A S S E S S

ADEM's Strategy for Sampling Environmental indicators of Surface water quality Status

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Field Operations Division
Alabama Department of Environmental Management

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I. INTRODUCTION

Pursuant to the Clean Water Act, the Alabama Department of Environmental Management (ADEM) is charged with monitoring the status of the State's water quality. The ADEM has maintained a fixed ambient monitoring station network located on most of the State's major drainage basins since 1974. With the passage of the Clean Water Act and the implementation of surface water quality monitoring programs by state and federal agencies, the emphasis was placed on the chemical contamination of the nation's waters. (National Research Council 1992). Therefore, most ambient monitoring networks, including Alabama's, were established to monitor trends in water quality below point sources of pollution (ADEM 1994c, ADEM 1996c). These programs have been successful in controlling and reducing certain kinds of chemical pollution from point source discharges (National Research Council 1992), however, ambient water quality monitoring data from fixed stations often does not provide adequate information for watershed planning purposes. A watershed monitoring program should: 1) identify other impacts present within the watershed; 2) provide water quality data from a larger number of water bodies within each basin throughout the state; 3) reflect the overall water quality within the state; and 4) provide the management and regulatory branches of water pollution control agencies with an assessment tool for prioritizing or targeting watersheds and/or sub-watersheds most in need of remedial action.

During the 1980's, the ADEM implemented a multi-faceted approach to monitor the surface waters of the state. This approach included a fixed-station ambient monitoring network, a reservoir water quality monitoring program, intensive and/or special waterbody specific water quality studies, a fish tissue monitoring program, and the compliance monitoring of point source discharges utilizing both chemical monitoring and toxicity screening with aquatic organisms. This monitoring strategy addresses many of the EPA's expanded monitoring goals and incorporates many environmental indicators identified by the EPA as pertaining to the national water quality objectives, but still does not reflect the overall water quality within the state or provide an assessment tool for prioritizing or targeting watersheds most in need of remedial action.

ASSESS is designed to meet the goals of the EPA's Section 106 Monitoring Guidance (EPA 1994a), as well as the goals of the Intergovernmental Task Force on Monitoring Water Quality published in The Strategy for Improving Water Quality Monitoring in the United States (EPA 1995). ASSESS links monitoring data generated by the various Field Operations Division (FOD) surface water quality monitoring programs to defined water quality objectives and their associated environmental indicators. An integral part of this strategy will be the incorporation of watershed monitoring by basin (Attachment 1). While most surface water monitoring conducted by the FOD will be focused within the targeted river basins, priority sub-watersheds identified by the regulatory branches of the ADEM will be monitored on a more frequent basis. This type of intensive monitoring is necessary to evaluate trends in water quality within these sub-basins. This "watershed" monitoring strategy will allow the synchronization of monitoring activities with inspections and permitting in order to support water quality protection activities on a geographic basis. By defining the major point and/or nonpoint source impacts within each basin, ASSESS will enable the permitting entities of the ADEM to make consistent and integrated decisions related to water resource issues within priority river basins.

The objective of ASSESS is to improve monitoring coverage within river basins, to improve spatial detail of water quality assessments, and to increase total stream miles monitored over the 5 year rotation period. Select historical ambient monitoring stations throughout the state will be monitored in June, August and October in order to provide data adequate for trend analysis. Specific objectives of ASSESS are as follows:

1. Implement a more efficient strategy to utilize and direct the water quality monitoring resources available to the ADEM by using a coordinated approach;
2. Document the water quality status of additional waterbodies within the State's river basins, thereby increasing the cumulative percentage of Alabama waters assessed year to year;
3. Implement a monitoring strategy that can be applied to all river basins and continue on the rotational cycle;
4. Identify existing major point and non-point pollution sources within each river basin;

5. Evaluate chemical, physical, biological, and habitat conditions of waterbodies within the targeted watershed using environmental indicators identified by the EPA as an appropriate assessment tool (EPA 1996b);

6. Identify watersheds impacted or impaired by point and non-point source pollution on a statewide basis;

7. Prioritize watersheds in greatest need of management and identify major sources of pollution within these watersheds;

8. Estimate the status and trends in ecological condition of priority watersheds and historical ambient monitoring stations;

9. Establish a basis of comparison through regular monitoring of least-impacted reference stations within each watershed and ecoregion; and,

10. Provide data that will assist in the implementation of a strategy to maintain and/or improve the status of the State's water resources and their associated use classifications.

This document describes the overall Field Operations Division (FOD) water quality monitoring strategy as well as the programs and program components utilized to meet the ASSESS objectives. The following summary of the FOD programs gives a brief description of each program and the types of information provided. The summary of the FOD program components providing data in support of EPA environmental indicators ties each component of a program to specific EPA water quality objectives and indicators to determine the status of each objective. (EPA 1996b)

II. SUMMARY OF FIELD OPERATIONS DIVISION PROGRAMS

Alabama Monitoring and Assessment Program (ALAMAP)

The Alabama Monitoring and Assessment Program is a statewide monitoring effort under development to provide data that can be used to estimate the current status of all streams and coastal/estuarine waters within the state using environmental indicators. Although the objectives are the same, the strategies used to provide the data are slightly different between the Coastal and Upland region of the state.

Upland ALAMAP

The Upland ALAMAP program (ADEM 1996d) is designed to enhance the current ambient monitoring program developed during the 1970's. First, stations in the historical ambient monitoring program were generally selected to monitor trends in water quality downstream of specific existing point sources. Therefore, the data collected at each of these sites represents only the area sampled and cannot be extrapolated to predict water quality at other similar size streams with any known level of uncertainty. To augment this type of monitoring, 50 stations will be selected statewide each year by EPA-Gulf Breeze using a probabilistic (random) design (Summers and Engle 1996). The data collected at these stations will statistically represent all upland stream miles and the level of uncertainty in the water quality estimates can be quantified. (Summers and Engle 1996). This type of assessment will be used in the 305(b) Water Quality Report to Congress to address overall State water quality.

Second, the historical ambient monitoring program required collection of water quality samples on a monthly basis at each of the stations in addition to water column metals samples on a quarterly basis. Statistical analysis of historical data by FOD and EPA Gulf Breeze suggests that sampling of water quality parameters on a quarterly schedule would have shown the same trends in water quality over time (ADEM 1996e, Summers and Engle 1996). Historically, water samples have been collected and analyzed for metal content. Metals have not been detected in the water column samples at ambient monitoring locations where metals have been detected in fish tissue or sediment samples. The modification of the historical ambient monitoring sampling

schedule to a June/August/October Schedule for water quality and an annual sediment sample, where appropriate, will allow additional locations to be assessed with little additional expenditure of resources. Data from the historical ambient monitoring stations can be used to update the CWA 303(d) list and to monitor site specific trends in water quality.

