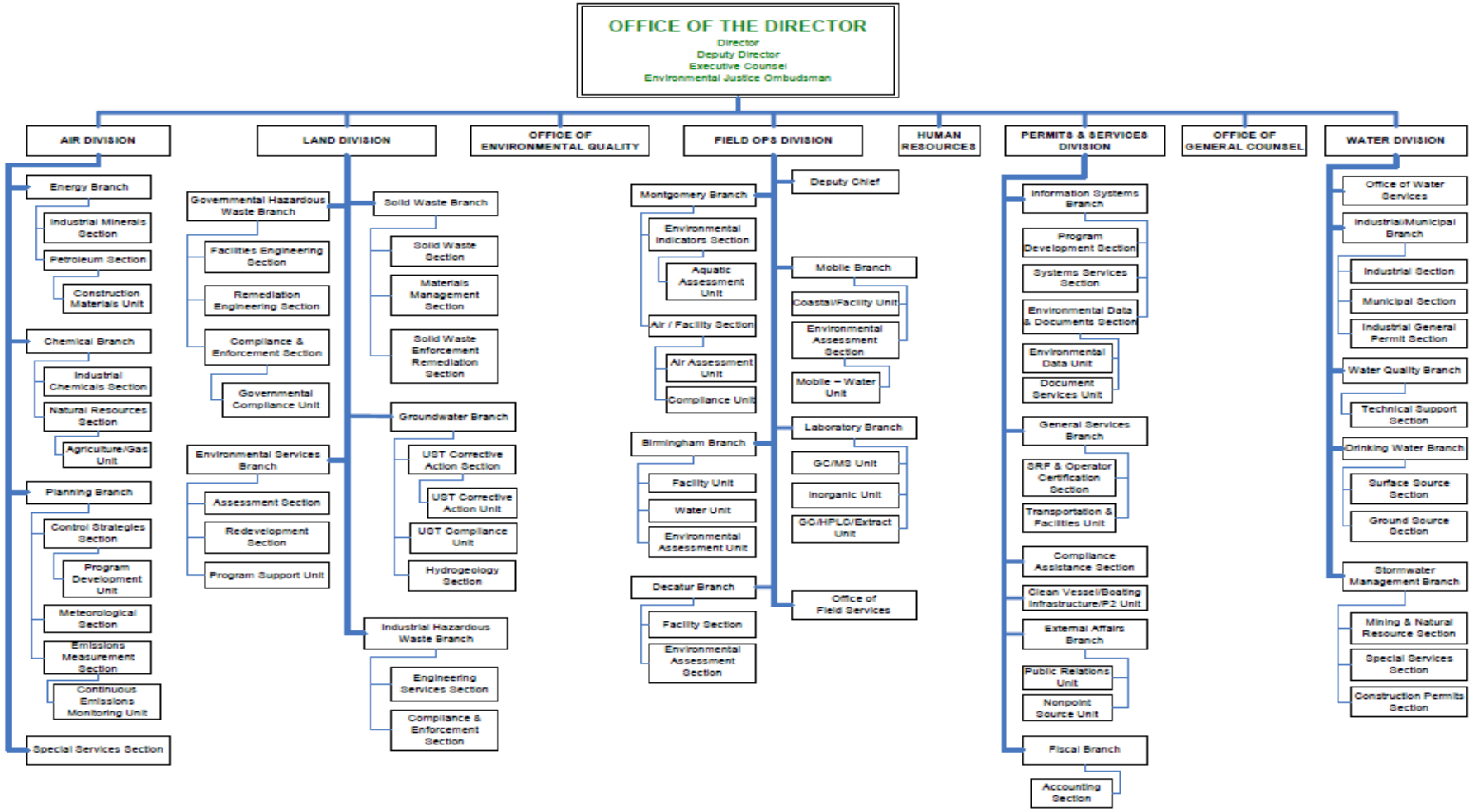
Communication

An important aspect of ADEM's Monitoring Strategy is communication. ADEM's 2005 Monitoring Strategy established a process of internal programmatic review and communication as an integral part of each 5-year monitoring cycle. ADEM's Field Operations Division, Water Division, and Nonpoint Source Unit meet to review results from the previous five-year monitoring cycle, identify data needs that were not met by the previous 5-year monitoring strategy, discuss and prioritize the goals of the next 5-year monitoring strategy, and determine how best to meet these goals. The 2005 and 2012 Monitoring Strategies were finalized and implemented based on the results of these discussions. These personnel also meet twice annually to discuss, prioritize, and

develop each Annual Surface Water Quality Monitoring Plan, which summarizes the sampling locations, sampling frequencies, and sampling parameters to be monitored each year. As part of the 2012 Monitoring Strategy, ADEM held Alabama's initial multi-state agency water quality monitoring strategy meeting in December 2011 to improve communication and coordination among all agencies conducting monitoring activities. ADEM's 2005 monitoring strategy and programs were discussed and comments incorporated into the final 2012 monitoring strategy.

A Departmental Water Quality Monitoring Coordinator was appointed in 2005 to improve communication within ADEM and with other agencies, and to ensure consistency in monitoring activities. A primary contact was also established for the Central and Branch Field Offices to assist with coordination and communication throughout ADEM.

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT



IV. CORE AND SUPPLEMENTAL WATER QUALITY INDICATORS

EPA guidance calls for state monitoring programs to include "a core set of baseline indicators selected to represent each applicable designated use, plus supplementary indicators selected according to site-specific or project-specific decision criteria." ADEM addressed these requirements in *Alabama's 2010 Water Quality Assessment and Listing Methodology*. Core criteria are determined by both waterbody type and use classification. A summary table of core indicators chosen for assessing and categorizing waters in Alabama's Integrated Assessment Report appears on the following two pages.

A primary objective of ADEM's Monitoring Strategy is to collect data so that all stations monitored could be fully assessed and categorized in Alabama's Integrated Report. ADEM developed the annual Surface Water Quality Monitoring Plan (SWQMP) as a first step towards meeting this monitoring goal and coordinating monitoring efforts among the different surface water monitoring programs. The SWQMP combines all surface water monitoring into one comprehensive monitoring plan for the year. A core set of parameters is set for coastal, nonwadeable rivers and reservoirs, wadeable rivers and streams. These are summarized at the end of each program description in Section XII.

Current Initiatives

By designing a program based on watershed monitoring and incorporating a measure of human disturbance within each watershed, ADEM's Monitoring Strategy was designed to collect data to develop indicators and assessment criteria that link chemical, physical, and biological conditions of a waterbody to conditions throughout its watershed. ADEM initiated the 2005 ACT Basin Assessment to assess the condition of wadeable rivers and streams in the Alabama, Coosa, and Tallapoosa River Basins and to evaluate the effectiveness of ADEM's monitoring design in meeting this objective. ADEM expanded its intensive monitoring efforts to include targeted, basin assessment, and ecoregional reference reaches. By conducting intensive monitoring of chemical, physical, and biological indicators over a range of watershed conditions,

Summary of minimum data requirements for assessing and categorizing reservoirs and embayments, nonwadeable rivers, wadeable rivers and streams, and coastal waters and estuaries in each use classification meeting EPA's goal of fishable/swimmable waters.

Use Classification	Waterbody Type			
	Reservoir and Embayment	Nonwadeable Rivers	Wadeable Rivers and Streams	Coastal and Estuaries
Outstanding Alabama Water (OAW)	No nutrient criteria: 10 Conventional 10 Bacteriological 1 Fish Tissue Nutrient criteria: 10 Conventional 10 Bacteriological 1 Fish Tissue 7 Chlorophyll a	10 Conventional 5 Bacteriological 3 Pesticide/Herbicide 3 Dissolved Metals	1 Bioassessment 3 Conventional 3 Bacteriological 3 Pesticide/Herbicide 3 Dissolved Metals	10 Conventional 10 Bacteriological 1 Fish Tissue
Public Water Supply (PWS)	No nutrient criteria: 10 Conventional 10 Bacteriological 1 Fish Tissue Nutrient criteria: 10 Conventional 10 Bacteriological 1 Fish Tissue 7 Chlorophyll a	10 Conventional 10 Bacteriological 1 Fish Tissue	1 Bioassessment 3 Conventional 10 Bacteriological (2 GM) OR 10 Conventional 10 Bacteriological 3 Pesticide/Herbicide	10 Conventional 10 Bacteriological 1 Fish Tissue
Shellfish Harvesting (SH)	10 Conventional 10 Bacteriological (2 GM) 3 Pesticide/Herbicide 3 Dissolved Metals Summary of ADPH shellfish harvesting closure notices			
Swimming (S)	No nutrient criteria: 10 Conventional 10 Bacteriological (2 GM) 1 Fish Tissue Nutrient criteria: 10 Conventional 10 Bacteriological (2 GM)	10 Conventional 10 Bacteriological (2 GM) 3 Pesticide/Herbicide 3 Dissolved Metals	1 Bioassessment 3 Conventional 3 Bacteriological OR 10 Conventional 10 Bacteriological (2 GM) 3 Pesticide/Herbicide	10 Conventional 10 Bacteriological (2 GM)

	1 Fish Tissue 7 Chlorophyll a			
Fish & Wildlife (F&W)	No nutrient criteria: 10 Conventional 10 Bacteriological (2 GM) 1 Fish Tissue Nutrient criteria: 10 Conventional 10 Bacteriological (2 GM) 1 Fish Tissue 7 Chlorophyll a	10 Conventional 10 Bacteriological (2 GM) 5 Pesticide/Herbicide 5 Dissolved Metals	1 Bioassessment 3 Conventional 3 Bacteriological OR 10 Conventional 10 Bacteriological (1 GM) 5 Pesticide/Herbicide 5 Dissolved Metals	10 Conventional 10 Bacteriological 1 Fish Tissue OR 10 Conventional 10 Bacteriological (2 GM) 5 Pesticide/Herbicide 5 Dissolved Metals

Summary of minimum data requirements for assessing and categorizing reservoirs and embayments, nonwadeable rivers, wadeable rivers and streams, and coastal waters and estuaries in each use classification not meeting EPA's goal of fishable/swimmable waters.

Use Classification	Waterbody Type			
	Reservoir and Embayment	Nonwadeable Rivers	Wadeable Rivers and Streams	Coastal and Estuaries
Limited Warmwater Fishery (LWF)	No nutrient criteria: 10 Conventional 5 Bacteriological (1 GM) 1 Fish Tissue Nutrient criteria: 10 Conventional 5 Bacteriological (1 GM) 1 Fish Tissue 7 Chlorophyll a	10 Conventional 5 Bacteriological (1 GM) 3 Pesticide/Herbicide 3 Dissolved Metals	10 Conventional 5 Bacteriological (1 GM) 3 Pesticide/Herbicide 3 Dissolved Metals	10 Conventional 5 Bacteriological (1 GM)
Agriculture & Industry (A&I)	No nutrient criteria: 10 Conventional 5 Bacteriological (1 GM) 1 Fish Tissue Nutrient criteria: 10 Conventional 5 Bacteriological (1 GM) 1 Fish Tissue 7 Chlorophyll *a*	10 Conventional 5 Bacteriological (1 GM) 3 Dissolved Metals	10 Conventional 5 Bacteriological (1 GM) 3 Dissolved Metals	10 Conventional 5 Bacteriological (1 GM)

Where:

- 1 Bioassessment= 2 screening-level macroinvertebrate assessments or 1 intensive-level macroinvertebrate assessment;
- Conventional=Collector name, Date, Time, Air Temperature, Water Temperature, Total stream depth, Sampling depth, Dissolved oxygen, Specific conductance, pH, Turbidity, Weather conditions, Stream flow (where appropriate), Five-day Carbonaceous Biochemical Oxygen Demand, Alkalinity, Total suspended solids, Total dissolved solids, Chlorides, Dissolved reactive phosphorus, Ammonia nitrogen, Nitrate+nitrite-nitrogen, Total Kjeldahl nitrogen, Total phosphorus, Hardness
- Bacteriological= Fecal Coliform in freshwater and Enterococci in salt or brackish waters; GM=Geometric mean

- Pesticide/Herbicide= Organochlorine pesticides by SW8081A, Organophosphorus pesticides by SW8141A, Chlorinated herbicides by SW8141, and Atrazine by Immunoassay
- Dissolved metals=Dissolved Antimony, Arsenic+3, Cadmium, Chromium+3, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, and Zinc
- Fish Tissue=Arsenic, Cadmium, Mercury, Selenium, Lead, Chlordane, 4,4-DDD, 4,4-DDE, 4,4-DDT, 2,4-DDD, 2,4-DDE, 2,4-DDT, Chlorpyrifos, Dieldrin, Endosulfan I, Endosulfan II, Endrin, Lindane, Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, Mirex, Toxaphene, PCBs, Dioxin, Percent lipids

ADEM will be able to establish water quality criteria that reflect overall watershed condition. It will also allow ADEM to make more informed decisions regarding whether a waterbody is meeting its designated uses as well as to refine existing water quality criteria to better protect these uses. More specifically, this type of monitoring effort will allow ADEM to continue to evaluate and refine its Periphyton, Macroinvertebrate, and Fish Community Bioassessment Methods and to develop Biological Condition Gradients, Assessment Criteria and Indices, and Tiered Aquatic Life Uses. This effort is described in more detail under Section XII. Wadeable Rivers and Streams.

