



MISSISSIPPI DEPARTMENT OF
ENVIRONMENTAL QUALITY

Surface Water Monitoring Program Strategy for Fiscal Years 2022-2025

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Table of Contents

Executive Summary	5
Introduction.....	6
Elements of MDEQ’s SWMP	6
Element 1: Monitoring Strategy.....	7
Element 2: Monitoring Objectives.....	8
Element 3: Monitoring Design.....	10
Surface Water Monitoring Program.....	12
Program Support Activities.....	15
Coastal Monitoring	20
Element 4: Core and Supplemental Indicators.....	25
Element 5: Quality Assurance	30
Element 6: Data Management.....	32
Element 7: Data Analysis/Assessment.....	33
Element 8: Reporting	36
Element 9: Program Evaluation	37
Program Accomplishments.....	39
Recommended Improvements	40
Element 10: General Support and Infrastructure Planning	42
Appendix A.....	48

Table of Tables

Table 1 Surface Water Monitoring Program Summary	22
Table 2 Parameters for Major MDEQ Surface Water Monitoring Programs	27
Table 3 Surface Water Use Classification	34
Table 4 Assessment Categories	35
Table 5 Estimated Additional Annual Funding Needs	44

Table of Figures

Figure 1 Surface Water Monitoring Program Design.....	11
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Acronyms and Abbreviations

ADB	Assessment Database
ALUS	Aquatic Life Use Support
ASPIRE	Assessment Surface Water Portal for Information and Repository Exchange
ATTAINS	Assessment TMDL Tracking & Implementation System
BEACH	Beaches Environmental Assessment and Coastal Health
BEACON	Beach Advisory and Closing Online Notification
BMP	Best Management Practices
BOD _u	Biological Oxygen Demand Ultimate
CALM	Consolidated Assessment and Listing Methodology
CWA	Clean Water Act
DDT	Dichloro-Diphenyl-Trichloroethane
DID	Data Integration Division
DQO	Data Quality Objectives
EDMS	Environmental Data Management System
enSPIRE	environmental Surface Water Portal for Information Repository and Exchange
FSD	Field Services Division
FTEs	Full Time Employees
GOMA	Gulf of Mexico Alliance
IBI	Index of Biological Integrity
LIMS	Laboratory Information Management System
MCBI	Mississippi Coastal Benthic Index
MBISQ	Mississippi Benthic Index of Stream Quality
MCA	Mississippi Coastal Assessment
MDEQ	Mississippi Department of Environmental Quality
MDMR	Mississippi Department of Marine Resources
NCA	National Coastal Assessment
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
NRCS	Natural Resource and Conservation Service
NRDA	Natural Resource Damage Assessment
NFWF	National Fish and Wildlife Foundation
OPC	Office of Pollution Control
PCB	Polychlorinated Biphenyls
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RESTORE	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
SI	Stressor Identification
SOP	Standard Operating Procedures

Mississippi Surface Water Monitoring Program Strategy 2022-2025

SWMP	Surface Water Monitoring Program
TAG	Technical Advisory Group
TMDL	Total Maximum Daily Load
TVA	Tennessee Valley Authority
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WLA	Waste Load Allocation
WQAB	Water Quality Assessment Branch
WQS	Water Quality Standards
WQX	Water Quality Exchange