Third, many of the stations in the historical ambient monitoring program were chosen in the 1970's to monitor specific pollution sources. These stations are generally concentrated in watersheds in the Birmingham area. An evaluation of each site was conducted to determine if the rational for monitoring the site is still applicable and if the information generated is of use to the Department. After this re-evaluation of each of the historical stations, only those stations of value to the Department were retained in the historical network.

And Fourth, EPA-Gulf Breeze is statistically analyzing the parameters at each historical ambient monitoring station to evaluate and select those that are most useful in determining status and trends and the least redundant (Summers and Engle 1996). A minimum core set of environmental indicator parameters (EPA 1996b) will be collected as well as others specific to each station.

Coastal ALAMAP

The Field Operations Division-Mobile Field Office implemented a probabilistic design for the coastal ambient monitoring program in 1993. The coastal monitoring program focuses on the larger, mostly estuarine receiving water bodies within Alabama's coastal area, including Mobile Bay, Bon Secour Bay, Mississippi Sound, Wolf Bay, Bay La Launch, Perdido Bay, Bayou St. John, Little lagoon, and the Mobile-Tensaw River Delta. River stations and stations from these larger waterbodies were chosen with consideration given to sub-areas having different Water-Use-Classifications. (ADEM 1993b) The coastal assessments are conducted annually at each randomly chosen site. This data was used to assess trends in the water quality of estuarine/coastal waters and was included in the 1996 305(b) report in order to assess 100% of the coastal waters.

The existing 'core' historical ambient monitoring stations were maintained and are sampled monthly for the same parameters traditionally monitored. Several of the historical 'non-

core' ambient monitoring sites were reintroduced to the program in 1996 to continue monitoring the trends at those select locations.

Coastal Watershed Survey Program

Beginning with Fiscal Year 1993, the Field Operations Division-Mobile Field Office initiated a program for assessing the condition of the small sub-basins located in Baldwin and Mobile Counties. The Coastal Watershed Survey utilizes a comprehensive, broad spectrum approach for assessing the "health" of a basin. This methodology was described in Water Quality and Natural Resource Monitoring Strategy for Coastal Alabama (ADEM 1993b) and incorporates a variety of information from multiple disciplines. Data are generated from water column and sediment samples as well as benthic macroinvertebrate fauna collections. Additional information is gathered and integrated into the survey including: land use, topography, soil characteristics, wetlands locations, and projected growth and development in the watershed.

The strategy employed for monitoring and sampling the coastal area waters follows a more varied regime than inland waters because of the high degree of seasonal variability of precipitation and water salinity. In order to accurately determine the effects of non-point sources on a watershed, it is necessary to collect samples and measure *insitu* 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., fecal coliforms, oil sheens and turbidity) and are tied to stormwater runoff. These types of problems are often best investigated during and immediately following a storm event. 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 variations is essential (ADEM 1993b).

The tendency for estuarine water column metals to adsord to suspended particulates and settle to the bottom sediments makes the investigation of sediment contaminants a vital part of the watershed survey (Baudau and Muntau 1990; Delfino et al. 1991; Long and Morgan 1990;

National Research Council 1990; NOAA 1989; Windom et al. 1989). To date, the evaluation of sediment quality in these surveys has delt solely with metal enrichment although analyses for organics might be included if the activities within a watershed have the potential for causing such contamination.

Nonpoint Source Assessment Program (NPSAP)

Basin Screening

Nonpoint Source Assessments are conducted at the request of the Nonpoint Source Unit of the Office of Education and Outreach as part of selected watershed projects. Intensive surveys conducted at nonpoint source priority stations are resource intensive. They are necessary, however, to assess subtle differences in water quality, to detect trends in water quality and to identify sources of impairment. Because these methods are resource intensive, an assessment tool is needed to identify sub-watersheds most impacted by point and nonpoint sources of pollution. The Department's regulating programs and the Nonpoint Source Unit can then use resources more effectively by targeting these basins for implementation of water pollution controls, total maximum daily load studies and intensive surveys. The objectives of the basin wide screening assessments developed by the FOD are to rank and prioritize sub-watersheds most in need of remedial action and to identify major pollution sources present in each sub-basin.

Intensive Watershed Assessment

Intensive nonpoint source watershed assessments generally consist of physical/chemical and bacteriological sample collection and analysis, instream community assessments (macroinvertebrate/fish/periphyton) and assessments of habitat quality. Assessments are conducted before and after implementation of Best Management Practices (BMPs) to evaluate trends in water quality and physical habitat due to BMPs implementation. This assessment method relies upon baseline data collected at reference stations to accurately assess trends in water quality.

Information generated during the basin screening and watershed assessments can be used to assess percent impaired waters within each major basin and will increase the miles monitored

within each basin. This information can be used to update the CWA 303(d) list, the Alabama NPS Assessment Report and the 305(b) Report to Congress.

Point Source Assessment Program (PSAP)

Point Source Assessments, such as Water Quality Demonstration (WQD) studies are requested by the Municipal Branch of the Water Division. These studies are conducted on selected streams that receive treated waste from municipal wastewater treatment facilities that have been newly constructed or have been renovated using partial funding through the Alabama Revolving Loan Program. A WQD study typically includes upstream and downstream monitoring during a period before construction or renovation has begun, and during a period after construction or renovation is complete. Stream monitoring of WQD studies includes collection of physical and chemical data, biological assessments, and stream flow determinations. The data is typically collected during the low flow period of the year, thereby documenting the greatest potential adverse impact attributable to discharge activity. The data collected serves to document improvement of stream water quality resulting from the implementation of improved wastewater treatment.

Intensive surveys such as Waste Load Allocation (WLA) and Total Maximum Daily Load (TMDL) studies are conducted at the request of the Water Quality Section of the Water Division. These studies are conducted to obtain the information to develop water quality models used in determining the allowable wasteload (permit limits) for each point source. These studies typically involve time-of-travel studies, flow determination, and intensive sampling of the waterbody and point sources for various water quality parameters over a three or four day period. Nonpoint sources are also considered and sampled if necessary.

In 1992, the Environmental Indicators Section and the Bioassay Unit began to integrate toxicity testing into selected stream assessment studies. These types of surveys are generally conducted when there is concern for a particular discharge and its effects on a receiving stream. In addition to chemical/physical water quality measurements and macroinvertebrate biological assessments, the potential toxicity of the effluent is surveyed. The facility discharge is tested at the permitted receiving water concentration (RWC) and the stream stations are tested at a

concentration of one hundred percent (100%). Short-term (7-day) chronic toxicity tests are conducted on the samples utilizing Pimephales promelas and Ceriodaphnia dubia. At the end of the test period a statistical determination is made relative to the effluent's toxicity and whether or not that toxicity, if present, is transferred to the receiving stream.