The Geological Survey of Alabama (GSA), in cooperation with the ADEM and the Alabama Department of Conservation and Natural Resources (ADCNR), is nearing completion of a multi-year research effort to develop and calibrate a comprehensive fish community bioassessment tool, known as the Index of Biotic Integrity (IBI), for the state of Alabama. This tool will be useful in helping agencies assign designated water-use classifications for all the state's waters to manage water quality more efficiently and effectively, to understand aquatic resources more broadly and in greater depth, and to better manage aquatic habitat

The ADEM has made substantial progress in the last few years in bacteria monitoring of coastal swimming areas as a result of the BEACH Act. *Enterococcus* is used as an indicator for coastal (marine) waters in the Coastal Alabama Recreational Waters Monitoring Program, as well as in some tidally-influenced areas. Water sample collection and analysis for *E. coli* were also initiated by ADEM in 2008 with criteria promulgated in 2009.

Water sample collection and analysis for low-level mercury concentrations was initiated in 2011 with the collection of samples from twenty stations in the Escatawpa, Tombigbee, Mobile focus basins. Data collected from locations statewide over the next several years will be used to develop NPDES permits and to develop TMDLs for those waters impaired by mercury concentrations in fish that exceed EPA advisory levels.

Future Initiatives

The ultimate goal of the Department is to implement a comprehensive monitoring program that includes wadeable rivers and streams, nonwadeable rivers and reservoirs, wetlands, and groundwater. If ADEM's Monitoring Strategy effectively develops indicators and criteria for wadeable rivers and streams, a similar approach can be used in the other waterbody types.

Although the State of Alabama currently has no comprehensive wetland monitoring program or comprehensive wetland protection program outside of the coastal areas of the state, wetland assessments that the Department is initiating will likely consist of surveys of the diversity, composition, and functional organization of the community of resident wetland biological communities (e.g., macroinvertebrates, plants, amphibians, birds, algae). These bioassessments will also include the collection of physical and chemical data to the extent necessary and possible.

Monitoring of low-level mercury concentrations was initiated in 2011. Other potentially important parameters for future analysis include endocrine disrupters, polybrominated diphenyl ethers (PBDE), and perfluorinated chemicals (PFCs). PFCs have been manufactured in the Decatur area and an investigation is ongoing to determine the concentration and areal extent of the compound. The ADEM has collected numerous water and fish tissue samples for PFCs over the last several years, with analyses performed by contract labs and the Alabama Department of Public Health.

V. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

Quality Management Plan

All of the monitoring efforts and related activities are performed under the ADEM quality system Quality Management Plan (QMP). The QMP is revised by the Department and approved by EPA Region 4 on a five-year cycle following procedures outlined in SOP# 8303 *Preparation, Review, Approval Distribution and Archival of the Departmental Quality Management Plan (QMP)* with the current version approved by EPA in July of 2008. The ADEM Quality Assurance Manager (QAM), who is also the Chief of the Office of Environmental Quality (OEQ), has the overall responsibility for the development, implementation, and continued operation of the Department's QA program.

Quality Assurance Program/Project Plans

One of the primary tools for QA management is the QA Program/Project Plan (QAPP). The monitoring program is responsible for producing and/or reviewing/updating these documents for approval by the QAM. The QAPPs are developed in accordance with ADEM SOP #8302 *Preparation, Review, Approval, Distribution, and Archival of Quality Assurance Program/Project Plans (QAPPs)* and *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5, 2001).

The *Quality Assurance Program Plan (QAPP) for Surface Water Quality Monitoring in Alabama* (4/18/2008, as amended) describes the standard activities and supporting documents to conduct this program. Routine and certain special studies including program monitoring activities are implemented under this generic program plan and specific annual study plan documents, while unique special studies have a QAPP specific to that study. Special studies involving an immediate public health threat or criminal investigation most often will be carried out under the generic program QAPP due to the limited time frame for response and obtaining samples. In addition to fulfilling the federal grant requirements, the QAPPs are intended to serve as an historic record of the activities and assessment methods used to ensure the quality, accuracy,

precision, and completeness of the data collected and analyzed for each project and describes the data quality objectives for the final use of the data.

Standard Operating Procedures

Field Operations Division is responsible for developing and reviewing/revising standard operating procedures (SOP) documents following procedures outlined in SOP# 8301 *Preparation, Review, Approval, Distribution, and Archival of Standard Operating Procedures (SOP) Documents* and implementing the described procedures, including quality assurance and quality control (QA/QC), for all activities related to water quality data generation (field and laboratory). Current SOPs include field-related documents for various procedures for sample collection/processing, field instrument calibration and field measurement, sample chain-of-custody, and laboratory–related procedures for analytical laboratory sample prep/extraction, sample analysis, general housekeeping procedures and data management, and biological community sample processing/identification/analysis. The OEQ maintains document control through standard procedures for document numbering, formatting, review and revision documentation/tracking and approval.

Quality Document Accessibility and Archival

Current copies of the QMP, QAPPs/Study Plans, field and laboratory SOPs are maintained on the ADEM intranet by the OEQ to allow Department-wide access to all approved quality documents. Additional documents available on the intranet include, sample chain-of-custody forms, required sample preservation/holding times/containers/sample volumes, and approved field and laboratory forms/data sheets, and database user manuals. Monthly Department-wide email notifications are sent by the QAM listing all updates to the intranet Quality Assurance website. All QA documents (QMP, QAPPs and SOPs) are archived in FileNet by the OEQ.

QA/QC Procedures

Physical/Chemical Field Procedures

Field procedures to determine the quality of the physical/chemical data collected are documented in SOP# 9021 *Field Quality Control: Measurements and Samples*. These include replicate water samples collected at five percent, and field parameters collected at ten percent, of the sampling events during each study. Replicate data are used as a relative measure of sample collection or measurement precision.

Blank samples are also collected at the same frequency as replicate samples by processing distilled water through any collection and/or filtration equipment in the same manner as regular samples. 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.

Biological Community Field Procedures

Crews of two conduct simultaneous intensive bioassessments of the site, including the physical characterization and habitat assessment, to ensure comparability of bioassessment techniques between sampling events and collectors. In addition, during the sampling year replicate samples are taken at 10 percent of the stations to ensure that results obtained can be duplicated, are representative of the sampling location, and to establish measurement precision of ADEM's standard collection procedures. (ADEM 2010a, ADEM 2012d)

QA/QC Laboratory Procedures/Methods

Biological Laboratory Procedures

Biological laboratory quality assurance procedures are an integral part of all biological programs. The bioassay program QA/QC encompasses all activities that affect the quality of effluent toxicity data. Quality control in the bioassay laboratory is a day-to-day routine that incorporates every aspect of organism culturing, general lab maintenance, and toxicity testing. Quality control is also measured with monthly bioassay reference tests to ensure comparability of test organisms. The Department

assesses the efficiency of all in-lab sample processing and the between-investigator comparability of macroinvertebrate or fish identifications for ten percent of the stations sampled. In addition, a specimen of each macroinvertebrate and fish taxon identified is maintained in reference collections (ADEM 2009, ADEM 2012e). The microbiological program conducts verification of colony identifications, water and glassware sterility checks, equipment functionality and completes annual proficiency testing studies (ADEM 2011).

Analytical Laboratory Procedures

Laboratory Support

Laboratory Analytical Support for the Department is provided by the ADEM Laboratory System with locations in Montgomery, Birmingham, and Mobile. The laboratory is responsible for organic, inorganic, and radiochemical analyses for the Department's water quality monitoring programs. Analyses are performed utilizing protocols as required by 40CFR136 and documented in SOPs available on the ADEM intranet. In addition, the Central Laboratory in Montgomery is fully certified by EPA Region 4 for the analysis of all regulated chemical drinking water contaminants.

It is the mission of the analytical Laboratory to provide quality data to support Departmental monitoring programs. This is achieved by maintaining a fully equipped environmental laboratory and a technically skilled, properly trained, and dedicated staff that produces physical and chemical data of a known and defensible quality. The Central Laboratory maintains a database to track laboratory staff training activities.

It is the policy of the Laboratory that all data generated by the laboratory is of the quality that meets or exceeds the data quality objectives of each project. Managers and analysts of the Laboratories share the responsibility of insuring that analytical methods, instruments, parameter detection and quantification are such that the data produced are scientifically sound and well documented. It is of utmost importance that the quality of all data produced by the Laboratory be well defined and communicated to the end user(s) of the data. This policy is implemented by:

- having in place and following a complete and systematic process of quality control activities to assist in defining data quality;
- insuring that data quality is documented and communicated to all users of the data by assigning appropriate qualifier codes according to prescribed procedures; and,
- having a review process to verify that data are generated in accordance with sound and appropriate technical procedures and to insure that all activities associated with the analyses, calculations, and data reduction are complete and accurate.

The ADEM Laboratory System develops a separate *Laboratory Operations and Quality Assurance Manual (LOQAM)* that deals specifically with the laboratory quality system. This document is developed through a coordinated effort between the laboratory managers and the QA staff. The document is reviewed and approved by the laboratory location managers, the Laboratory Quality Assurance Officer (LQAO), and the Quality Assurance Manager (QAM)." (LOQAM Chapter 1 Rev 2.0 June 2010)

QA Program Oversight

The ADEM quality assurance program oversight is conducted by the *Office of Environmental Quality* (OEQ). The OEQ is charged with development/enhancement of the Department-wide quality assurance program through continued dialogue with all Divisions regarding issues related to quality documentation, data quality/management and laboratory needs and to enhance compliance with QA/QC procedures via "quality assistance", quality assurance, quality document review, and internal quality assessments.

The OEQ has systematically implemented internal quality assessments of: 1) field data collection and documentation activities, 2) laboratory methods, standard processes, and documentation; 3) field staff entry accuracy into the ALAWADR database. Results of these assessments are communicated through the chain-of-command to the Branch Chief and the applicable Monitoring or Laboratory Coordinator.

In addition to the OEQ staff, each FOD Branch has a partial work-year allocated as *Field Office Quality Assurance Coordinator*. This staff member serves as the point-of-contact for OEQ staff to disseminate new information and/or procedures and as a focal point for quality-related questions and suggestions.

Current and Future Initiatives

ADEM will continue to enhance the quality system over the next five years. This process will use the *Guidance for Developing Quality Systems for Environmental Programs* (EPA QA/G-1) as its primary resource.

OEQ staff will continue to provide assistance with implementation and coordination of additional quality control activities, as needed.

External Data Sources

Each year, multiple government agencies, industries, universities, and citizen groups use a variety of methods to collect data and information on the chemical, physical, and biological conditions of Alabama's waters. The Department reviews all existing and readily available data, including data submitted by outside entities, to develop the Integrated Report. Alabama's 2012 Listing and Assessment Methodology describes how data are currently reviewed and what factors determine how different data can be used by the Department. The review process is described in Section VII. Data Analysis and Assessment.

As a first step, ADEM determines whether the data are "evaluated" or "monitored". "Evaluated" data or observations are generally limited water quality data, water quality data older than six years, or estimated impacts from observed or suspected activities. Evaluated data are placed in Category 2 (insufficient to make an assessment) and generally used as an indicator that further study is needed.

Monitored assessments (Categories 1 and 5) are based on readily available chemical, physical, and/or biological data collected during the previous six years, using commonly accepted and well-documented methods. Data more than six years old may be used on a case-by-case basis. All chemical and physical data must be collected using an approved quality assurance project plan (QAPP), an approved study plan, and

ADEM or EPA approved sample collection or analysis methods. The QAPP or study plan should include sampling and field protocols for each parameter or parameter group, including sampling methods, equipment and containers, sample preservation, holding times, and any analysis proposed to be completed in the field or outside the laboratory. Additionally, ADEM recommends, but currently does not require that the QAPP or study plan include quality control protocols that describe the number and type of field and laboratory quality control samples for the project that includes field blanks, equipment blanks, split samples, duplicate samples, the name of the laboratory performing the analyses, name of the laboratory contact person, and the number and type of laboratory quality control samples.

For any biological data from a source outside of the Department to be considered as "monitored" data, it must have been collected in accordance with QA/QC procedures outlined in the Department's SOPs and the adherence to these procedures must be documented and verified. Sharing ecological data can increase the amount of information available for agencies to make more informed management decisions. However, several recent studies have shown that results can be affected by differences in the methods used to collect, process, and analyze samples (Taylor 1988, Colwell and Coddington 1995, Lenz and Miller 1996, Warren-Hicks et al. 2000, Houston et al. 2002). For ADEM to provide the most accurate and efficient assessments of water quality, the quality and comparability of data from these data sources must be fully understood. The documentation of measurement quality objectives (MQOs), data quality objectives (DQOs), and performance characteristics has been recommended as a way to compare data collected using different methods (Diamond et al. 1996, ITFM 1995, MDCB 2005). The Methods and Data Comparability Board (MDCB) has also identified laboratory accreditation or certification as necessary to the collection of better data of known quality. The MDCB is working on a framework to compare biological assessment methods and their data. ADEM is assisting with these efforts by participating in the Biological Assessment Methods Workgroup and Advisory Board and has additionally spear-headed two Region 4 inter-agency studies to test the use of performance characteristics to compare results collected using different bioassessment methods.