Executive Summary

The Mississippi Department of Environmental Quality (MDEQ) is responsible for conserving the quality of Mississippi's surface waters for public use by the citizens of the state. This responsibility, coupled with legislative mandates set forth by the Mississippi Water Pollution Control Act (Miss. Code Ann. §§ 49-17-1 to 49-17-43.) and the Federal Clean Water Act (CWA) (33 U.S.C.A. §§ 1251 to 1387), serve as the foundation for development and implementation of the Surface Water Monitoring Program (SWMP). The purpose of this document is to provide a framework of MDEQ's SWMP strategy according to U.S. Environmental Protection Agency (USEPA) guidelines specified for state monitoring and assessment programs. Key elements include clearly defined objectives, and an outline of the overall strategy and structure used to meet these goals. A conceptual model of the SWMP consists of three major branches: Ambient Monitoring, Program Support Monitoring, and Coastal Monitoring. The first module addresses general water quality assessment of status and trends of inland waters. The second component addresses specific surface water monitoring and assessment needs of MDEQ Office of Pollution Control (OPC) programs (i.e. Total Maximum Daily Load Program (TMDL), Water Quality Standards Program (WQS), Non-point Source Program (NPS), Basin Management Approach Program, and Natural Resource Damage Assessment (NRDA), Restoration, etc.). The last part addresses general water quality assessment of status and trends solely within coastal waters. Ecological indicators used in the SWMP consist of a suite of physical, chemical, and biological parameters subjected to a rigorous quality assurance/quality control program ensuring a collection of scientifically defensible and accurate data. The environmental Surface Water Portal for Information Repository and Exchange (enSPIRE) database houses all data collected via the SWMP. Data from enSPIRE moves into USEPA's Water Quality Exchange (WQX) Network/Node. Currently, MDEQ has deployed and is currently using the enSPIRE database to house all ambient surface water quality data. In addition, the agency continues to devote resources to enhancing the capabilities of this data warehouse. Data is available to the public directly through MDEQ's response to individual information requests and through use of USEPA's publicly accessible Water Quality Portal. Routine water quality assessments are made on these data by OPC Field Services Division (FSD) personnel; and, are stored in MDEQ's Assessment Database (ADB), within USEPA's Assessment, and in Total Maximum Daily Load Tracking and Implementation System (ATTAINS), and are reported within Mississippi's biennial §305(b) Water Quality Report to Congress. In addition, internal reports are generated and available to the public. Triannual evaluation of the monitoring strategy occurs to meet surface water programs and resource needs of MDEQ and Federal surface water quality requirements.

Introduction

The MDEQ OPC is responsible for conserving the quality of the natural resources of Mississippi and has primary responsibility for providing an effective statewide surface water quality monitoring and assessment program. This responsibility, coupled with legislative mandates set forth by the Mississippi Air and Water Pollution Control Law (Miss. Code Ann. §§ 49-17-1 to 49-17-43) and the CWA (33 U. S. C. §§ 1251 to 1387), serve as the main purpose for development and implementation of the MDEQ SWMP.

This strategy intends to aid the state in the development, implementation and maintenance of an effective surface water monitoring program. The purpose of the SWMP is to:

- Outline the elements and establish the overall goals and objectives of the SWMP,
- Achieve mandates set forth by the Mississippi Air and Water Pollution Control Act, and the CWA, and;
- Protect, maintain and improve the physical, chemical, and biological integrity of Mississippi's inland and near-coastal waters.

The quality of the state's surface waters has a profound effect upon the health and welfare of Mississippi's citizens. Along with the state's wildlife, fish, and other aquatic life, the quality of Mississippi's waters also significantly affects domestic, agricultural, industrial and recreational water use activities. To support the goal of protecting, maintaining, and improving water quality set forth in the CWA, the agency's SWMP provides the water quality information necessary for state and USEPA water quality management decision-making and for reporting on the overall status of Mississippi's surface waters.

Elements of MDEQ's SWMP

The key elements of the SWMP include clearly defined objectives and an outline of the overall strategy used to meet these objectives. Below are the strategy elements designed to meet guidelines for national and state monitoring and assessment needs as expressed in USEPA surface water monitoring guidance, *Elements of a State Water Monitoring and Assessment Program* (USEPA 2003). This guidance defines the recommended basic elements of a state water monitoring program and is used by USEPA as a tool to help determine if state programs meet the prerequisites of CWA §106(e)(1) by maintaining an adequate state monitoring and assessment program. The ten basic state monitoring program elements are:

1. Monitoring Strategy,
2. Monitoring Objectives,
3. Monitoring Design;
4. Core and Supplemental Water Quality Indicators,
5. Quality Assurance,
6. Data Management,
7. Data Analysis/Assessment,