Compliance Monitoring Program

The compliance monitoring program conducted by FOD includes a compliance monitoring inspection (CSI). During the CSI, representative samples required by the facilities' National Pollutant Discharge Elimination System (NPDES) permit are obtained. Chemical and bacteriological analyses are performed, and the results are forwarded to the appropriate Departmental permitting entity, where they are 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 provide evidence for enforcement proceedings where appropriate.

Reservoir Water Quality Monitoring Program (RWQMP)

With the exception of reservoirs in the Tennessee River system which are assessed by the TVA, the Reservoir Water Quality Monitoring Program assesses the water quality and trophic status of all publicly accessible lakes and reservoirs in the State. Monitoring takes place during the algal growing season at least once every two years with many lakes/reservoirs being monitored every year. This routine reservoir monitoring is supplemented with information gained from more intensive studies conducted on selected reservoirs as funding becomes available. RWQMP studies typically include vertical profiles of select physical/chemical parameters, chemical and bacteriological sample collection, chlorophyll *a* and phytoplankton analysis. Objectives of the program are: a) to develop an adequate water quality database for all publicly owned lakes in the state; b) to establish trends in lake trophic status that are only established through long-term monitoring efforts; and, c) to satisfy Section 314 (a)(1) of the Water Quality act of 1987.

Fish Tissue Monitoring Program (FTMP)

The ADEM Fish Tissue Monitoring Program was initiated in 1991 as a cooperative agreement with the Alabama Department of Public Health (ADPH), the Alabama Department of Conservation and Natural Resources (ADCNR) and the Tennessee Valley Authority (TVA) to monitor fish tissue throughout the state for bioaccumulative contaminants that can pose a risk to human health. Twenty-eight (28) major reservoirs, 26 stream locations and 19 ADCNR-managed public fishing lakes are sampled on a five-year rotational basis. Additional water bodies are also monitored based on identified need. Each year's sampling locations are determined based upon information available to the ADEM and input from the cooperative agencies. Water bodies that have been identified as having elevated concentrations of bioaccumulative fish tissue contaminates, or greater potential for contamination, are more closely monitored.

At each location, a composite sample of six individuals (same species) from both the predator and the omnivore/bottom feeding groups is collected (usually six bass and six catfish). Skinless-fillet composite samples are screened for a select list of organo-chlorine pesticides, metals and PCBs. Screening results will normally dictate the need for additional sampling trips and analyses. Most contaminants are stored/concentrated primarily in fatty tissue. Therefore, sampling is conducted in the fall of the year when fatty tissue is accumulated for over-wintering. The results of these analyses are provided to the ADPH for their consideration. If data warrants, the ADPH will issue consumption advisories as appropriate.

The physical condition of important sport and/or commercial fish species collected for tissue monitoring is also evaluated using relative weights. 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.

III. SUMMARY OF FOD PROGRAM COMPONENTS PROVIDING DATA IN SUPPORT OF NATIONAL ENVIRONMENTAL GOALS FOR WATER

In 1996, EPA published Environmental Indicators of Water Quality in the United States (EPA 1996b). This document outlined two National Environmental Goals for Water, the objectives to meet these goals, and the environmental indicators used to measure the successful attainment of the objectives (Table 1). FOD programs and program components provide valuable data supporting at least one environmental indicator for each of the five objectives (Table 2). Figure 1 (modified from EPA 1996b) illustrates how each FOD program provides information for multiple objectives. 'These objectives are like the building blocks in a pyramid, where success in reaching the goals at the top is dependent on successful attainment of those lower in the pyramid' (EPA 1996b). The following section describes each of the FOD program components and how it provides data to support environmental indicator(s) and water objective(s).

GOAL NO. 1: CLEAN WATERS

GOAL NO. 2: SAFE DRINKING WATER

Water Quality Objective I: Conserve and enhance public health

Indicator: Fish consumption advisories -- Percentage of rivers and lakes with fish that states have determined should not be eaten, or should be eaten only in limited quantities.

FOD Program: Fish Tissue Monitoring Program

Program Component(s): Fish Tissue Analysis

Fish Tissue Analysis

At each sampling location, a composite sample of six individuals (same species) from both the predator and the omnivore/bottom feeding groups is collected (usually six bass and six catfish). Skinless-fillet composite samples are screened for a select list of organo-chlorine pesticides, metals and PCBs. Sampling is conducted in the fall of the year when contaminants, if present, would most likely be stored in fatty tissue. The results of these analyses are provided to the ADPH for their consideration. If data warrants, the ADPH will issue consumption advisories as appropriate.

Water Quality Objective II: Conserve and Enhance Aquatic Ecosystems

Indicator: Biological Integrity -- Percentage of rivers and estuaries with healthy aquatic communities

FOD Program(s): Alabama Monitoring and Assessment Program (ALAMAP) - Upland and Coastal; Nonpoint Source Assessment Program (NPSAP); Point Source Assessment Program (PSAP); Coastal Watershed Survey Program (CWSP); Reservoir Water Quality Monitoring Program (RWQMP); Fish Tissue Monitoring Program(FTMP)

Program Component(s): Macroinvertebrate/Fish/Periphyton Community Bioassessments (ALAMAP, NPSAP, PSAP, CWSP); Trophic State Determinations (RWQMP); Fish Health Analysis (FTMP)

Macroinvertebrate Community Bioassessment

The FOD benthic macroinvertebrate assessment program is an integral part of the Department's biological monitoring effort. The use of the benthic macroinvertebrate community has proven to be a cost-effective water quality monitoring tool that reflects overall ecological integrity; i.e., chemical, physical, and biological integrity of the survey sites. These results, therefore, directly

assess the status of a water body relative to the primary goal of the Clean Water Act (Plafkin et al. 1989). A Multihabitat Bioassessment Protocol is currently utilized to sample wadeable and nonwadeable streams (Lenat 1988, Plafkin et al. 1989). All methods utilized are documented in the Department's Standard Operating Procedures and Quality Control Assurance Manual, Volume II (ADEM 1996a).

The Biological Condition Scoring Criteria (BCSC) as outlined in Rapid Bioassessment Protocols for Use in Streams and Rivers: Macroinvertebrates and Fish (Plafkin et al. 1989) is currently utilized to evaluate the biotic integrity of each wadeable stream sampled in relation to the ecoregional reference site determined to be most comparable. These assessments are then used to determine the Aquatic Life Use Designations. These comparisons have aided the Department in evaluating the "best attainable biotic community" within an ecoregion.

The FOD Coastal Watershed Survey Program incorporates macroinvertebrate community bioassessments. In the absence of well defined scoring criteria applicable to estuarine species, such as the protocols of Plafkin et al. (1989), communities are evaluated relative to the presence and/or absence of tolerant-intolerant taxa.