VI. DATA MANAGEMENT/STORAGE

Background

Water quality programs and projects at ADEM generate a substantial amount of critical data and meta-data that require a defined process to ensure efficient, yet complete, data management. The data from these projects are stored in a dual method of archiving laboratory reports in the Laboratory Information Management System (LIMS) and the entering of the data into the ORACLE Water Quality Database, known as the Alabama Water-Quality Assessment & Monitoring Data Repository (ALAWADR).

The data from the biological collection activities (macroinvertebrates, fish community assessments, and the fish tissue monitoring program) are stored in a dual method of archiving copies of the laboratory reports and entering of the data into the BIOWADR module of ALAWADR. Periphyton (ACCESS database) and toxicity testing (WANG database) data are entered into separate databases which remain housed on the Departmental server.

Data collections from all projects are stored in multiple locations. Original field forms, notes and laboratory results are part of the permanent station visit record and are maintained in a dedicated file system in the applicable Field Offices. These and other historical data are archived in the ADEM FileNet system.

The Water Quality Branch of the Water Division uses the EPA's Assessment Database (ADB). The ADB is currently populated with the stream segments that are specifically listed in Chapter 11 of ADEM's regulations (Water Use Classifications for Interstate and Intrastate Waters) and stream segments listed on the current 303(d) list. Each stream segment is being assigned to one of five EPA support categories. The ADB will then be used to track these waters and document any improvements in use support.

Data Recording

Field books, notes and forms are maintained by the field crew and are checked for completeness and accuracy. The data entry process includes a data-entry QA/QC component and a QA tracking system.

All *in-situ* data are stored in the data logger or on a dedicated Field Datasheet, if the multiprobe datasonde does not have memory capability. Data stored in the data logger is downloaded and imported into ALAWADR. Data that has been transcribed onto a Field Datasheet is manually entered and verified by the Crew Leader.

Biological community data are entered into the BIOWADR module of ALAWADR. This includes ancillary data collected during the bioassessments: field parameters, flows, chemical data, habitat assessment and physical characterization sheets.

Data Entry QC

Quality control occurs at all levels of data acquisition, assimilation, verification, and distribution. Status reports are generated and used to track the progress from data collection through the data distribution via reports, presentations, and storage. Project quality control is conducted by each field office and documented in ALAWADR for all station visits. In an effort to ensure accuracy of data, the crew leader is responsible for overseeing all sampling at each site and ensuring that all required sample parameters are collected. After data entry into ALAWADR, a percentage of the data are periodically retrieved in report format and audited for errors or discrepancies.

Data Transmittal

For both *in-situ* water quality data and field observations as well as laboratory analytical data, it is the responsibility of the Field Operations Project Coordinator to ensure the timeliness of data imports, data entry, and quality control activities. Within three weeks of receipt of the laboratory reports and after field office review of the laboratory data, the assigned field office staff should import/enter the results into ALAWADR.

The biological community collection and FTMP data and associated meta-data should be entered in the BIOWADR module of ALAWADR or an appropriate departmental database in a timely manner. The field data and observations associated with a station visit are reported in ALAWADR within 30 days of the station visit. The laboratory data are reported in ALAWADR within 30 days of receipt of the laboratory data.

Data Storage and Retrieval

Chemical, bacteriological, biological, and habitat data are stored electronically in ALAWADR or the Periphyton Community ACCESS database. Paper copies are stored in files during the annual project at the respective Field Office where the data originated. A complete set of field sheets and laboratory reports are maintained in the applicable Field Office. At the end of the year, paper copies and final reports are stored electronically in the ADEM FileNet System. The ACCESS and WANG databases are stored on a server with access rights limited by user_id/user group. The ALAWADR Database is maintained by ADEM Information Systems Branch on the Oracle Server. All published FOD reports are available on the Department's website. The original field forms, notes and laboratory results are part of the permanent station visit record and are maintained in a dedicated file system in the applicable Field offices.

Future Initiatives

The Department's goal is to use EPA's Water Quality Exchange Network (WQX) and STORET for the storage, analysis, and retrieval of physical, chemical, and biological surface water data. The in-house web-based ALAWADR has allowed the Department to flow all current physical, chemical and microbiological data through WQX to STORET. Though it meets the requirements of the Department in its current form, future enhancements will allow improved functionality and ease of use. Planned enhancements include:

- Improving the portability of ALAWADR with the use of Adobe forms in the PORTA-WADR module. This would allow greater efficiency by allowing more of the data to be entered electronically in the field resulting in quicker data availability.
- Incorporating the State of Mississippi module for data evaluation, allowing an administrator to "user qualify" or flag data or identify as reference dataset, adjusting the existing module to meet the Department's needs.
- Allow imports of other types of electronic files directly to ALAWADR to avoid hand transcription of an electronic data type to the database.

- Adding a calibration module to be accessed at the trip level in ALAWADR. The equipment calibration information would then be easily associated with each station on that trip.
- Ability to attach and import hard copy files to each station visit either by hyperlink or by import.
- Improvements to the BIOWADR module including the incorporation of the periphyton database.
- Work on a website application for surface water quality, NPS, TMDL, assessment and monitoring programs; which would allow for data downloads and incorporate a site map linked to all applicable reports and data.

The development of these components of the ALAWADR will be considered as resources become available.

VII. Data Analysis/Assessment

Introduction

Sections 305(b) and 303(d) of the Federal Clean Water Act direct states to monitor and report the condition of their water resources. Recent guidance published by the Environmental Protection Agency (EPA) provides a basic framework that states may use to fulfill this reporting requirement. The *Guidance for 2006 Assessment, Listing, and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act (2006 Integrated Report Guidance (IRG)* issued by EPA in July 2005, provides recommendations on the delineation of assessment units, reporting the status and progress towards comprehensive assessment of state waters, attainment of state water quality standards and the basis for making attainment decisions, schedules for additional monitoring, listing waters which do not fully support their designated uses (i.e. impaired waters), and schedules to address impaired waters (EPA 2005).

Monitoring and accurately reporting the condition of the state's abundant surface water resources is a tremendous challenge for ADEM and other agencies in partnership. Alabama's 2010 Assessment and Listing Methodology establishes a process, consistent with EPA's guidance, to assess the status of these abundant surface waters in Alabama relative to the beneficial uses assigned to each waterbody. The methodology also describes the procedure to assign the size or extent of assessed waterbodies.

Alabama's Water Quality Standards

State water quality standards are the yardstick by which the condition of the nation's waters is measured. They are intended to protect, restore and maintain the condition of the nation's waters. In Alabama, water quality standards were first adopted in 1967 by the Alabama Water Improvement Commission (AWIC). In 1982 the Alabama Department of Environmental Management (ADEM) was formed by merging AWIC with elements of the Alabama Department of Public Health (ADPH) and the Alabama Air Pollution Control Commission. Since first being adopted in 1967, Alabama's water quality standards have been amended on numerous occasions (ADEM 2005).

The Alabama Environmental Management Commission (AEMC) has the authority to adopt revisions to the ADEM Administrative Code. The Designated Uses (Chapter 335-6-11 of the Administrative Code) and the Water Quality Criteria (Chapter 335-6-10 of the Administrative Code) are reviewed once every three years pursuant to EPA regulations at 40 CFR Part 131.20. This review process, known as the triennial review, affords the public the opportunity to make comments and suggestions regarding Alabama's water quality standards. Any changes that ADEM may propose as a result of the review process are subject to further public comment as part of the rulemaking process before consideration for adoption by the AEMC.

Water quality standards consist of three components: designated uses, numeric and narrative criteria, and an antidegradation policy. These three components have been compared to the three legs of a stool which work together to provide water quality protection for the nation's surface waters.

Designated uses describe the best uses reasonably expected of waters. These uses should include such activities as recreation in and on the water, public water supply, agricultural and industrial water supply, and habitat for fish and wildlife. While all waters may not support all of these uses, the goal of the Clean Water Act is to provide protection of water quality consistent with "fishable/swimmable" uses, where attainable. In Alabama, waters can be assigned one or more of seven designated uses pursuant to ADEM Administrative Code 335-6-11. These uses include:

1. Outstanding Alabama Water (OAW)
2. Public Water Supply (PWS)
3. Shellfish Harvesting (SH)
4. Swimming and Other Whole Body Water-Contact Sports (S)
5. Fish and Wildlife (F&W)
6. Limited Warmwater Fishery (LWF)
7. Agricultural and Industrial Water Supply (A&I)

Designated uses 1 through 5 in the list above are considered by EPA to be consistent with the "fishable/swimmable" goal.

The state also has two special designations – Outstanding National Resource Water (ONRW) and Treasured Alabama Lake (TAL). Waters designated as ONRW are high quality waters that are protected from new or expanded point sources of pollutants and may also be assigned one or more of the first five designated uses in the list above. Waters designated as TAL are high quality waters within impoundments and natural lakes that constitute an exceptional resource and are afforded additional water quality protections from new and expanding point sources. The ONRW and TAL special designations are described in ADEM Administrative Code 335-6-10-.10.

Numeric and narrative criteria provide the means to measure the degree to which the quality of waters is consistent with their designated use or uses. The criteria are intended to provide protection of water quality commensurate with the water's use, to include protection of human health. Narrative criteria generally describe minimum conditions necessary for all uses and may include certain restrictions for specific uses. Numeric criteria include pollutant concentrations or physical characteristics necessary to protect a specific designated use. Alabama's narrative and numeric criteria are defined in ADEM Administrative Code 335-6-10.

The state's antidegradation policy provides for protection of high quality waters that constitute an outstanding national resource (Tier 3), waters whose quality exceeds the levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water (Tier 2), and existing instream water uses and the level of water quality necessary to protect the existing uses (Tier 1). In Tier 3 waters, ADEM Administrative Code 335-6-10-.10 prohibits new or expanded point source discharges. In Tier 2 waters, ADEM Administrative Code 335-6-10-.04 provides for new or expanded discharge of pollutants only after intergovernmental coordination, public participation, and a demonstration that the new or expanded discharge is necessary for important economic or social development. Alabama's water quality standards regulations (ADEM Administrative Code 335-6-10 & 11) are available on the ADEM website at www.adem.state.al.us.

Waterbody Categorization

The water quality assessment process begins with the collection, compilation, and evaluation of water quality data and information for the purpose of determining if a waterbody is supporting all of its designated uses. It is imperative that the data and information used in the process be of adequate quality and provide an accurate indication of the water quality conditions in the waterbody since decisions arising from the assessment process may have long-term consequences. Issues of data sufficiency and data quality must be addressed to ensure that use support decisions are based on accurate data and information.

The use support assessment process considers all readily available data and information with a goal of placing waterbodies in one of five separate categories. This process is specific to the highest designated use assigned to the waterbody.

Waterbody data and information are evaluated using the use support assessment methodology and the waterbody is assigned to one of the following categories.

Category 1

Waters that are attaining all applicable water quality standards.

Category 2

Waters for which readily available data, which meet the state's minimum data requirements, support a determination that some but not all applicable water quality standards are met and there is insufficient data to determine if remaining water quality standards are met. Attainment status of the remaining standards is unknown because data are insufficient. Waters for which the minimum data requirements (as described later) have not been met will be placed in Category 2.

1. *Category 2A*

   For these waters available data does not satisfy minimum data requirements but there is a high potential for use impairment based on the limited data. These waters will be given a higher priority for additional data collection.

2. *Category 2B*

   For these waters available data does not satisfy minimum data requirements but there is a low potential for use impairment based on the limited data. These waters will be included in future basin monitoring rotations as resources allow.

Category 3

Waters for which there is no data or information to determine if any applicable water quality standard is attained or impaired. These waters will be considered unassessed.

Category 4

Waters in which one or more applicable water quality standards are not met but establishment of a TMDL is not required.

1. *Category 4A*

   Waters for which all TMDLs needed to result in attainment of all applicable WQSs have been approved or established by EPA.

2. *Category 4B*

   Waters for which other required control measures are expected to attain applicable water quality standards in a reasonable period of time. Adequate documentation is required to indicate that the proposed control mechanisms will address all major pollutant sources and should result in the issuance of more stringent effluent limitations required by either Federal, state, or local authority or the implementation of "other pollution control requirements (e.g., best management practices) required by local, state, or federal authority" that are stringent enough to implement applicable water quality standards.