8. Reporting,
9. Programmatic Evaluation and,
10. General Support and Infrastructure Planning.

Element 1: Monitoring Strategy

In order to successfully develop, implement, and maintain a surface water monitoring program, a strategy is necessary to steer, guide, and address the broad range and variety monitoring activities carried out in support of program objectives. A comprehensive monitoring program strategy should address all water quality management needs in all waters of the state and still be cost-effective and logistically adaptable (Yoder 1997; Strobl & Robillard 2008). MDEQ's SWMP strategy document provides a description of program elements and establishes the overall goals and objectives of the SWMP. This document closely follows USEPA's *Elements of a State Water Monitoring and Assessment Program* guidance (USEPA 2003).

This monitoring strategy intends to address the comprehensive range of water quality management decisions that require surface water monitoring data for all types of waters in the state, including streams, rivers, lakes, reservoirs, coastal areas, and to the extent possible, wetlands. The SWMP is also intended to support the implementation of water management programs as required under §§ 303, 305, 402, 314, and 319 of the CWA. Due to the complexity of calculating improvement in water quality, cost, and benefits of CWA objectives, and determining the extent of non-point source pollution, MDEQ has focused resources on developing assessment tools that accurately evaluate the water quality status of Mississippi's water resources. The development and maintenance of robust assessment tools are integral in accurately determining current water quality status, tracking improvement, and supporting management decisions.

Mississippi's strategy for achieving an all-inclusive, statewide monitoring and assessment of its surface waters involves coordination of various levels of MDEQ surface water monitoring activities in the state's rivers, streams, lakes, and coastal waters. In addition to MDEQ's efforts, other state and federal government agencies along with public/private groups conduct surface water quality monitoring in state waters. MDEQ actively promotes data sharing and coordination with these groups by soliciting their contributions of data and uses this information in a comprehensive evaluation and assessment of Mississippi surface water quality.

The MDEQ fosters stewardship of Mississippi's water resources through collaborative watershed planning, education, protection, and restoration initiatives via the Basin Management and Nonpoint Source Program initiatives. To facilitate these efforts, Mississippi has organized ten major river basins into four basin groups. Through the Basin Management Approach, each basin group has an established a team comprised of state and federal agencies, local organizations, and stakeholders. Each basin team provides the opportunity for multiple levels of government and local partners to coordinate their efforts.

Together, basin team members help prioritize watersheds for water quality restoration and protection activities. The Basin Management Approach also encourages and provides the opportunity for basin team members to pool both technical and financial resources to address water quality initiatives in priority watersheds.

The MDEQ has implemented all of the ten basic elements outlined by USEPA (2003), but continuous refinement and improvements to SWMP activities are necessary to achieve the comprehensive and nationally consistent surface water monitoring program and assessment goals set forth by USEPA for all state waters by 2025. To track MDEQ's progress in meeting State Water Monitoring and Assessment Program element goals, and annual monitoring work plans are prepared and submitted to USEPA that identify monitoring projects, milestones, and status in accomplishing the various program elements within each annual monitoring cycle. Sampling locations, parameters, methods, and index periods for individual monitoring projects and program element developments are also included in the annual work plans. In addition, every three years, the overall strategy undergoes full review and update.

While this strategy currently addresses traditional surface waters only (i.e. streams, rivers, lakes, and coastal waters), the CWA requirements and intent of state comprehensive assessment of all waters are also applicable to wetlands. MDEQ currently does not have a wetland monitoring component in its surface water monitoring program, but has identified the need for future incorporation to the long-term strategy when funding is available.

Within MDEQ, the OPC FSD is responsible for the planning and implementation of MDEQ's SWMP. Personnel from the Surface Water Monitoring Branch and the Enforcement Monitoring Branch of the FSD Laboratory in Pearl, the Coastal Monitoring Branch in Biloxi, the Water Quality Assessment Branch (WQAB) in Jackson, and the FSD regional field offices in Oxford, Stoneville, Pearl, and Biloxi, Mississippi undertake the implementation of statewide monitoring.