Fish Community/Periphyton Community Bioassessment

At present, the macroinvertebrate community is the only biological indicator used by the Department to assess water quality. The EPA recommends biological assessments include more than one taxonomic group (EPA 1996b). Including more than one taxonomic group encompasses more than one trophic level, providing data than can assist investigators in evaluating the extent of impairment, the type of impairment, and degree of recovery (KDEP 1993, EPA 1996b). It is recommended that, as resources allow, fish and periphyton community collections be incorporated into the intensive biological assessments.

Trophic State Determinations

The extent of reservoir eutrophication is determined by trophic state determinations. The concern about eutrophication from a water quality standpoint is primarily due to cultural eutrophication. Cultural eutrophication negatively affects biological communities of water bodies through changes in water quality variables such as dissolved oxygen, pH, water temperature and light availability.

Chlorophyll a concentrations are used to calculate Carlson's Trophic State Index (TSI). Carlson's TSI provides limnologists and the public with a single number that serves as an indicator of a lake's trophic status. The Trophic State classification scale is used as follows:

Oligotrophic	TSI <40
Mesotrophic	TSI 40-49
Eutrophic	TSI 50-70
Hypereutrophic	TSI > 70

Fish Condition Analysis

The physical condition of important sport and/or commercial fish species collected for tissue monitoring is evaluated using relative weights. 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.

Water Quality Objective III: Support Uses Designated by States in their water quality standards.

Indicator: Designated uses in state and tribal water quality standards

a) *Aquatic life designated use* -- Percentage of assessed waterbodies that can support healthy aquatic life, as designated by the states and tribes.
b) *Drinking water supply designated use* -- Percentage of assessed waterbodies that can support safe drinking water supply use, as designated by the states and tribes.
c) *Fish and shellfish consumption designated use* -- Percentage of assessed waterbodies that can support fish and shellfish consumption, as designated by the states and tribes.
d) *Recreational designated use* -- Percentage of assessed waterbodies that can support safe recreation, as designated by the states and tribes.

FOD Program(s): Point Source Assessment Program (PSAP); Nonpoint Source Assessment Program (NPSAP); Reservoir Water Quality Monitoring Program (RWQMP); Alabama Monitoring and Assessment Program (ALAMAP) - Upland and Coastal; Coastal Watershed Survey Program (CWSP).

Program Component(s): Chlorophyll a, Fecal Coliform, Physical/Chemical *(RWQMP, NPSAP, PSAP);* Fecal Coliform, Physical/ Chemical *(ALAMAP; CWSP);* Toxicity Testing *(PSAP, NPSAP)*

Water quality studies of differing types are conducted each year at various locations throughout Alabama in response to identified informational needs. These studies typically include several monitoring locations and a frequency of sampling specific to the objectives of a particular study. Studies may include chemical, physical, and biological parameters.

Chlorophyll a

The RWQMP uses Carlson's trophic state index (TSI) for determination of the trophic state of Alabama lakes. Using chlorophyll *a* concentrations to determine trophic state is considered to give the best estimate of the biotic response of lakes to nutrient enrichment when phytoplankton is the dominant plant community. The TSI is a single number that serves as an indicator of

trophic status of a lake but does not necessarily define it. Lakes with a TSI of 70 or greater are generally considered to be hypereutrophic and in need of regulatory action appropriate for protection and restoration. A TSI of 50 - 70 indicates eutrophic conditions in a lake. Trophic state index values of 40 to 50 indicate mesotrophic conditions while oligotrophic conditions are indicated by TSI values less than 40.

Fecal Coliform

Bacteriological samples for Fecal Coliform analysis are routinely collected as a part of most field studies. Single samples from each station are used for screening purposes to determine if there is a potential problem. More intensive sample collection methods are used to determine if a segment warrants upgrade to a use classification of *Swimming and other whole body water-contact sports*.

Physical / Chemical

Water samples for analysis of Physical/Chemical parameters are collected as a part of most Departmental monitoring efforts. These samples are analyzed and the data made available to the Department through reports and/or storage in the EPA STORET database. The following parameters are routinely analyzed: Dissolved Oxygen, pH, Water Temperature, Conductivity, Turbidity, (Fecal Coliform - see above) as well as others that may be specific to a particular study.

Toxicity Testing

Water samples are collected from effluent sources, when appropriate, and analyzed for indications of toxic effects. At the conclusion of the tests, the results are included in any reports and forwarded to the Departmental entity responsible for regulating the effluent sources.

Water Quality Objective IV: Conserve and Improve Ambient conditions

Indicator: Surface water pollutants -- Trends of selected pollutants found in surface water

Indicator: Contaminated sediments -- Percentage of sites with sediment contamination that might pose a risk to humans and aquatic life

Indicator: Habitat Assessment (Suggested as a regional indicator and future national indicator)

FOD Program*: ALAMAP - upland and coastal, Point Source Assessment Program (PSAP); Nonpoint Source Assessment Program (NPSAP); Reservoir Water Quality Monitoring Program (RWQMP); Coastal Watershed Survey Program (CWSP).*

Program Component(s): Physical/Chemical, Fecal Coliform (ALAMAP - upland and coastal, PSAP, NPSAP, RWQMP, CWSP), Sediment Analysis (ALAMAP - upland and coastal, NPSAP, CWSP), Habitat Assessment (ALAMAP - upland, NPSAP, PSAP)

Habitat Assessment and Physical Characterization

Biological integrity and water quality are directly affected by physical habitat. In addition, the assessment of habitat quality is an important step in documenting the adverse impacts of NPS pollution. The Department utilizes the Habitat Assessment Matrices developed by EPA (Plafkin et al. 1989) and Barbour and Stribling (1994) in conjunction with physical characteristics and water quality parameters to evaluate and document habitat quality of each wadeable bioassessment sampling site.

Sediment Analysis

"Certain types of chemicals in water tend to bind to particles and collect in sediment. Chemicals often persist longer in sediment than in water because

conditions might not favor natural degradation. When present at elevated concentrations in sediment, pollutants can be released back to water. Pollutants can also accumulate in bottom dwelling organisms and in fish and shellfish and move up the food chain. In both cases, excessive levels of chemicals in sediment might become hazardous to aquatic life and humans." (EPA 1996b) Sediment samples are collected annually, where appropriate, as part of the ALAMAP historical ambient monitoring program as well as select NPSAP and CWSP assessments.

Physical / Chemical

Water samples for analysis of Physical/Chemical parameters are collected as a part of most Departmental monitoring efforts. These samples are analyzed and the data made available to the Department through reports and/or storage in the EPA STORET database. A routine suite of parameters includes those chosen by EPA and its partners (EPA 1996b) to have significant effects on our surface waters (Total Suspended Solids (TSS), Total Phosphorus, Nitrogen (and Nitrate), Total Dissolved Solids (TDS), and Dissolved Oxygen (Fecal Coliform - see below) as well as others that are specific to a particular study.