3. *Category 4C*

   Waters in which the impairment is not caused by a pollutant. This would include waters which are impaired due to natural causes or pollution. A pollutant is defined in Section 502(6) of the Clean Water Act (CWA) as "spoil, solid waste, incinerator residue, sewerage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or

discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water." Pollution is defined as "the man-made or man-induced alteration of the chemical, physical, or radiological integrity of a waterbody." Invasive plants and animal species are considered pollution.

Category 5

Waters in which a pollutant has caused or is suspected of causing impairment. If the impairment is caused by a pollutant the water should be placed in Category 5 and the pollutant causing the impairment identified. Waters in this category comprise the state's list of impaired waters or §303(d) list.

When the information used to assess the waterbody consists primarily of observed conditions, (limited water quality data, water quality data older than six years, or estimated impacts from observed or suspected activities), the assessment is generally referred to as an evaluated assessment (Category 2). Evaluated assessments usually require the use of some degree of professional judgment by the person making the assessment and these assessments are not considered sufficient to place waters in or to remove waters from the impaired category (Category 5).

Monitored assessments (Categories 1 and 5) are based on readily available chemical, physical, and/or biological data collected during the previous six years, using commonly accepted and well-documented methods. Readily available data are data that have been collected or assembled by the Department or other groups or agencies and are available to the public. Data older than six years old may be used on a case-by-case basis. (For example, older data could be used if conditions, such as land use, have not changed.) The remainder of this Section will pertain to the use of monitoring data to make use support determinations.

The Water Quality Assessment Process

The water quality assessment process is different for each of Alabama's seven designated uses because each use is protected by specific numeric and narrative water quality criteria. As such, the methodology for assigning a given waterbody to one of

the five categories of use support may have different data requirements and thresholds for determining the waterbody's use support status. In addition, interpretation of narrative criteria may differ by classified use and waterbody type. Data and information that may be considered when assessing state waters could include water chemistry data such as chemical specific concentration data, land use or land cover data, physical data such as water temperature and conductivity, habitat evaluations, biological data such as macroinvertebrate and fish community assessments, and bacteriological data such as *Escherichia coli* or *Enterococci* counts.

In order to ensure consistent and accurate assessment of a waterbody's support status and proper categorization of the waterbody, minimum data requirements must be defined that address data quality and data quantity. Data requirements will not only be dictated by the classified use of the waterbody but also by the waterbody type. A summary table of the requirements used for assessing and categorizing waters in Alabama's Integrated Water Quality Assessment Report appears in Section IV. *Core and Supplemental Water Quality Indicators*.

VIII. REPORTING

Data collected by ADEM's monitoring programs are provided to the requesting Division or compiled into reports that are designed to meet requirements of the Clean Water Act, fulfill EPA grant requirements, and /or inform stakeholders.

Water quality monitoring program/project reports and 305b/Integrated Assessment Reports can be found on the Department's Web Site (www.adem.alabama.gov) under the heading "Water Quality Reports".

The Integrated Water Quality Monitoring and Assessment Report is published in written and electronic format and submitted to EPA by April 1 of every even-numbered year. The report is also placed on the Department's internet web site for access by the public.

Reports and documents pertaining to Use Attainability Analyses (UAAs) and TMDL development, and water quality criteria implementation are submitted to EPA in written and electronic format and placed on the Department's web site.

Projects to assess water quality in the coastal watersheds are generally conducted over a two-year sampling period. The reports summarizing these projects are sent to the funding agency, the National Oceanic and Atmospheric Administration (NOAA).

Bacteria levels monitored at public recreational beaches along the Gulf Coast for the Coastal Alabama Recreational Waters Quality Monitoring Program (BEACH*)* are posted on the ADEM website. Advisories are publicized through press releases and posted on signs at each of the 25 sampling locations.

Current and Future Initiatives

Current and future initiatives for Reporting include the following:

- Work through the backlog of water quality reports that developed during water quality database design/development and extensive duties related to the Deepwater Horizon oil spill to the Gulf of Mexico;

- Develop a probabilistic report for wadeable streams that provides a statistical assessment of 100% of wadeable streams using data collected through the most recent basin rotation;
- Continue to develop the synthesis and continuity of the wadeable and nonwadeable portions of the Surface Water Quality Basin Reports;
- Continue to upload completed reports to the ADEM website as quickly as possible;
- Improve content and applicability of reports in general.

IX. PROGRAMMATIC EVALUATION

Evaluation of water quality monitoring programs in the Department consists of annual intradepartmental coordination meetings and development of annual Section 106 Workplans with EPA Region 4 containing monitoring program commitments for the coming fiscal year. In addition, the Department also assists EPA in mid-year and end-of-year reviews of progress toward implementation of these Workplan commitments.

For the annual coordination meetings, representatives involved in standards, regulatory activities, nonpoint source management, and monitoring activities within the Department meet to discuss all phases of water quality monitoring and assessment. Coordination activities conducted during this intradepartmental meeting consist of status reports and review of water quality monitoring activities from the previous year and initiation of planning for monitoring activities in the year to come. The previous year's data collection efforts are evaluated to determine if all data collection and data quality objectives have been met. The data requirements for the coming sampling year are then discussed. The needs for data to support permitting (development and compliance), standards development, revision and/or compliance, 303(d) listing/delisting, TMDLs, etc., are identified and documented in the annual Surface Water Quality Monitoring Plan. The data quality objectives are defined and documented, and the lines of communication for feed-back during the sampling year are established.

In July 2004, the first comprehensive review of water quality monitoring activities in the Department was conducted. Representatives involved in standards, monitoring, and regulatory activities within the Department participated in the review. Topics discussed included the following:

- Purpose and Goals of the Review
- Historical Monitoring Activities
- Elements of a State Water Monitoring and Assessment Program Requirements
- Departmental monitoring strategy

- Overview of Current Strategy and Programs
- Review and analysis of current water quality monitoring programs and activities
- Data analysis and assessment
- Reporting
- QA/QC
- Data management
- Nutrient criteria
- Additional monitoring duties
- Funding
- Future needs

Discussion, review, and revision formally initiated in this process were incorporated into Departmental monitoring programs in 2005 and in development of the 2005 Monitoring Strategy. This process was repeated in 2011, after a delay of one year because of the extraordinary demands to staff from the *Deepwater Horizon* oil spill to the Gulf of Mexico.

Current and Future Initiatives

Evaluation of water quality monitoring programs conducted during the annual intradepartmental coordination meetings and development of annual Section 106 Workplans, as well as mid-year and end-of-year reviews of progress toward implementation of these commitments will continue as before. In addition, a comprehensive review of water quality monitoring activities in the Department is conducted every five years upon completion of each five-year basin rotation as a prelude to any necessary update and revision of the Monitoring Strategy. Representatives involved in standards, regulatory, and monitoring activities within the Department will participate in this evaluation and revision process. In addition, the State Agency Water Quality Meeting, initiated in 2011, will continue in the future at a

frequency to be determined. The Department Water Quality Monitoring Coordinator will be responsible for the Monitoring Strategy and subsequent review efforts and revisions.

X. GENERAL SUPPORT AND INFRASTRUCTURE PLANNING

As demands for water quality monitoring programs increase each year while funding decreases, it is critically important that support and infrastructure be maintained at the current level and continue to progress at some level where the need is greatest.

Current and future needs and initiatives for the Department's water quality monitoring programs include:

Current initiatives:

- increase wadeable stream biological assessment capabilities
- increase nonwadeable river and stream biological assessment capabilities
- increase chemical laboratory analytical capability
- increase biological laboratory analytical capability
- increase data management capability
- increase reporting capability
- development of mandated nutrient criteria for all waterbodies with emphasis on effects-based criteria for rivers and streams.
- compliance monitoring of nutrient criteria for all waterbodies
- development of wetlands monitoring program
- development of clean sampling/trace metals collection and analysis capabilities

Future initiatives:

- development of a centralized, comprehensive groundwater monitoring program
- development of multi-year sampling schedules to facilitate long-range planning

Given the accelerated pace of water quality monitoring program needs and incorporation of new techniques, the following table of current support and infrastructure resources is considered to be only an estimate of the resources needed to maintain the current level of effort for the next five years. Continued improvements in monitoring programs over time will be contingent upon available resources, qualified staff, and core program changes and additions.

Program Status	**Annual FTEs**
Water sample collection and Biological assessment (Wadeable & Nonwadeable) (Macroinvertebrate, fish, periphyton, phytoplankton, wetlands)	16
Data Processing (QA/QC & Data Management)	21
Laboratory (Chemical and bacteriological analysis)	34
Reporting	10
Nonpoint Source Management	10
Assessment, Listing, TMDLs, Criteria	6

XI. MONITORING PROGRAM TIMELINE

The following timeline spans the development of current and future monitoring program activities. Historical information is provided as a reference to current program development and the projected future course. All programs and projects listed are included because of the commitment of staff and resources to all of these efforts and the related effect to schedules and timelines. Water quality monitoring needs are currently very dynamic. The future course and schedule of program development will depend heavily on availability of resources, core program changes/additions, future priorities, and emerging issues.

- Initiation of fish tissue contaminant sampling and analyses: **1970**
- Initiation of NPDES Compliance Sampling Inspections (CSIs): **1973**
- Initiation of Ambient Monitoring Program: **1974**
- Initiation of Wasteload Allocation and Time-of-Travel Studies: **1983**
- Initiation of Use Attainability Analyses Studies: **1984**
- Initial EPA/ADEM statewide reservoir water quality monitoring survey: **1985**
- Initiation of Water Quality Demonstration Studies: **1985**
- Initiation of state groundwater monitoring: **1989**
- ADEM/Auburn University statewide reservoir water quality monitoring survey: **1989**
- ADEM Reservoir Monitoring Program initiated: **1990**
- EPA/ADEM/Auburn University Clean Lakes Program Phase I Intensive Reservoir Surveys: **1990-1998**
- Fish Tissue Monitoring Program initiated: **1991**
- Ecoregional Reference Reach Monitoring Program for Streams: **1991**

- Initiation of Coastal Watershed Surveys: **1993**
- Initiation of Coastal ALAMAP probabilistic water quality assessments: **1993**
- Initiation of Intensive Fecal Surveys: **1996**
- Development of initial monitoring strategy, ASSESS: **1997**
- Initiation of Upland Alabama Monitoring and Assessment Program (ALAMAP) probabilistic stream water quality assessments: **1997**
- Implementation of watershed approach/basin rotation in monitoring programs: **1997**
- Initiation of 303d (Targeted) stream water quality assessments: **1999**
- Initiation of Coastal Alabama Recreational Waters Monitoring Program: **1999**
- ADEM statewide probabilistic groundwater assessment: **2000-2002**
- Initiation of National Coastal Assessment monitoring: **2000**
- Initiation of EPA-Required Nutrient Criteria development: **2000**
- Development and implementation of Nutrient Criteria for Alabama Lakes: **2001-2013**
- Initiation of compliance monitoring for lakes nutrient criteria: **2001**
- Initiation of periphyton assessment techniques: **2002**
- Initiation of annual Surface Water Quality Monitoring Coordination Meetings: **2003**
- Initiation of NPS Intensive Surveys: **2003**
- River segment monitoring incorporated into Reservoir Monitoring Program: **2004**
- Internal Review of Monitoring Programs: **2004**

- Initiation of Environmental Quality Unit: **2004**
- Initiation of Cahaba River/Hatchet Creek Intensive Survey for Nutrient Target Development: **2004**
- Initiation of ACNPNP Marina Water Quality Study: **2004**
- Mobile Bay Water Quality Study conducted: **2004**
- New ADEM Central Laboratory construction: **2005-2006**
- Initiation of Assessment Database (ADB): **2005**
- Initiation of database module development for STORET upload: **2005**
- Designation of Water Quality Monitoring Coordinator: **2005**
- Initiation of Water Quality Assessment and Listing Methodology: **2005**
- Implementation of revised Monitoring Strategy: **2005**
- Expansion of Ambient Monitoring Network: **2005**
- Rivers and Streams Monitoring Program initiated: **2005**
- Rivers and Reservoirs Monitoring Program initiated: **2005**
- Initiation of Mobile Bay NEP Sub-estuary study: **2005**
- Initiation of Elk River Watershed TMDL Development study: **2005**
- 316b Regulations and required Biological Assessments: **2005**
- Development and Implementation of Clean Sampling/Trace Metals Collection/Analysis Techniques: **2005-2011**
- Nonwadeable/Large River Bioassessment Development and Initiation: **2005-2011**
- Coastal Monitoring Program Development and Initiation: **2005-2011**
- Surface Water Quality and Biological Database Development, Implementation, and Historical Data Migration Completion: **2005-2011**

- Stream Fish Index of Biotic Integrity (IBI) Development: **2005-2012**
- Annual ADEM Water Quality Monitoring Coordination meetings: **2006-Present**
- Initiation of National Lakes Assessment monitoring: **2007**
- Development of Nutrient Criteria for Estuarine and Coastal Waters: **2007-2015**
- *E. coli* criteria development and implementation: **2008-2009**
- Auburn University Algal Toxin Program Participation: **2009-2012**
- Southeast Wetlands Monitoring Intensification Project: **2009-2013**
- Development of ADEM Wetlands Monitoring Program: **2010-2015**
- Weeks Bay Nutrient Sources Fate, Transport, and Effects Study: **2010-2012**
- Tallapoosa River Basin-Nutrient Criteria Development for Wadeable Streams Project: **2010-2012**
- Assessment of Water Quality Near Surface Coal Mining Facilities in the Black Warrior River Basin: **2010-2012**
- National Wetlands Condition Assessment: **2010-2012**
- Review and update of 2005 Monitoring Strategy: **2011-2012**
- State Agency Monitoring Strategy Meeting Initiation: **2011**
- Development of Nutrient Criteria in Rivers and Streams: **2011-2015**
- Development and Implementation of Nutrient Criteria for Wetlands: **2011-2016**

XII. SUMMARY OF ADEM WATER QUALITY PROGRAMS

A summary of each of ADEM's monitoring programs follows. These summaries are generally arranged by major monitoring program: Coastal Monitoring Programs, Rivers and Reservoirs Monitoring Program, Rivers and Streams Monitoring Program, Fish Tissue Monitoring Program, Wetlands Monitoring Program, Groundwater Monitoring, and General Surface Water Quality Programs. Different types of monitoring that have historically occurred (basin screening, ambient monitoring, 303d monitoring, intensive surveys) are conducted under these major programs using procedures that are consistent for the types of waterbodies in which they occur.