To achieve and maintain surface water quality, prioritization of monitoring initiatives and projects is necessary to address the varied demands competing for resources in order to respond to the goals and needs of MDEQ's surface water programs. Determination of monitoring priorities is an iterative process involving collaboration and coordination among MDEQ's CWA program areas. Selection and precedence of monitoring sites occurs in response to the state's needs and continually evolving USEPA program requirements. Although priorities may fluctuate, monitoring needs are usually dependent upon assessment priorities, budgetary constraints, and staff resources.

Element 2: Monitoring Objectives

Surface water monitoring involves the acquisition of data to characterize the physical, chemical, and/or biological integrity of surface waters. These monitoring activities provide the foundation for assessment of the condition of Mississippi's waters to meet varying surface water program needs. Without monitoring data and information, the state's water

quality management and regulatory programs cannot effectively report on the status of Mississippi's water resources, identify and solve problems, characterize water pollution causes and effects, and/or evaluate the overall effectiveness of state management and regulatory actions.

The structure and design of a monitoring program depends on the set of questions that can provide answers about the data for end users. MDEQ designed an appropriate monitoring strategy to answer the following questions outlined by MDEQ surface water programs:

1. What is the general water quality *status* of Mississippi surface waters?
2. What are the general water quality *trends* of Mississippi surface waters?
3. What is the water quality status of specific water bodies of public concern or special waters needing protection (i.e. high-quality resource)?
4. What water quality standards are necessary to gauge use attainment and establish permits or implementation strategies protective of the use?
5. What water bodies in Mississippi are impaired or of concern?
6. What are the causes and sources of impairment of Mississippi surface waters?
7. Are MDEQ surface water management and regulatory programs effective?
8. What are better ways of monitoring and assessing surface water quality?

Once these questions were developed and monitoring objectives identified, OPC created protocols for implementation of the SWMP. The specific objectives of the SWMP established by this strategy and the questions primarily addressed are:

- Meet requirements of legislative mandate (§106 of CWA) – Questions 1-8;
- Monitor, assess, and report on the overall status and trends of surface water quality in Mississippi (§305(b) of CWA) – Questions 1, 2, 3, 5, and 6;
- Provide information and data for identification of impaired water bodies (§303(d) of CWA) and determination of causes and sources of impairment (§§ 305(b) and 303(d) of CWA) – Questions 5, and 6;
- Provide information and data to establish and revise water quality standards (§303(c) of CWA) – Questions 2, 4, 7, and 8;
- Evaluate effectiveness of OPC environmental management and regulatory programs in maintaining and improving surface water quality (§§ 303, 305, 314, 319, 402, e.g. of CWA) – Questions 1, 2, and 7;
- Support surface water monitoring and assessment needs or activities of other OPC Programs (i.e. Basin/watershed management, National Pollutant Discharge Elimination System (NPDES) compliance, WQS, NPS, TMDL/Waste Load Allocation (WLA) development and implementation, emergency response, environmental education, NRDA, Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE) – Questions 1-8;
- Address surface water quality issues (water quality degradation, watershed restoration, high quality resource protection, e.g.) and economic development interests of public concern and/or environmental welfare – Questions 1-3. and;

- Determine better ways of monitoring and assessing surface waters to provide data for decision-making of known and sufficient quality for intended uses – Question 8.