Fecal Coliform

Bacteriological samples for Fecal Coliform analysis are routinely collected as a part of most field studies. Single samples from each station are used for screening purposes to determine if there is a potential problem. More intensive sample collection methods are used to determine if a segment warrants upgrade to a use classification of *Swimming and other whole body water-contact sports*.

Water Quality Objective V: Reduce or prevent pollutant loadings and other stressors

Indicator: Selected point source loadings to (a) surface water and (b) ground water -- Trends for selected pollutants discharged from point sources into surface water, and underground injection control wells that are sources of point source loading into ground water.

FOD Program*: Point Source Assessment Program (PSAP)*

Program Component(s): Physical/Chemical, Toxicity Testing, Time-of-Travel, AGPT

Physical / Chemical

Water samples for analysis of Physical/Chemical parameters are collected as a part of most Departmental monitoring efforts. Composite samplers are used to collect 24 hour composite samples from effluent sources. These samples are analyzed and the data made available to the Department through reports and/or storage in the EPA STORET database. EPA and its partners have chosen a suite of toxic and conventional pollutants to track as indicators of progress toward reducing point source pollution: Cadmium, Copper, Lead, Mercury, Phenol, Total Residual Chlorine, Total Suspended Solids (TSS), Total Phosphorus, Nitrogen (and Nitrate), Pathogens, BOD and Ammonia (EPA 1996b).

Toxicity Testing

Water samples are collected from effluent sources, when appropriate and analyzed for indications of toxic effects. At the conclusion of the tests, the results are included in any reports and forwarded to the Departmental entity responsible for regulating the effluent sources.

Time-of-travel

The use of fluorescent dyes and tracing techniques provides a means for measuring the time-of-travel and dispersion characteristics of steady and gradually varied flow in streams. Measurements of the dispersion and concentration of dyes give insight into the behavior of soluble contaminants that may be introduced into a stream. (Hubbard 1982) This information can be used by Departmental staff to determine NPDES permit limits.

AGPT

More specialized types of biological monitoring such as algal growth potential testing (AGPT) are also increasingly utilized in the surface water monitoring program. AGPT provides valuable information such as the estimation of limiting nutrients that is useful in waste load modeling efforts, non-point source monitoring, and reservoir trophic status determinations.

The Algal Growth Potential Test was developed 24 years ago as a standard, inexpensive, reproducible, and interpretable method to determine the potential of natural waters, wastewater effluent, and various compounds to support or inhibit algal growth. The assay is based on the premise that the maximum yield is proportional to the amount of the limiting nutrient present and biologically available with respect to the growth requirements of the alga. It is intended that the test be used: 1) to identify algal growth-limiting constituents; 2) to determine biologically the availability of algal growth-limiting nutrients; and 3) to quantify the biological response to changes in concentrations of algal growth-limiting constituents. These measurements are made by adding the test alga to the test water and determining algal growth at appropriate intervals (Raschke and Schultz 1987).

IV. DATA MANAGEMENT/STORAGE

The FOD utilizes EPA's national STORET database for the storage, analysis, and retrieval of physical, chemical, and some biological surface water data collected throughout the State.

The Environmental Indicators Section of FOD has several databases housed on the Department's mini-mainframe computer: The macroinvertebrate database created in 1991 and updated in 1995, the fish tissue database created in 1993, and the toxicity testing database added to the mainframe computer system in 1995. All data entered into the mainframe databases are checked for accuracy. The macroinvertebrate database facilitates the management and analysis of data by both calculating the biometrics and creating the standardized reports used in macroinvertebrate studies. Accuracy of the biometric results is hand verified for 10% of the sampling events each year. The toxicity testing database is used in evaluation of toxicity effects of wastewater discharges and allows users to view facility test results in a standardized and accessible format. Historical toxicity data are currently being incorporated into this database. The fish tissue database is used in evaluation of fish health as related to human fish tissue consumption. The database allows compilation of data for reports and easy access to almost twenty years of data. Manuals for the use of these databases regarding data entry and analysis are currently being developed.

V. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

Laboratory Analytical Support for the Department is provided by the ADEM Central Laboratory in Montgomery, the Birmingham Branch Laboratory, and the Mobile Branch Laboratory. These laboratories are responsible for organic, inorganic, and radiochemical analyses for the Department's Surface Water Monitoring Program. Analyses are performed utilizing the protocols found in the Standard Methods for the Examination of Water and Wastewater, 18th edition (APHA 1992), and the EPA's Methods for Chemical Analysis of Water and Wastes (EPA 1983) manuals. In addition, the Central Laboratory is fully certified by EPA Region IV for the analysis of Phase II and Phase V drinking water parameters.

As a regulatory agency, it is necessary to document the methodologies used in the monitoring programs conducted by the FOD to ensure the accuracy, comparability, and representativeness of the data collected (Plafkin et al. 1989). Quality assurance and quality control programs have therefore been established as an integral part of each of the monitoring programs conducted by FOD. Each program is fully documented in one of the FOD Standard Operating Procedures Manuals. As recommended by the EPA (Plafkin et al. 1989, EPA 1993, EPA 1994b), these programs include the development of standard operating procedures manuals, quality assurance of both field and laboratory procedures, as well as the management and analysis of data.

Standard Operating Procedures Manuals

Written protocols of methodologies utilized by the FOD have been developed and updated in conjunction with each of the monitoring programs.

The Field Operations Division Standard Operating Procedures and Quality Control Assurance Manual, Volume I - Physical Chemical (SOP) (ADEM 1994a) is a comprehensive document covering safety, sample collection and field measurements, microbiological analysis, QA/QC, and other information necessary to conduct quality field and laboratory work.

The Field Operations Division Standard Operating Procedures and Quality Control Assurance Manual, Volume II - Freshwater Macroinvertebrate Biological Assessment (SOP) (ADEM 1996a) documents all methodologies currently utilized by the Department to collect and analyze freshwater macroinvertebrate samples and to conduct site assessments of habitat quality and characterization of the physical attributes.

The Field Operations Division also has in effect a Fish Tissue Monitoring SOP (Standard Operating Procedures and Quality Control Assurance Manual, Volume III - Fish Sampling and Tissue Preparation for Bioaccumulative Contaminants) (ADEM 1996b). This latest revision includes many of the most recent changes recommended by EPA.

In 1994, a comprehensive standard operating procedures manual documenting all methodologies used by the Bioassay Unit was developed (Standard Operating Procedures and Quality Control Assurance Manual, Volume IV - Toxicity Testing Procedures) (ADEM 1994b).

A standardized effluent toxicity test report format was also created for the submission of self-monitoring test results.