COASTAL MONITORING PROGRAMS

COASTAL WATERS MONITORING PROGRAM (CWMP)

Background

This program provides data to develop indicators and assessment criteria that link chemical, physical, and biological conditions for estuaries and coastal rivers within Alabama's coastal area. This data is used to identify long-term trends in water quality, provide data for the development of Total Maximum Daily Loads (TMDLs), develop nutrient criteria and to update or revise protocols and methodologies to more accurately assess related water quality conditions for designated estuaries and coastal rivers and streams. The CWMP also incorporates monitoring in priority watersheds identified by ADEM's Nonpoint Source Management Program to provide corroborating data concerning the effectiveness of BMPs implemented using Section 319 funds. Depending on available resources approximately 50 stations are sampled for the CWMP each year, to include historical trend monitoring sites and new stations added in 2011.

This CWMP is designed to provide support for the following ongoing complementary programs that also provide water quality data from the coastal area:

a. **Coastal Alabama Recreational Waters Program** involves the collection of water samples from twenty-five public recreational sites in Alabama's coastal waters. Samples are analyzed for the indicator bacteria, *Enterococci*. The objective of this program is to increase public awareness and provide valuable water quality information to help the public make more informed decisions concerning their recreational use of Alabama's natural coastal waters.

b. **Alabama Coastal Non-Point Pollution Control Program (ACNPCP)** implements Coastal Alabama Targeted Water Quality Studies that are des**i**gned to locate sites, identify and document baseline water quality conditions that exist within the two coastal counties. These studies are designed to correlate Best Management Practices (BMPs) as they relate to land uses and potential

nonpoint source (NPS) impacts in close proximity to waterbodies within the Mobile and Baldwin County sub-watershed areas.

c. **Gulf of Mexico Alliance (GOMA)** is a partnership of the states of Alabama, Florida, Louisiana, Mississippi, and Texas, with the goal of significantly increasing regional collaboration to enhance the ecological and economic health of the Gulf of Mexico. Supported by 13 federal agencies, academia, businesses and non-governmental organizations in the region, GOMA has identified priority issues that are regionally significant and can be effectively addressed through increased collaboration at local, state, and federal levels.

   As part of the Governors' Action Plans, these priorities represent an initial focus for action through the Alliance:

   - Water Quality: to help ensure healthy beaches and safe seafood in our coastal areas
   - Habitat Conservation and Restoration: advance conservation and restoration of coastal habitats and ecosystems throughout the Gulf and associated watersheds
   - Ecosystem Integration and Assessment: improve accessibility and awareness of the extensive data available throughout the Gulf region
   - Nutrients & Nutrient Impacts: to make communities more resilient in order to sustain and grow the region’s economic prosperity
   - Coastal Community Resilience
   - Environmental Education: to provide educational programs to improve the nation’s understanding and appreciation of the Gulf and its abundant natural and living resources.

   Each priority identifies long term goals for the region and a number of actions to achieve those goals and will address challenges facing the Gulf.

Design

The CWMP focuses on monitoring wadeable and nonwadeable waters in the coastal area. Routine assessments and water quality data collection (*in situ* parameters, nutrients, chlorophyll-a, and toxics (including metals) are conducted at: 1) historical trend sites; 2) permanent fixed sites located in 12 coastal watersheds where additional long term monitoring data are needed; 3) targeted sites selected to verify and document current conditions at 303(d)/TMDL stream segments; and 4) targeted sites within watersheds selected as priorities by ADEM's NPS Management Program. Sampling is conducted 3 to 12 times per year as needed and as resources allow.

Core and Supplemental Water Quality Indicators

Core Indicators: Secchi transparency, temperature, turbidity, total dissolved solids, total suspended solids, specific conductance, alkalinity, salinity, dissolved oxygen, pH, ammonia, nitrate + nitrite-nitrogen, total Kjeldahl nitrogen, dissolved reactive phosphorus, total phosphorus, chlorophyll *a*, 5-day carbonaceous biochemical oxygen demand, chloride, field observations (recent/current weather, air temperature, and flow conditions).

Supplemental Indicators: *Enterococcus*, Fecal coliform, hardness, total/dissolved metals.

COASTAL ALABAMA RECREATIONAL WATERS QUALITY MONITORING PROGRAM (BEACH)

Background

In 1999, the Alabama Department of Environmental Management (ADEM), in cooperation with the Alabama Department of Public Health (ADPH), initiated a program to routinely monitor bacteria levels at five public recreational beaches along the Gulf Coast. The effort was later expanded to include six additional sites along the Gulf Coast and Mobile Bay. In October of 2000, the federal Beaches Environmental Assessment and Coastal Health (BEACH) Act was signed into law. This Act mandates the monitoring and assessing of coastal recreational waters and the prompt notification of the public when applicable water quality standards are not being met. The act also authorizes EPA to award grants to help governments implement monitoring and notification programs consistent with the published EPA guidance and criteria. ADEM was designated as the state's lead agency for implementation of the BEACH Act and was awarded grant money to carry out this program. Through the BEACH Act, ADEM and ADPH expanded and enhanced monitoring and notification efforts for Alabama's public recreational waters defined pursuant to the Act.

Objectives

Increase public awareness and provide water quality information to help the public make more informed decisions concerning their recreational use of Alabama's natural coastal waters.

Design

The monitoring program involves the routine collection of water samples from twenty-five high-use and/or potentially high-risk public recreational sites from Perdido Bay to Dauphin Island, including Mobile Bay and its surrounding waters. The selection of sites and the frequency of sampling have been determined using a risk based evaluation and ranking process. This process considers a number of factors for a given site, most importantly the amount of recreational use and the amount of risk. Depending on the site rankings, samples are collected twice per week, once per week,

or once every other week during the swimming season (May through September) and once per month during the cooler months (October through April). Samples are analyzed for the indicator bacteria *Enterococci*. The indicator bacteria and the threshold concentration, which triggers an advisory, are based on recommendations provided by the EPA in the documents Ambient Water Quality Criteria for Bacteria (EPA 1986) and Water Quality Standards Handbook, second edition (EPA 1994c). All *Enterococci* analysis is performed by the ADPH Laboratory using EPA Standard Method 1600. EPA Method 1600 provides a direct count of bacteria in the water based on the development of colonies on the surface of the membrane filter. ADPH and EPA Whole Body Water Contact Standard for *Enterococci* is 104 colonies/100ml (single sample maximum).

Approximately 9,000 samples have been collected since the inception of the Beach Program, resulting in 157 advisories issued by ADPH. During 2011, 991 samples were collected and analyzed, resulting in 12 beach advisories being issued by ADPH.

Core and Supplemental Water Quality Indicators

Core Indicators: Enterococcus, temperature, dissolved oxygen, pH, conductivity, salinity, turbidity.

Reporting

ADPH reviews all data and is responsible for issuing any advisories. All test results are posted on the ADEM website and advisories are publicized through press releases and posted on signs at each of the 25 sampling locations.

ALABAMA COASTAL NONPOINT POLLUTION CONTROL PROGRAM (ACNPCP)

Some of the projects that this Program develops and implements are Coastal Alabama Targeted Water Quality Studies that are designed to locate sites, identify, and document baseline water quality conditions that exist within the two coastal counties. The studies implemented for this Program are also designed to correlate Best Management Practices (BMPs) as they relate to category designated land uses, including potential NPS impacts in close proximity to waterbodies within the Mobile and Baldwin County subwatersheds.

Background

In June of 1998, the NOAA Office of Coastal and Resource Management (OCRM) and USEPA awarded conditional approval to the Alabama Coastal Nonpoint Pollution Control Program (ACNPCP). Since achieving conditional approval, ADEM has coordinated with ADCNR-Coastal Section to further develop the ACNPCP, seeking full program approval, and to ensure that program components are implemented to the maximum extent practicable. The ACNPCP also works cooperatively with the ADEM-CWA §319 program to address nonpoint source pollution management program needs and issues for coastal Alabama. The state has received the joint NOAA/EPA Interim Decision in 2005, in response to the 2003 ACNPCP submissions. This set of documents outline recommended actions to allow full program approval and implementation.

The approved *Management Area* for this Program is inclusive of the 12 digit HUC sub-watersheds of the Escatawpa, Mobile-Tensaw, and Perdido Sub-Basins, that are within the geo-political boundaries of Baldwin and Mobile Counties.

ACNPCP WQ Projects are designed and implemented to provide baseline coastal streams information and to provide corroborating data concerning the effectiveness of various management measures, best management practices, or sustainable land-use practices that relate directly to potential NPS impacts. ADEM's ACNPCP monitoring focuses on a watershed approach, addressing sub-watersheds and the related waterbodies that comprise the coastal waters of Alabama. Several Coastal Watershed

Surveys and Targeted Water Quality Studies have been completed. The most recent coastal sub-watershed survey was conducted as *A Study of the Fowl River Sub Watershed* (HUC 031602050206) in Mobile County, Alabama. These watershed surveys generate important data to develop science-based projects and components for the ACNPCP implementation and strategy plans that are based upon the ACNPCP's *Projects Template*. The ACNPCP utilizes these data to develop database and GIS information applications that support the ACNPCP and corroborate ADEM's other water quality monitoring programs. The ADEM's focus during the next five years is to develop and implement new ACNPCP projects that will monitor and promote the effectiveness of nonpoint source pollution controls, coastal NPS management measures and program approval criteria for Alabama's Coastal Nonpoint Pollution Control Program.

Objectives

The initial focus toward implementation of the ACNPCP is to develop baseline water quality information as they relate to the Program's land-use categories in order to better assess the 'Health' of designated sub-watersheds in Baldwin and Mobile Counties.

Design

Basic data are generated from water column and sediment samples (as appropriate, some may include benthic macroinvertebrate and obligate flora assessments). Other important considerations such as land use, topography, soil characteristics, and projected growth and development within the subwatershed are examined and integrated into the watershed survey and project design. Environmentally sensitive areas, such as wetlands, riparian buffers, shorelines or submerged aquatic vegetation are noted and included in these studies. Investigation of sediment chemical parameters are also an integral part for many of these surveys because estuarine water column pollutants tend to attach to suspended particulates and become incorporated in bottom sediments. Evaluation of sediment parameters may include physical characteristics, as

well as analyses for metals, organics or other specific compounds, if the activities within a watershed have the potential for causing such contamination.

The strategy employed for monitoring and sampling the coastal waters follows a more varied regime than inland waters because of the high degree of seasonal variability of precipitation, flow, and water salinity. In order to accurately determine the effects of non-point sources on a watershed, it is often necessary to collect samples and measure *in situ* field parameters with respect to meteorological events and seasonal conditions rather than on a routine schedule (National Research Council 1990; U.S. Environmental Protection Agency 1991; U.S. Fish and Wildlife Service 1991). Many of the problems related to non-point sources occur on an acute and irregular basis (i.e., bacteria, oil sheens and turbidity) and are linked to stormwater events and runoff. These types of problems may be investigated during and immediately following storm events. Other forms of degradation manifest themselves on a more regular schedule, are often more chronic in duration (i.e., hypoxia, fish kills and phytoplankton blooms), and are best studied during times of stream low flows, salinity stratification, and warm temperatures (National Research Council 1990). A sampling regime that accounts for these seasonal and hydrologic variations is essential (ADEM 1993).

Core and Supplemental Water Quality Indicators

Core Indicators: Ammonia, nitrate-nitrite, TKN, dissolve reactive phosphorus, total phosphorus, turbidity, total suspended solids, total dissolved solids, fecal coliforms, Enterococcus, sediment metals, temperature, dissolved oxygen, pH, conductivity, salinity. [Note that these and other indicators may be selected, sampled and measured based upon the associated potential land-use impacts.]