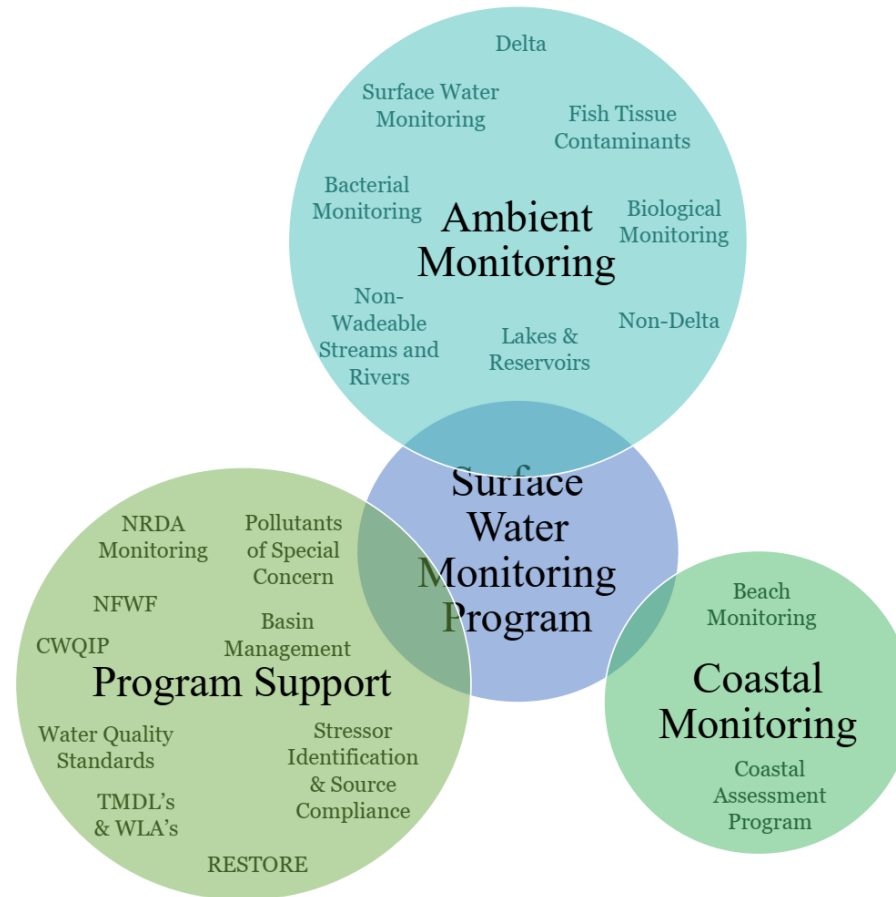
In order to meet these objectives, the FSD carries out a broad range of monitoring activities. These various activities consist of the actual measurement of water quality parameters and community measures in state waters followed by the investigation and evaluation of factors contributing to these water quality findings. Finally, the monitoring process culminates with an overall assessment of the specific effects of such quality upon the beneficial uses of Mississippi waters.

Element 3: Monitoring Design

Program objectives, or more specifically the questions that are to be answered, drive the conceptual monitoring design as it is multifaceted, incorporating several approaches for site selection, indicators, intensity of monitoring, magnitude and frequency of data collection, and monitoring schedules (see Appendix A tables 1-5).

To ensure the success of the Surface Water Monitoring Program the most effective design breaks down group monitoring activities so that program objectives address management needs efficiently. Figure 1 shows a schematic the program.

Figure 1 Surface Water Monitoring Program Design



The SWMP model consists of three major types of monitoring activities: Ambient Monitoring, Program Support Monitoring, and Coastal Monitoring.

Surface Water Monitoring Program

Ambient Monitoring

Ambient Monitoring addresses comprehensive water quality status and trends management questions in all potential freshwater body types (i.e. streams, rivers, and lakes):

- What percentages of water bodies are meeting their designated uses?
- Is water quality getting better or worse over time?
- Is a water meeting its designated use(s)?