A manual, developed in 1993 and finalized in 1997, documents the procedures used in the Algal Growth Potential bioassay currently used by the Field Operations Division (Standard Operating Procedures and Quality Control Assurance Manual, Volume V - Algal Growth Potential Bioassay Methods) (ADEM 1997).

QA/QC Field Procedures

Duplicate water samples and field parameters are collected at 10 percent of the sampling events during each study.

Every individual that will be involved in stream bioassessments during the year participates in a joint bioassessment conducted prior to the sampling season. Crews of two conduct simultaneous intensive multihabitat bioassessments (MB-I) of the site, including the physical characterization and habitat assessment to ensure comparability of macroinvertebrate bioassessment techniques between sampling events and collectors. In addition, during the sampling year duplicate macroinvertebrate samples are taken at 10% of the stations to ensure that results obtained can be duplicated and are representative of the stream site.

Reservoir monitoring completed as part of the Clean Lakes Program also incorporates duplicate and "blank" samples. Field duplicate samples are obtained by completely duplicating the collection process of both field parameters and each sample type at 10% of the sampling sites. Blank samples are also collected at the same frequency as duplicates by processing distilled water through the collection and filtration equipment in the same manner as regular samples. This procedure documents that the procedures used to rinse equipment prevent contamination between samples and stations.

QA/QC Laboratory Procedures

The laboratory QA procedures for the bioassay program encompass 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. New procedures are currently being developed to integrate chronic toxicity tests to the QA/QC program.

The Environmental Indicators Section assesses comparability of macroinvertebrate identifications between investigators for 10% of the sampling stations. In addition, a specimen of each macroinvertebrate taxon identified is maintained in a reference collection.

VI. REPORTING

All data collected by the FOD are provided to the requesting Division or incorporated into reports by FOD for circulation. Table 3 lists all of the reports generated by the various organizational units of the FOD since 1989. The following are a list of reports routinely generated by FOD or that FOD provides a substantial amount of data.

Biennial Water Quality Report to Congress (305B)

ADEM Fish Tissue Monitoring Report

ADEM Reservoir Water Quality Monitoring Report

ALAMAP (Coastal) - Annual Data Summary

Coastal Watershed Survey Reports

Various special studies reports as projects are completed

Tables and Figures

Table 1. EPA Water Quality Objectives and Indicators (EPA 1996b)

Objective I: Conserve and Enhance Public Health

1. *Population served by community drinking water systems violating health-based requirements*---Population served by drinking water systems with one or more violations of health-based requirements.
2. *Population served by unfiltered surface water systems at risk from microbiological pollution*---Population served by, and number of, systems that have not met the requirements to filter their water to remove microbiological contaminants.
3. *Population served by drinking water systems exceeding lead action levels*---Population served by, and number of, systems with lead levels in drinking water exceeding the regulatory threshold.
4. *Source water protection*---Number of community drinking water systems using ground water that have programs to protect them from pollution.
5. *Fish Consumption advisories*---Percentage of rivers and lakes with fish that states have determined should not be eaten, or should be eaten in only limited quantities.
6. *Shellfish growing water classification*---Percentage of estuarine and coastal shellfish growing waters approved for harvest for human consumption.

Objective II: Conserve and Enhance Aquatic Ecosystems

7. *Biological integrity*---Percentage of rivers and estuaries with healthy aquatic communities.
8. *Species at risk*---Percentage of aquatic and wetland species currently at risk of extinction.
9. *Wetland acreage*---Rate of wetland acreage loss.

Objective III: Support Uses Designated by the States and Tribes in Their Water Quality Standards

10. *Designated uses in state and tribal water quality standards*
    a. *Drinking water supply designated use*---Percentage of assessed waterbodies that can support safe drinking water supply use, as designated by the states and tribes.
    b. *Fish and shellfish consumption designated use*---Percentage of assessed waterbodies that can support fish and shellfish consumption, as designated by the states and tribes.
    c. *Recreational designated use*---Percentage of assessed waterbodies that can support safe recreation, as designated by the states and tribes.
    d. *Aquatic life designated use*---Percentage of assessed waterbodies that can support healthy aquatic life, as designated by the states and tribes.

Objective IV: Conserve and Improve Ambient Conditions

11. *Ground water pollutants*---Population exposed to nitrate in drinking water. In the future, the indicator will report the presence of other chemical pollutants in ground water.
12. *Surface water pollutants*---Trends of selected pollutants found in surface water.
13. *Selected coastal surface water pollutants in shellfish*---The concentration levels of selected pollutants in oysters and mussels.
14. *Estuarine eutrophication conditions*---Trends in estuarine eutrophication conditions.
15. *Contaminated sediments*---Percentage of sites with sediment contamination that might pose a risk to humans and aquatic life.

Objective V: Reduce or Prevent Pollutant Loadings and Other Stressors

16. *Selected point source loadings to (a) surface water and (b) ground water*---Trends for selected pollutants discharged from point sources into surface water, and underground injection control wells that are sources of point source loadings into ground water.
17. *Nonpoint source loadings to surface water*---Amount of soil eroded from cropland that could run into surface waters. Future reports will include additional nonpoint source surface water pollutants as well as sources of nonpoint source ground water pollution.
18. *Marine debris*---Trends and sources of debris monitored in the marine environment.

Table 2. Field Operations Division Programs and Program Components providing Data toward EPA Environmental Indicators for EPA Water Objectives to Meet National Environmental Goals (EPA 230-D-96-002).

EPA Environmental Objective	*EPA Environmental Indicator*	*FOD Program Component*	*FOD Program*
I. Conserve and Enhance Public Health	Fish consumption advisories	Fish Tissue Analysis	Fish Tissue Monitoring Program (FTMP)
II. Conserve and Enhance Aquatic Ecosystems	Biological integrity	Macroinvertebrate / Fish / Periphyton Community Bioassessment	Alabama Monitoring and Assessment Program (ALAMAP) - upland
	Biological integrity	Macroinvertebrate / Fish Community Bioassessment	Alabama Monitoring and Assessment Program (ALAMAP) - Coastal
	Biological integrity	Macroinvertebrate Community Bioassessment	Coastal Watershed Survey Program (CWSP)
	Biological integrity	Macroinvertebrate / Fish / Periphyton Community Bioassessment	Nonpoint Source Assessment Program (NPSAP)
	Biological integrity	Macroinvertebrate / Fish / Periphyton Community Bioassessment	Point Source Assessment Program (PSAP)
	Biological integrity	Trophic State Determination	Reservoir Water Quality Monitoring Program (RWQMP)
	Biological integrity	Fish Health Analysis	Fish Tissue Monitoring Program (FTMP)