NATIONAL COASTAL CONDITION ASSESSMENT PROGRAM (NCCA)

Background

The National Coastal Condition Assessment (NCCA) is a multi-year partnership among EPA's Office of Research and Development (ORD), EPA's Office of Water (OW), EPA's Regional Offices, all coastal states, and selected territories. As part of this effort, ORD has developed a coastal monitoring program with EPA Region 4 and the Alabama Department of Environmental Management (ADEM). The ORD National Health and Environmental Effects Research Laboratory's Gulf Ecology Division in Gulf Breeze, Florida is coordinating the effort.

Objectives

Determine the condition of estuarine waters in the coastal resources of Alabama and allow comparisons to other U.S. coastal areas.

Design

Each state uses a compatible probabilistic design and a common set of environmental indicators to survey its coastal resources and assess their condition. These estimates can then be aggregated to assess conditions at the EPA Regional, biogeographical, and national levels.

Fifty sampling locations in Alabama's coastal area were randomly-selected and sampled for the National Coastal Assessment (NCA). Each of these locations was sampled during the summers' 2000 - 2004 index periods. The NCA was again sampled in 2006 at a different fifty locations. NCA and the ambient trend stations of the CWMP were designed to work together so that the condition of geographical sub-areas within Alabama's coastal area can be assessed with known confidence. The NCA was repeated in 2010 as NCCA, assessing twenty sampling locations with plans to repeat in five year cycles. The ADEM intends to continue participation in this program.

Core and Supplemental Water Quality Indicators

Core Indicators: Total suspended solids, total dissolved solids, turbidity, chlorophyll *a*, nitrite, nitrate, nitrate+nitrite-nitrogen, ammonia, dissolved reactive phosphorus, total Kjeldahl nitrogen, total nitrogen, total phosphorus, dissolved nitrate-nitrite, dissolved total Kjeldahl nitrogen, dissolved total phosphorus, dissolved ammonia, sediment metals, % Clay, sediment organics, total organic carbon, sediment toxicity, benthic macroinvertebrates, fish tissue metals, pesticides, PCBs, and PAHs, mercury in fish tissue, fish lengths, Secchi disk transparency, temperature, dissolved oxygen, pH, conductivity, salinity, and light transmittance.

RIVERS AND RESERVOIRS MONITORING PROGRAM (RRMP)

Background

The Rivers and Reservoirs Monitoring Program assesses the water quality and trophic status of nonwadeable rivers and publicly-owned lakes/reservoirs in the state, with monitoring in the Tennessee River system conducted through a collaborative monitoring effort between ADEM and the Tennessee Valley Authority (TVA). ADEM has defined publicly-owned lakes/reservoirs as those that are of a multiple-use nature, publicly-accessible, and exhibit physical/chemical characteristics typical of impounded waters. Lakes designated strictly for water supply, privately owned lakes, or lakes managed by the Alabama Department of Conservation and Natural Resources (ADCNR) strictly for fish production are not included in this definition. Currently, forty-one lakes/reservoirs meet this definition of being publicly-owned. Initiated in 1990 as the Reservoir Water Quality Monitoring Program, the program was given the name Rivers and Reservoirs Monitoring Program (RRMP) in 2004 with the addition of free-flowing river reaches.

Objectives

Objectives of the program are to:

a) develop and maintain a water quality database for all rivers and publicly-accessible lakes in the state sufficient to conduct comprehensive assessments of water quality, categorize waters for the Integrated Assessment Report, develop criteria, and determine criteria compliance;

b) establish trends in river and lake trophic status that are only established through long-term, consistent monitoring efforts; and,

c) conduct biennial assessments of water quality for all publicly-accessible lakes as required by Section 314 of the Clean Water Act.

Water quality monitoring of mainstem reservoir locations in the Tennessee River system is conducted by the TVA. TVA monitors ecological conditions at 69 sites on 31 reservoirs in several states. Each site is monitored every other year unless a

substantial change in the ecological health score occurs during a two-year cycle. If that occurs, the site is monitored the next year to confirm that the change was not temporary. Roughly half the sites are sampled each year on an alternating basis. The overall health ratings of TVA reservoirs are based on five ecological indicators: dissolved oxygen, chlorophyll, fish, benthic community, and sediment. When monitoring ecological conditions at each reservoir, TVA takes samples from up to four locations as follows: forebay, mid-reservoir, inflow, embayment. TVA only monitors the Elk River embayment in Alabama.

Design

Lakes monitored for the program range in size from 350 to 45,200 acres. Smaller lakes have a minimum of one station, typically in the dam forebay. In larger reservoirs, additional stations are added in the mid-reservoir and upper reservoir (transition area) as needed. Tributary embayment stations are established in larger embayments and/or those with larger inflows, with selection of embayments distributed throughout the range of human disturbance. River stations are located along the length of the flowing reach to the extent that resources allow, with stations partitioned according to tributaries and point/nonpoint sources.

At each station, collection of water samples and *in situ* measurements (depth, temperature, dissolved oxygen, pH, and conductivity) are conducted at the thalweg. Water samples are collected as a photic zone composite. *In situ* measurements are conducted at one-meter intervals. Beyond thirty meters in depth, measurements are made at five-meter intervals to the bottom if there is little observed change in measurements. Chlorophyll *a* concentrations are used to calculate Carlson's Trophic State Index for determinations of oligotrophic, mesotrophic, eutrophic, and hypereutrophic conditions.

Monitoring of rivers and lakes occurs at two levels of effort under the RRMP:

1) Intensive monitoring of river, main-stem reservoir, and tributary embayment stations is conducted monthly April-October on a five-year rotating basin schedule to provide a comprehensive determination of water quality throughout the algal

growing season and provide data that can be used to develop nutrient criteria and total maximum daily loads; and,

2) Compliance monitoring of reservoirs with established nutrient criteria is conducted monthly April-October at least once every three years.

Water quality assessments of these nonwadeable waterbodies serve as a complement to the assessment of wadeable rivers and streams. Determinations of water quality in tributary embayments allow for more definitive determinations of water quality because these embayments function as the settling basin for nutrients and sediment originating upstream in the flowing portion of the tributary. With decreased shading and increased retention time, full expression of the biological impacts of excessive nutrients is often observed in the embayment. Therefore, in addition to determining the water quality of these portions of the rivers and reservoirs, monitoring tributary embayments also serves as an excellent indicator of the water quality of upstream tributaries.

Core and Supplemental Water Quality Indicators

Core Indicators: Secchi transparency, temperature, turbidity, total dissolved solids, total suspended solids, specific conductance, alkalinity, dissolved oxygen, pH, ammonia, nitrate+nitrite-nitrogen, total Kjeldahl nitrogen, dissolved reactive phosphorus, total phosphorus, chlorophyll *a*, 5-day carbonaceous biochemical oxygen demand, chloride, field observations (recent/current weather, air temperature, and flow conditions).

Supplemental Indicators: *E. coli*, hardness, ultimate carbonaceous biochemical oxygen demand, total/dissolved metals, algal growth potential tests.

RIVERS AND STREAMS MONITORING PROGRAM (RSMP)

Background

ADEM's Rivers and Streams Monitoring Program (RSMP) assesses the chemical, physical, and biological conditions of non-navigable, flowing waters in the state. It is a watershed-based monitoring program designed to provide data that links watershed condition and assessment results. A Watershed Disturbance Gradient (WDG), based on landuse and other factors, was developed in 2004 to classify each potential monitoring location by the level of disturbance within its watershed. The RSMP uses this information to plan biological monitoring activities along a full disturbance gradient to produce a dataset representing both the full stressor gradient and the full biological condition gradient. A primary goal of this monitoring design was to provide stressor-response data that can be used to develop criteria and indicators.

Objectives

The objectives of the RSMP are to provide data to:

- Develop or revise water quality standards;
- Determine water quality standards attainment;
- Identify impaired waters;
- Identify the causes and sources of impairment;
- Identify high-quality waters;
- Estimate water quality trends;
- Evaluate program effectiveness;
- Support management decisions; and,
- Estimate overall water quality.

Design

ADEM's 2012 monitoring strategy is implemented by basin on a 5-year rotation. It incorporates a combination of fixed, targeted, and probabilistic monitoring sites and

projects to meet state monitoring goals and objectives. A description of each of the key aspects of the program follows.

Ecoregions: The ADEM uses the Level 4 ecoregions (subecoregions) to select and sample least-impaired monitoring locations statewide. The taxa collected from verified reference reaches are then analyzed to identify sites with similar macroinvertebrate communities. Stable site characteristics, such as ecoregion, drainage area, gradient, etc., are compared within and among the "taxonomic" site groupings to help define site classes or "bioregions".

For parameters that do not have criteria or where data are limited, study-specific least-impaired ecoregional reference reach data are used as the basis of comparison for assessing wadeable stream and river segments.

Monitoring Units: ADEM defines a wadeable, flowing MU (WFMU) as the watershed directly upstream of the downstream-most, accessible, and completely wadeable, 300-foot reach. All stream reaches meeting these requirements are delineated using the 2010 12-digit hydrologic unit codes (HUCs), National Hydrography Dataset (NHD), and the National Elevation Dataset (NEDs). Statewide, 976 WFMUs have been delineated.

Watershed Disturbance Gradient: A Watershed Disturbance Gradient (WDG) was developed in 2004 to classify each watershed by its potential level of disturbance. The Landscape Development Intensity Index (LDI) or disturbance gradient, used by the Florida Department of Environmental Protection, relates water quality conditions (physical, chemical, and biological) to human activity within a watershed (Fore 2004), using landuse data and a development-intensity measure derived from energy use per unit area (Brown and Vivas 2004).

Between 2005-2010, ADEM applied the Florida LDI to all WFMUs within each basin group using the 2000 USEPA National Land Cover dataset (NLCD), Departmental permit databases, population estimates, and the number of road crossings to place each WFMU into one of eight WDG categories (1=least potential for disturbance and 8=greatest potential for disturbance). In 2012, the WDG scores were updated to reflect the 2006 NLCD coverage and statewide WDG categories.

Analysis has shown the WDG to be predictive of some stressors, including nitrate+nitrite and total phosphorus, and also correlated with ADEM's wadeable macroinvertebrate indices to some degree. Improving the correlation between watershed disturbance, stressors and biological conditions would improve the overall estimate of water quality within each basin. The ADEM is currently testing methods that have the potential to improve these correlations.

Watershed and Reach Selection: The RSMP incorporates probabilistic, targeted, ecoregional reference, and fixed ambient trend sites. The WDG is used to plan biological monitoring activities along a full disturbance gradient to produce a dataset representing both the full stressor gradient and the full biological condition gradient.

The WDG is used to identify and sample the least-disturbed (WDG categories 1-3; top 25^{th} percentile) watersheds in each bioregion as candidate reference reaches. Statewide, one-hundred and twenty-one least-disturbed MUs were sampled as candidate reference reaches between 2005 and 2010. ADEM is currently developing an ecoregional reference reach selection process and ecoregional selection criteria for each Level 4 ecoregion.

The WDG is also used to identify and sample the most-disturbed watersheds. It assists with stressor identification for §303(d) listing and TMDL development. Thirteen waterbodies were added to the 303d list based on 2005 RSMP biological assessment results.

Core and Supplemental Indicators

Core Indicators: Flow (where appropriate), Total stream depth, Sampling depth, Water temperature, Dissolved oxygen, pH, Specific conductance, Turbidity, Total suspended solids, Total dissolved solids, Hardness, Alkalinity, Ammonia-nitrogen, Nitrate+nitrite-nitrogen, Total Kjeldahl nitrogen, Total phosphorus, Dissolved reactive phosphorus, Chlorophyll *a*, Total organic carbon, Five-day carbonaceous biochemical oxygen demand, Chlorides

Supplemental Indicators: Supplemental indicators are determined by the data needs at each targeted site and may include: Total and dissolved Aluminum, Total and dissolved Iron, Total and dissolved Manganese, Total Mercury, Dissolved Antimony,

Dissolved Arsenic^{+3}, Dissolved Cadmium, Dissolved Chromium^{+3}, Dissolved Copper, Dissolved Lead, Dissolved Nickel, Dissolved Selenium, Dissolved Silver, Dissolved Thallium, Dissolved Zinc, Habitat assessment/physical characterization, Macroinvertebrate Assessment, Periphyton Bioassessment, Fish IBI Assessment, Diurnal dissolved oxygen surveys, Intensive bacteriological studies, Pesticides, Herbicides, Atrazine

FISH TISSUE MONITORING PROGRAM (FTMP)

Background

The Alabama Department of Environmental Management (ADEM) and its predecessor, the Alabama Water Improvement Commission (AWIC), have collected fish for analysis of contaminant levels since 1970. For the 20 years that followed, fish collections focused on areas of known or suspected contamination. In 1991, ADEM expanded its Fish Tissue Monitoring Program (FTMP) to provide statewide screening of bioaccumulative contaminants in fish tissue, and to provide the Alabama Department of Public Health (ADPH) with data needed for determination of potential risk to those who consume fish from Alabama waters. The expanded program historically exists as a cooperative effort between the ADEM, the ADPH, the Alabama Department of Conservation and Natural Resources (ADCNR), and the Tennessee Valley Authority (TVA).