This monitoring effort will be of long-term duration and involve routine data collection that will help make general statements about specific or broad scale questions (e.g., what are the main causes and sources of impairment of Mississippi waters). The majority of ambient monitoring involves targeted collections of data that assist in the detection of water quality trends, document beneficial use support and baseline conditions, provide information for water quality standards refinement, and help estimate loading for specially selected water bodies throughout the state. Table 1 shows a summary of Ambient programs, sampling site quantities, frequencies and parameters. As a rule, FSD uses the following selection criteria to determine monitoring locations:

- Least disturbed or minimally impacted streams, from which an assessment of baseline conditions can be made;
- Streams below critical or major discharges, from which long-term effects can be established and/or improvements observed where pollution control measures are implemented;
- Streams or rivers which represent a composite of a large watershed which will allow broad evaluations of overall abatement programs, and;
- Waters of general concern and/or high public interest (i.e., large rivers, major streams entering or leaving the state, recreational lakes and reservoirs, and near-coastal waters and marine waters within the state jurisdiction).

The state's ambient monitoring program is of the highest priority for MDEQ. Over time the program will grow, expand, and be modified to incorporate varying study design criteria to meet ever changing monitoring objectives. Projected enhancements to the current monitoring components include:

- Ambient Biological Monitoring (wadeable probabilistic design),
- Ambient Biological Monitoring (non-wadeable, probabilistic design),
- Ambient Biological Monitoring (non-wadeable, targeted design),
- Ambient Biological Monitoring (estuarine/marine),
- Ambient Fish Tissue Monitoring (lotic systems),
- Ambient Fish Tissue Monitoring (estuarine/marine systems),
- Ambient Physical/Chemical Monitoring (wadeable, probabilistic design),

- Ambient Physical/Chemical Monitoring (non-wadeable, probabilistic design),
- Ambient Bacteriological Monitoring (lakes/reservoir, targeted design),
- Ambient Bacteriological Monitoring (all water body types; probabilistic design), and;
- Ambient Coastal Beach Monitoring (estuarine/marine source tracking).

The following paragraphs provide a more in-depth discussion of each of the monitoring programs currently operating under the Ambient Monitoring component of the SWMP (MDEQ 2003, 2007, 2018b, 2020b, and 2020c; Stribling et al. 2016).

Biological Monitoring

Non-Delta

Historically, the focus of the state's surface water monitoring strategy utilized a static, fixed-station, targeted methodology centered on water chemistry with limited biological sampling. In 2003, MDEQ developed the Mississippi Benthic Index of Stream Quality (MBISQ), which placed the ambient monitoring emphasis more on direct water quality indicators for Aquatic Life Use Support (ALUS). The initial development and calibration of the index, delineated bioregions, as well as established reference conditions for wadeable streams throughout the state excluding the Mississippi Alluvial Plain (Delta). Subsequent sampling done during 2002-2012 provided an additional biological community data set and a broader spatial coverage. This dataset improved the initial bioregional delineations and reference condition thresholds from the original MBISQ. Recalibration and testing completed in 2016 further refined the MBISQ. More information on the initial development and re-calibration of the index is available on MDEQ's Surface Water Quality Assessments [Related Water Quality Documents](#) page.

Under the MBISQ program, FSD or its designee annually collect benthic community samples, along with measures of habitat, and in stream water quality at approximately ± 100 perennial stream sites statewide. The sampling period is from December 1st through the first week of March and the primary indicator is macroinvertebrates. Using the MBISQ score, these waters are assessed for attainment of ALUS during the biennial §305(b) assessment process.

Delta

Funding permitting, monitoring occurs annually at 25-30 targeted sites on wadeable streams within the Delta portion of the Yazoo Basin. Collection of macroinvertebrates, physical/chemical measurements, and habitat quality happens during the September-October index period.

To date the Delta does not have an index of biological integrity. In 2005, MDEQ generated a pilot project to develop an index based on collected macroinvertebrates. In 2007 & 2008, the United States Geological Survey (USGS) provided supplemental data to add to the original data set. The first attempt to develop an index for the Delta did not allow for the discrimination among sites required for a robust index. To address this issue, an additional data collection took place in 2009. Development of this index is an ongoing project, and MDEQ is exploring the use of LiDAR data for catchment delineation to determine better classification variables. Due to funding and staff limitations, MDEQ has not continued with the development of this biological index.