EPA Environmental Objective	*EPA Environmental Indicator*	*FOD Program Component*	*FOD Program*
III. Support Uses Designated by the States and Tribes in their Water Quality Standards	Designated uses in state and tribal water quality standards	Chlorophyll *a*	Nonpoint Source Assessment Program (NPSAP)
	Designated uses in state and tribal water quality standards	Chlorophyll *a*	Point Source Assessment Program (PSAP)
	Designated uses in state and tribal water quality standards	Chlorophyll *a*	Reservoir Water Quality Monitoring Program (RWQMP)
	Designated uses in state and tribal water quality standards	Fecal coliform	Alabama Monitoring and Assessment Program (ALAMAP) - upland
	Designated uses in state and tribal water quality standards	Fecal coliform	Coastal Watershed Survey Program (CWSP)
	Designated uses in state and tribal water quality standards	Fecal coliform	Point Source Assessment Program (PSAP)
	Designated uses in state and tribal water quality standards	Fecal coliform	Nonpoint Source Assessment Program (NPSAP)
	Designated uses in state and tribal water quality standards	Fecal coliform	Reservoir Water Quality Monitoring Program (RWQMP)
	Designated uses in state and tribal water quality standards	Physical / Chemical	Alabama Monitoring and Assessment Program (ALAMAP) - upland

EPA Environmental Objective	*EPA Environmental Indicator*	*FOD Program Component*	*FOD Program*
	Designated uses in state and tribal water quality standards	Physical / Chemical	Alabama Monitoring and Assessment Program (ALAMAP) - Coastal
	Designated uses in state and tribal water quality standards	Physical / Chemical	Coastal Watershed Survey Program (CWSP)
	Designated uses in state and tribal water quality standards	Physical / Chemical	Reservoir Water Quality Monitoring Program (RWQMP)
	Designated uses in state and tribal water quality standards	Physical / Chemical	Nonpoint Source Assessment Program (NPSAP)
	Designated uses in state and tribal water quality standards	Physical / Chemical	Point Source Assessment Program (PSAP)
	Designated uses in state and tribal water quality standards	Toxicity Testing	Nonpoint Source Assessment Program (NPSAP)
	Designated uses in state and tribal water quality standards	Toxicity Testing	Point Source Assessment Program (PSAP)
IV. Conserve and Improve Ambient Conditions	Habitat quality (suggested as a regional indicator and future national indicator)	Habitat Assessment	Alabama Monitoring and Assessment Program (ALAMAP) - upland

EPA Environmental Objective	*EPA Environmental Indicator*	*FOD Program Component*	*FOD Program*
	Habitat quality (suggested as a regional indicator and future national indicator)	Habitat Assessment	Nonpoint Source Assessment Program (NPSAP)
	Habitat quality (suggested as a regional indicator and future national indicator)	Habitat Assessment	Point Source Assessment Program (PSAP)
	Surface water pollutants	Physical / Chemical	Alabama Monitoring and Assessment Program (ALAMAP) - upland
	Surface water pollutants	Physical / Chemical	Alabama Monitoring and Assessment Program (ALAMAP) - coastal
	Surface water pollutants	Physical / Chemical	Coastal Watershed Survey Program (CWSP)
	Surface water pollutants	Physical / Chemical	Point Source Assessment Program (PSAP)
	Surface water pollutants	Physical / Chemical	Nonpoint Source Assessment Program (NPSAP)
	Surface water pollutants	Physical / Chemical	Reservoir Water Quality Monitoring Program (RWQMP)
	Surface water pollutants	Fecal Coliform	Alabama Monitoring and Assessment Program (ALAMAP) - upland
	Surface water pollutants	Fecal Coliform	Alabama Monitoring and Assessment Program (ALAMAP) - coastal

EPA Environmental Objective	*EPA Environmental Indicator*	*FOD Program Component*	*FOD Program*
	Surface water pollutants	Fecal Coliform	Coastal Watershed Survey Program (CWSP)
	Surface water pollutants	Fecal Coliform	Point Source Assessment Program (PSAP)
	Surface water pollutants	Fecal Coliform	Nonpoint Source Assessment Program (NPSAP)
	Surface water pollutants	Fecal Coliform	Reservoir Water Quality Monitoring Program (RWQMP)
	Contaminated sediments	Sediment Analysis	Alabama Monitoring and Assessment Program (ALAMAP) - upland
	Contaminated sediments	Sediment Analysis	Alabama Monitoring and Assessment Program (ALAMAP) - coastal
	Contaminated sediments	Sediment Analysis	Coastal Watershed Survey Program (CWSP)
V. Reduce or Prevent Pollutant Loadings and other stressors	Selected point source loadings to surface water	Physical / Chemical	Point Source Assessment Program (PSAP)
	Selected point source loadings to surface water	Toxicity Testing - Ceriodaphnia / Fathead Minnows	Point Source Assessment Program (PSAP)
	Selected point source loadings to surface water	Time of Travel	Point Source Assessment Program (PSAP)