Following expansion of the program to statewide screening, fish from all of Alabama's major reservoirs, rivers, streams, and state-managed public fishing lakes were collected over a five-year period. Data from these locations were provided to the ADPH for issuance, modification, or removal of fish consumption advisories. To date, several thousand fish have been collected from 342 sites and analyzed for the FTMP.

Objectives

Because of the variability in contaminant concentrations observed in fish collected from locations over several years, and the need for additional monitoring at a number of locations, the approach to annual monitoring was refined in 2002. Annual fish tissue monitoring by ADEM became multi-faceted and directed toward accomplishing three objectives:

a) sampling locations throughout the focus basin (Tier I basin screening);
b) repetitive sampling of sites where the ADPH has determined that EPA/FDA action levels have been exceeded (Tier II known impact); and,
c) sampling remaining areas across Alabama where fish have not been collected for the FTMP (Tier I screening).

Repetitive sampling of sites where EPA/FDA action levels have been exceeded proceeds as follows:

a) Sites that exceed EPA/FDA action levels for the first time will be sampled for a minimum of two concurrent years to provide verification of contaminant concentrations, as requested by the ADPH;
b) Sites where ADPH consumption advisories currently exist will be sampled at a minimum of every three years to provide data for analysis of trends in contaminant concentrations.

The frequency of sampling for these sites is dependent on available resources. The Program also continues to monitor dioxin levels in fish tissue below paper mills, as well as sample sites outside the focus basin as needed or when requested by cooperating agencies.

Design

In 1997, the FTMP was incorporated into the ADEM Watershed Management Approach. With this approach, water quality of each major drainage basin in the state is assessed by ADEM on a five-year rotating basis.

The number of sampling locations each year typically varies from forty to fifty stations, consisting of a mix of Tier I stations (screening and basin assessment) and Tier II stations (EPA/FDA limit exceedance sites). The number of fish collected each year typically ranges from 480-500. Stations sampled and numbers of fish collected vary according to the size of the basin, number of Tier II sites, and resources available in a given year.

Sampling is typically conducted in the fall of the year, generally October-December . These months are preferred in fish tissue monitoring programs because:

a) Organic pollutants, primarily stored in fatty (lipid) tissue, would be at the greatest concentration as fat content of fish is highest at this time of year;
b) Target species are more easily collected while water levels are low and as water temperatures cool;
c) Fall collections do not interfere with spawning seasons of target species.

Collection methods may include electrofishing and/or gillnets as needed. At each location, six individuals of the same species are collected from each of two primary feeding groups, predators and bottom-feeders. Where mercury contamination is the primary concern, only predator species may be collected if resources are limited. Collected fish are within a size range identified in SOP#2300, with the additional requirement that catfish weigh a minimum of one pound as requested by the ADPH.

Collected fish at each location may be analyzed as species-specific composite samples (Tier I screening), or as individuals (Tier II known impact) when more definitive contaminant concentration data in fish is needed from an impacted site. Following completion of analyses, all data are compiled and distributed to cooperating agencies.

The physical condition of important sport and/or commercial fish species collected for tissue monitoring is evaluated using relative weight. Relative weight is a condition indicator used by fishery biologists to compare individual fish or a group of fish with a standardized norm. Using this system a fish that scores 80 to 100 would be considered in good-to-excellent condition while a fish that scores 79 or below would be considered fair-to-poor. These same fish are also examined for any external anomalies such as lesions (sores), tumors, parasites, and deformities. This relative weight condition indicator is used to evaluate the trends in the health of a fish community.

Core and Supplemental Water Quality Indicators

Core Indicators: Arsenic, cadmium, lead, mercury, selenium, chlordane, chlorpyrifos, 4,4-DDD, 4,4-DDE, 4,4-DDT, 2,4-DDD, 2,4-DDE, 2,4-DDT, dieldrin, endosulfan I, endosulfan II, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, lindane, mirex, toxaphene, PCBs, dioxin, relative weight.

Supplemental Indicators: As needed for Tier II assessments.

WETLANDS MONITORING PROGRAM (WMP)

Background

In 2006, EPA developed the *Elements of a State Water Monitoring and Assessment Program* (EPA-841-B-03) to help states plan and implement a comprehensive water quality monitoring and assessment program to protect and restore water quality of all waters of the state as described in the Clean Water Act [CWA]. The *Elements* document requires that each state develop a wetland monitoring program by 2014, and serves as a guideline to ensure that a state's Wetland Monitoring and Assessment Program not only meets the needs of the state's Monitoring Objectives but also those required by the CWA Section 106(e)(1).

In 2011, ADEM began sampling wetland systems statewide as part of EPA's National Wetlands Conditional Assessment Survey (NWCA). Beginning in 2012 ADEM will begin sampling Piedmont and Coastal Plain wetland systems as part the Southeast Wetlands Monitoring Intensification Survey, a 2-year multi-state project. ADEM will analyze the protocols and data obtained during these surveys to develop a comprehensive wetland monitoring program that can be incorporated in Alabama's current Water Quality Monitoring Strategy.

Based on EPA's 2008 "Core Elements of an Effective state or Tribal Wetland Program Framework" ("Core Elements Framework") document, ADEM developed a 5-year wetland program development plan that outlined ADEM's approach to the development of a Wetlands Monitoring Program (WMP). This approach will meet ADEM's current and future monitoring needs, including monitoring and assessing Category 2B and 4A wetlands, wetland restoration projects, mitigated wetlands, and protected wetland areas. A workgroup will be established to ensure full participation of each of the agency programs in the development of the WMP. Program needs and progress towards program goals and objectives will be communicated to EPA annually via conference call.

The primary goals and activities described in ADEM's five-year program development plan are summarized below.

Year One:

Goals and Objectives: Develop a WMP workgroup and identify program partners. Identify and document the objectives of Alabama's long term wetlands monitoring program. Identify the data needed to achieve these goals and objectives for all wetlands statewide. Determine the objectives, methods, and indicators for the first 5-yr Wetland Monitoring Strategy Design to include in Alabama's overall Surface Water Monitoring Strategy.

Activities

1) Establish a WMP Workgroup to establish long term wetland monitoring objectives to satisfy program needs and incorporate the elements of the "Core Element Framework".
2) Gather and compile existing wetland inventory maps and location information such as: watershed, ecoregion size, landuse, and wetland types from available resources to categorize wetlands of the state.
3) Research and develop a wetland delineation/determination method for wetland identification and verification, review methods used during the 2011 NWCA Survey and the multi-state Piedmont and Coastal Wetland Assessment Study to select the best indicators and sampling methods to meet ADEM's monitoring objectives as described in the 2011-2015 Surface Water Monitoring Strategy.
4) Integrate the 5-yr WMP into the ADEM Surface Water Monitoring Strategy. It will include a process for revising the WMP annually, based in part on the data needs of, and input from, program partners.
5) Report progress updates and program design modification to EPA for comments.

Year Two:

Goals and Objectives: Complete an updated, accurate wetland inventory for the State of Alabama. Research and develop core and supplemental indicators to assess the condition and function of the wetlands to establish and compare "quality standards" and potential stressors that may impact wetland quality for long term monitoring and assessment to protect and restore water quality as described in the CWA as well as ADEM's Monitoring Strategy Objectives.

Activities

1) Train field staff to delineate/determine wetlands for identification and categorizing wetland types based on vegetation, hydrology, and hydric soil indicators and begin recons of wetlands identified in existing wetland inventory.
2) Research and adopt a list of indicators and stressors to measure wetland condition and function that are best suited to reach ADEM's monitoring objectives.
3) Compile wetland inventory data collected and verified into an Arcview GIS program to create an accurate and updated wetland inventory for the State of Alabama to include level 1 assessment of the watershed indicators such as landuse information, population density, and potential disturbances.
4) Train staff in Arcview and GIS Mapping programs for the interpretation of wetland inventory data, evaluation of potential stressors within the watershed to monitor and protect water quality standards, and provide conditional information to be used in future project planning as well as and reporting condition to public.
5) Research and develop field methods and parameters for the collection of biological and water quality samples that will be used to evaluate wetland water quality.
6) Report progress updates and program design modification to EPA.

Years Three and Four:

Goals and Objectives: Research and develop a Quality Assurance Plan to be approved by EPA that ensures the validity and accuracy of data gathered. Research and develop a monitoring design to meet the State of Alabama's Monitoring and Assessment goals and objectives. Process data collected using selected methodologies and indicators to determine the effectiveness of the strategy in meeting ADEM's monitoring objectives. Test the ability of ADEM's surface water database (ALAWADR) to manage all WMP data and to identify gaps that need to be addressed.

Activities:

1) Develop and revise existing SOPs, QAPPs, etc. as needed, based on data analysis and workgroup input, to incorporate wetlands monitoring and assessment into state's current monitoring plans.
2) Develop a design that relies on a combination of stratified random sampling (probabilistic sampling along a gradient of wetland watershed conditions) and targeted sampling to support specific management decisions and needs. This approach mirrors ADEM's current Monitoring Strategy.
3) Test ability of ALAWADR to manage all data used to identify, delineate, and classify wetlands, as well as all data and information collected as part of the WMP.
4) Analyze and process wetlands data to establish baseline for reference conditions based on wetland types.
5) Report progress updates and program design modification to EPA.

Year Five:

Goals and Objectives: Evaluate monitoring program. Modify the wetlands monitoring strategy as needed to better meet the goals and objectives for the State of Alabama and to allow the future incorporation of other elements outlined in the "Core Elements

Framework" into the Wetland Monitoring Program as needed. Research and modify SOPs and QAPPs to ensure the validity and accuracy of data gathered after any changes in strategy. Implement necessary changes to ALAWADR to manage all WMP data. Migrate WMP data into ALAWADR.

Activities:

1) Develop a schedule to re-evaluate the monitoring program.
2) Continue to research other wetlands program elements for future development.
3) Update documents as needed to reflect changes in the program i.e., SOPs, QAPPs, and reporting documents.
4) Identify and prioritize wetlands selected for monitoring to capture wetland quality over a variety of wetland conditions and functions such as protected and least-impacted wetlands to establish background or reference conditions statewide, restored or mitigated wetlands to document project effectiveness, and Category 2B and 4A wetlands as well as other wetlands as requested.
5) Revise ALAWADR as needed to manage all WMP data.
6) Migrate 2011-2014 WMP data into ALAWADR.
7) Provide a final Wetland Program Development summary to EPA.
8) Update WMP Strategy based on program evaluation.

PERMIT COMPLIANCE MONITORING PROGRAM

Background

Congress passed the Federal Water Pollution Control Act (1965) requiring state development of water quality standards for all interstate waters. Thereafter, the law was amended to include revisions outlined in the Clean Water Act (1972) which further delineated water quality standards on an intrastate level and to require discharging facilities to comply with set-forth permits in order to achieve these water quality standards. The Act was further amended by the Water Quality Act of 1987 which, in part, brought about the regulation of industrial and municipal stormwater.

ADEM has developed a comprehensive monitoring strategy that includes, as a component, the compliance monitoring of NPDES, SID and UIC permits issued by the Department.

Objectives

Determination of a facility's compliance with the Departmental issued National Pollutant Discharge Elimination System (NPDES), State Indirect Discharge (SID) or Class V Underground Injection Control (UIC) permit(s).

Design

Alabama implements various compliance sampling techniques to assure the implementation of state and federal laws and the protection of overall environmental quality. One of the compliance monitoring programs conducted by ADEM consists of compliance sampling inspections (CSI) of permitted facilities. During the CSI, representative samples required for monitoring parameters listed in the facilities' permit are obtained. Alabama also conducts Compliance Biomonitoring Inspections (CBI) which includes collection of effluent samples to evaluate the biological effect of a permittee's effluent on test organisms (i.e., bioassays).

The Department has agreed with EPA to conduct inspections at varying frequencies forpermitted entities. Generally, a priority list is developed at the beginning of each inspection year based upon factors such as the classification of the discharger (e.g. major or minor source), the status of the receiving waterbody (e.g., TMDL or impaired water), facilities with the longest period between inspections, citizen complaints, federal request and proximity of locations.

A compliance sampling inspection may include (but is not limited to) collection of samples by grab or composite (flow or timed) of influent, effluent, receiving waterbody, or overland flow. Samples of the receiving waterbody may be collected from both upstream and downstream of the outfall/discharge point. Samples may be collected for field measurements, chemical laboratory analysis, microbiological analysis, and/or bioassay. The sample results can then be used to interpret the degree of potential impact to the receiving water and assess permit compliance.