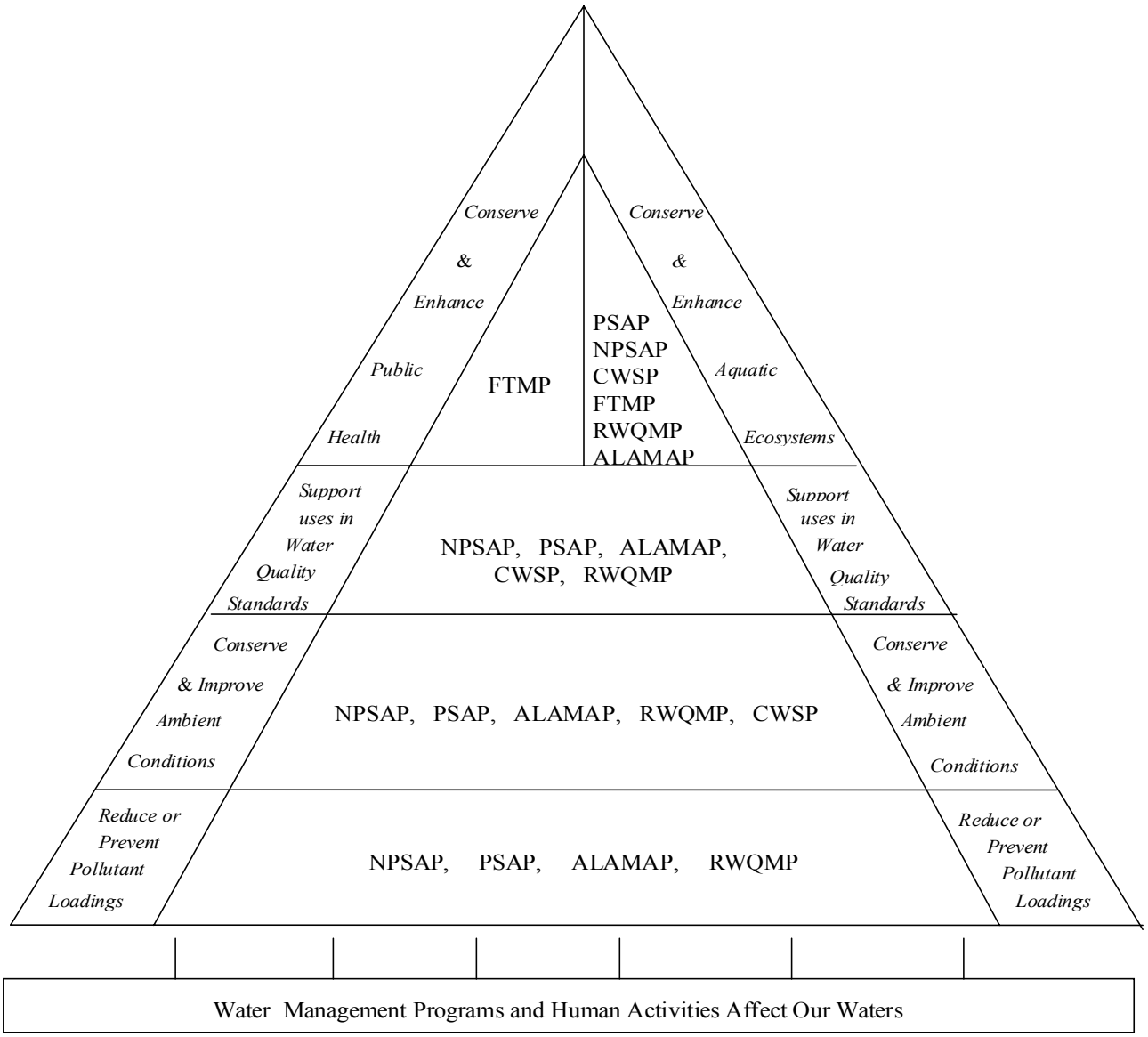
EPA Environmental Objective	*EPA Environmental Indicator*	*FOD Program Component*	*FOD Program*
	Selected point source loadings to surface water	AGPT	Point Source Assessment Program (PSAP)

Table 3. Reports Generated by Field Operations Division Since 1990

FY Report Completed	Title
1990	A Comparison of Direct and Indirect Analyses of Nutrient Concentrations in the Particulate Fraction of Water Samples
1990	Choccolocco Creek WQDS- Anniston
1990	Coastal Program Water Quality Trend Report FY90
1990	Mud Creek WQDS - Hanceville
1990	Town Creek and Swan Creek WQDS - Athens
1990	Waxahatchee Creek WQDS - Columbiana
1991	A Sediment Chemistry Baseline Study of Coastal Alabama
1991	Alabama Reservoirs - Water Quality Monitoring Program Report - 1990
1991	Aldridge Creek WQDS -Huntsville
1991	An Investigation of the Fish Kills Occurring in Lower Fish River, Baldwin County, Alabama
1991	Huntsville Spring Branch WQDS- Huntsville
1991	Moore Creek WQDS- Haleyville
1991	Patsaliga Creek WQDS - Luverne
1990 - 1991	Portersville Bay WQDS
1991	Riley Maze Creek WQDS - Arab
1991	Talladega Creek WQDS - Talladega
1992	A Survey of the Water Quality and Sediment Chemistry of Selected Sites in the Mobile Delta System
1992	A Survey of the Water Quality and Sediment Chemistry of Shipyards in Coastal Alabama
1992	Alabama Reservoirs - Water Quality Monitoring Program Annual Report: 1991
1992	Big Wills Creek WQDS - Fort Payne
1992	Puppy Creek WQDS - Citronelle
1993	Klondike Creek WQDS - Ozark
1993	Limestone Creek WQDS - Monroeville
1993	Pigeon Creek WQDS - Fort Deposit
1993	Sand Mountain Lake Guntersville Watershed Project: Macroinvertebrate Bioassessment - June 1992

FY Report Completed	Title
1993	Sandy Creek WQDS - Camp Hill
1994	A Survey of the Dog River Watershed: 1st Year's Study. An Overview of Land-Use Practices and the Effects of Development on the Basin.
1994	ADEM Reservoir Water Quality and Fish Tissue Monitoring Program Report: 1992 - 1993
1994	Choccolocco Creek Watershed Study
1994	Omussee Creek WQDS - Dothan
1994	Sand Mountain Lake Guntersville Watershed Project: Macroinvertebrate Bioassesssment - June 1993
1994	Water Quality Trends of Selected Ambient Monitoring Stations in Alabama Utilizing Aquatic Macroinvertebrate Assessments: 1974-1992
1994	West Point Lake Phase I Diagnostic / Feasibility Study: Final Report (Joint report with Georgia Environmental Protection Division)
1995	A Survey of the Dog River Watershed: 2nd Year's Study. Ongoing Development and Assessment of the Effects of Urban Nonpoint Sources on the Aquatic Resources of the Basin. Macroinvertebrate Community and Sediments.
1995	Alabama/Mississippi Pilot Reference Site Project: 1990-1994
1990 - 1995	Black Warrior River Water Quality Study 1989 - 1994
1995	Sand Mountain Lake Guntersville Watershed Project: Macroinvertebrate Bioassesssment - June 1994
1995	Sugar Creek Water Quality Demonstration Report - Phase I
1996	A Survey of the Bon Secour River Watershed: An Overview of Land Use Practices and an Examination of the Effects of Development on the Aquatic Resources of the Basin.
1996	ADEM Fish Tissue Monitoring Program Report 1991-95
1996	ADEM Reservoir Water Quality Monitoring Program Report 1990-95
1996	Alabama Regional Environmental Monitoring and Assessment Program, Data Report for 1993 and 1994 (Coastal)
1996	Flint Creek Watershed Project: Macroinvertebrate Bioassessment, 1992 and 1995
1996	Sand Mountain Lake Guntersville Watershed Project: Macroinvertebrate Bioassesssment - May 1995
1996	Trends in Water Quality of Ambient Monitoring Stations of the Coosa and Tallapoosa Watersheds: Aquatic Macroinvertebrate Bioassessments, 1980-1995

Fig. 1. EPA Environmental Objectives and FOD Programs providing indicator data.



FTMP - FISH TISSUE MONITORING PROGRAM
NPSAP - NONPOINT SOURCE ASSESSMENT PROGRAM
PSAP - POINT SOURCE ASSESSMENT PROGRAM
RWQMP - RESERVOIR WATER QUALITY MONITORING PROGRAM
ALAMAP - ALABAMA MONITORING AND ASSESSMENT PROGRAM
CWSP COASTAL WATERSHED SURVEY PROGRAM

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