For those facilities that have intermittent discharges, samples are generally only collected if a discharge is present during the time of the facility visit. For some types of facilities, only a subset of the permitted discharges may be monitored during any one facility visit. Chemical and bacteriological analyses are performed, as applicable, and the results are reviewed by the appropriate regulatory entity, where they may be used to verify the accuracy of the permittee's self-monitoring program and reports, determine compliance with discharge limitations, determine the quantity and quality of effluents, develop permits, and/or provide evidence for enforcement proceedings where appropriate.

A core set of environmental indicator parameters may also be analyzed from effluent samples collected during CSIs. These data are forwarded to the Water Division for use in TMDL development and other water quality assessments. Each indicator parameter is evaluated on a systematic basis to determine its usefulness for assessing NPDES SID, and UIC compliance status.

Core and Supplemental Water Quality Indicators

As applicable on a programmatic basis:

Core Indicators: Total alkalinity, aluminum, antimony, arsenic, atrazine, alachlor, metolachor, aldicarb, cadmium, total organic carbon, chemical oxygen demand, chlorine, chlorophyll *a*, chromium, copper, cyanide, dissolved oxygen, E-coli, Enterococci, carbonaceous biochemical oxygen demand, hardness, iron, lead, manganese, mercury, nickel, ammonia, nitrate+Nitrite, total Kjeldahl nitrogen, organo-chlorine pesticides, oil and grease, organo-phosphorus pesticides, pH, zinc, selenium, semi-volatiles, silver, total dissolved solids, total suspended solids, specific conductance, temperature, thallium, total phosphorus, dissolved reactive phosphorus, toxicity, turbidity.

Supplemental Indicators: As required by permit.

GROUND WATER MONITORING PROGRAM

Background

Many of the elements of Alabama's ground water programs are managed by subdivisions within the Alabama Department of Environmental Management (ADEM), including the Land, Field Operations, and Water Divisions. The Groundwater Branch in the Land Division provides the hydrogeological support for these programs. Other programs related to ground water management and protection are managed by other state and federal agencies. The on-site sewage program is managed by the Alabama Department of Public Health and the Class II Underground Injection Control Program is managed by the State of Alabama Oil and Gas Board. Ground water quantity issues are addressed by the Alabama Department of Economic and Community Affairs Office of Water Resources. Other ground water monitoring and regulatory programs are managed by the Geological Survey of Alabama and the Alabama Surface Mining Commission (ASMC). The U.S. Environmental Protection Agency (EPA) provides oversight on all federally funded and delegated ground water programs, except for the ASMC, which is overseen by the U.S. Department of Interior, Office of Surface Mining.

The State of Alabama recognized that there was a need to coordinate management of groundwater programs and as a result set up the Ground Water Programs Advisory Committee (GWPAC) in 1994 to aid in completing the requirements for EPA's Core Comprehensive State Ground Water Protection Program (CSGWPP). This committee met for several years but is not active at the present time.

The Groundwater Assessment Program (GAP) at the Geological Survey of Alabama (GSA) is responsible for storage and maintenance of Alabama water well data, state wide monitoring of groundwater levels, and applied hydrogeologic research related to Alabama's water resources. The GSA has maintained a program to collect water levels from all of the major aquifers in the state for more than 40 years. The GAP manually measures water levels in about 400 water wells each year and maintains a system of 18 continuously monitored wells outfitted with electronic monitoring equipment that require periodic manual data downloads. In order to upgrade this program with the

latest technology, the GAP has initiated implementation of the first phase of a real time groundwater level monitoring system. Phase 1 consists of 30 wells distributed throughout the state. Water levels, measured every 30 minutes, are transmitted to GSA where the data are stored. The GAP is currently developing the capability to post real-time groundwater levels along with interpretations of the data on the GSA web site. These data will indicate current aquifer conditions and climatic and production impacts. GSA has also received a legislative mandate to conduct a state-wide groundwater resource assessment. One of the components of this assessment will be assessment of groundwater quality. However, currently, the GSA only monitors groundwater quality related to local projects and has no program for systematic state-wide groundwater quality assessment.

The following items summarize some of the other significant ground water developments that have occurred within the last several years in Alabama:

- Initiation of a ground water quality database for reporting.
- Regulations have been developed by ADEM and implemented to deal with Animal Feeding Operations and Concentrated Animal Feeding Operations (AFOs and CAFOs). Hydrogeologic site evaluations and ground water monitoring requirements have been included in the regulations as part of siting and operation requirements for AFO/CAFO lagoons and land application sites.
- The U.S. Geological Survey has also conducted National Water Quality Assessment for two study units that include significant parts of Alabama's Mobile River and Lower Tennessee River Basins.
- The Non-Point Source Program has provided funding for pesticide sampling of residential wells in vulnerable areas in the southernmost half of the Coastal Plain Ground Water Province. Sampling, analysis, and reporting have been completed.
- The state Groundwater Program has provided funding for pesticide sampling of residential wells in vulnerable areas in the northernmost half of the Coastal Plain Ground Water Province. Sampling, analysis, and reporting have been completed.

- ADEM has implemented an ambient ground water monitoring program in the Piedmont District for radionuclides. Sampling was completed and a report was developed in December 2003.
- ADEM has implemented an ambient ground water monitoring program for nutrients in watersheds with heavy poultry industry.
- The Alabama Department of Agriculture and Industries (ADAI) provided funding for pesticide and metals sampling of residential wells in vulnerable areas in the Valley and Ridge and the Cumberland Plateau Provinces of Central and North Alabama. Sampling was completed and a report developed. The ADAI also provided funding for sampling of residential wells in vulnerable areas of the Tennessee River Watershed. Sampling was completed and a report developed.
- ADEM has completed a statewide ambient ground water quality monitoring effort using the probabilistic monitoring grid approach.

Information that follows pertains to this statewide monitoring effort. Available funding allowed only one year of monitoring. If funding and necessary resources are available in the future the effort will be repeated.

In support of the State Pesticides in Groundwater Plan, ADEM and the Alabama Department of Agriculture and Industries have worked cooperatively to determine ambient groundwater quality in Alabama. Monitoring of selected private residential wells in targeted counties began in 1989 using conventional techniques for analysis. In 1992 ADEM began using immunoassay analyses for county-wide studies and in 2000 began a systematic study of the state.

Funding for the immunoassay monitoring program was through the Clean Water Act Section 106 and 104(b)(3) Grant programs, the Alabama Department of Agriculture and Industries, EPA Nonpoint Source Section 319 grant, and a Special Appropriation for the Tennessee Valley Area.

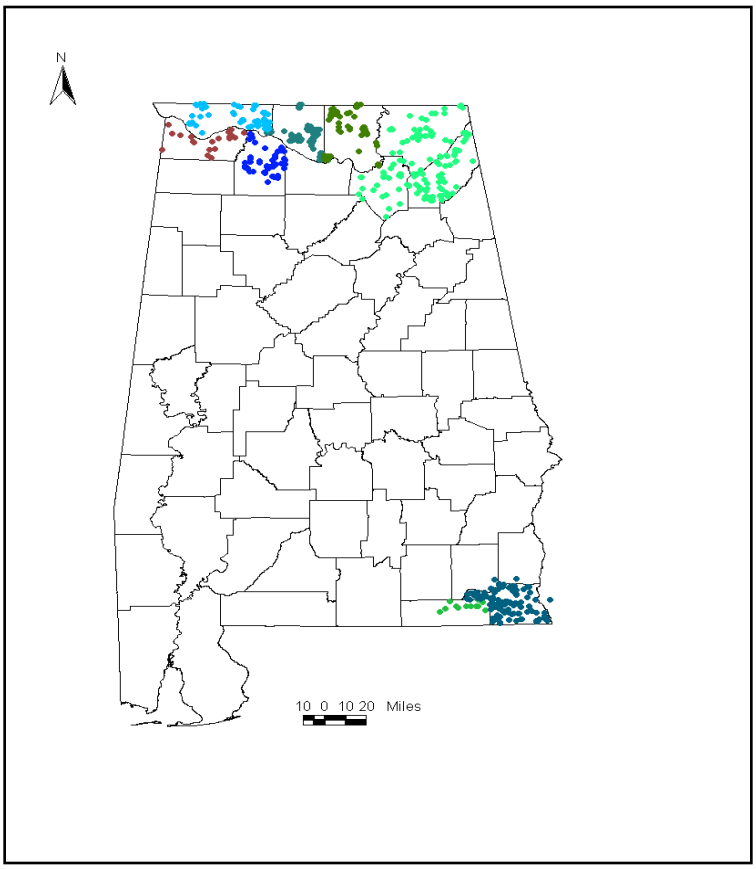
Objectives

Objectives for this statewide ambient ground water quality monitoring effort were as follows:

1) Characterize the ambient groundwater quality in the state; and,
2) Focus monitoring efforts in key agricultural counties with vulnerable aquifers.

Design

Random Sampling: County-wide studies were developed based on aquifer specific characteristics such as vulnerability and use. Use was defined as drinking water, agricultural use such as field products or poultry, and the ratio of residential homes to on-site sewage systems. Private residential wells were sampled and field parameters logged, with 30-100 wells sampled per county. Wells were randomly selected and located in rural areas (see map).



Counties and locations where random sampling procedures were used.

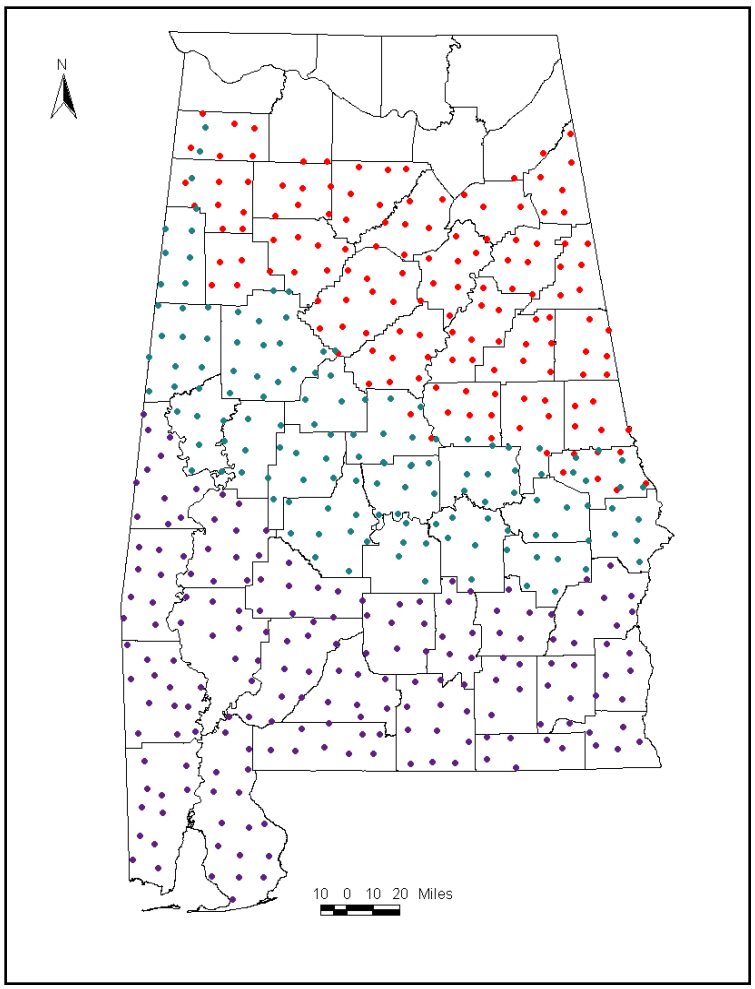
Spatial Sampling: The state-wide study was designed similarly to two previous studies by the Center for Disease Control (CDC) and state health departments. The studies were conducted in 1994 in nine Midwestern states and a similar study conducted in 1995 for Alabama, Georgia and Florida. The CDC study developed an equal-area sampling design by laying a ten-mile grid over Alabama, Georgia and Florida. The CDC monitoring program was used to estimate the extent of bacterial contamination in private wells. Samples were collected from wells at or within a 3-mile radius of the intersections of the grid lines. If a suitable well was not located within the 3-mile radius the closest well to the nodal point was sampled.

The sampling grid in Alabama was divided into 3 areas based on hydrologically distinct physiographic provinces. The provinces included the Lower Coastal Plain, the Upper Coastal Plain, and the Valley and Ridge. In 2000, 140 wells were sampled in the Upper Coastal Plain, 190 wells were sampled in 2001 from the Lower Coastal Plain and 147 samples were collected in 2002 from the Valley and Ridge province (see map).

Core and Supplemental Water Quality Indicators

Core Indicators/Random Sampling: pH, conductivity, temperature, nitrates, atrazine, aldicarb, alachlor, and metolachlor

Core Indicators/Spatial Sampling: fecal coliform bacteria, atrazine, aldicarb, alachlor, and metolachlor, total organic carbon, sulfate, silicate, phosphate, nitrate, bromide, flouride, chloride, and 61 metals.



Spatial sampling grid. Red nodes are sampling locations for the Valley and Ridge Province, green nodes are locations in the Upper Coastal Plain and purple nodes are locations in the Lower Coastal Plain.

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