Fish Tissue Contaminants

Fish tissue contaminant monitoring (DDT & Toxaphene) occurs at 25 lake/river/reservoir sites from the east of the MS Ricer Levee to the Loess Bluff Hills that are currently under advisory. Collection of fish occurs via electro-fishing. FSD will continue to sample fish tissue in these Delta waterbodies until tissue contaminant levels fall below the 1ppm contaminant threshold after three continuous sampling events; once the target is met the water body is removed. Sample species include primarily bottom feeders such as Common Carp, Big and Smallmouth Buffalo, Spotted or Short-Nosed Gar, and Catfish over 22 inches.

Target species for Ambient Fish Tissue sampling are, one predator or carnivore such as Flathead Catfish or Largemouth Bass, and one bottom feeder, or omnivore such as Channel Catfish or Smallmouth Buffalo.

Ideally, the analysis for both programs includes composite samples consisting of fillets from five individuals of similar size. All fish in the composite are within 75% of the weight of the largest fish in the composite sample. Collections are done May – October. Delta samples require and 25 sites, and Ambient 20.

The FSD laboratory has the capability of analyzing fish tissue samples for approximately 336 organic and pesticide compounds, Polychlorinated Biphenyls (PCB's), Pentachlorophenol, and 7 heavy metals. MDEQ plans to expand this monitoring to other water body types including estuaries, and coastal waters.

Surface Water Monitoring

Non-Wadeable Streams & Rivers

FSD collects water samples at 37 bridge sites under the Fixed Station Monitoring Program as part of status and trends monitoring. This subset of 37 sites (10+ per regional office) affiliated with the original Statewide Fixed Monitoring Network was chosen to provide continuous evaluation between the historical network and the new network. The subset of statewide stations provides systematic water quality sampling at regular intervals and uniform parametric coverage to monitor water quality status and trends over a long-term period. The

data collected are ultimately used for §305(b) reporting. FSD samples these locations on a monthly for routine water chemistry and quarterly for metals. Pursuit of the development of a probabilistic design to 100% of non-wadeable streams and rivers in the state is a goal of MDEQ; however, funding is not currently available for the ongoing development of this the design or to implement probabilistic programs.

Lakes & Reservoirs

Historically, lake monitoring had been accomplished through a combination of USEPA program involvement (e.g., National Lakes Assessment, Clean Lakes, etc.), targeted stations (impairment questions), and special study observations that focused on physical, chemical, and biological parameters. In 2008, MDEQ reevaluated its program and developed a cyclical monitoring schedule to maximize its lake monitoring capabilities. Each year of the cycle involves the collection of samples from approximately 20 randomly selected public lakes ≥ 100 acres in size. This rendered 100 monitored lakes over a 5-year period. A modification occurred in 2015 to change how collection was completed. Sampling currently occurs at approximately 30 lakes, but each lake site now has two years' worth of data before a new lake rotates into its position. Lakes were/are monitored during the summer index period (May – October) for traditional physical, chemical, and biological water quality parameters to aid in ALUS §305(b) assessment. The last alteration happened in 2016 to include collections within the state's Public Water Supply lakes.

Bacterial Monitoring

Bacterial monitoring takes place at 51 primary contact recreational water sites statewide as part of the Ambient Recreational Network in accordance with Mississippi's WQS. The sampling sites are located on rivers and streams that are designated for primary contact recreation and the data collected are used in the §305(b) process to assess for attainment of the primary contact recreation use. In the future, MDEQ would like to expand this monitoring network to include monitoring locations on lakes and reservoirs that are of primary contact recreational waters.

Program Support Activities

As a primary component of the SWMP model, monitoring addresses immediate and specific water quality monitoring and assessment questions:

- What is the cause and source of impairment of a specific water body?
- What water quality changes happen after Best Management Practice (BMP) or wastewater treatment improvements?
- What is the pollutant load reduction needed to meet WQS or restore designated uses of a waterbody?

- What is the environmental impact and needed restoration in a water body as performed through a NRDA after an oil spill?

Site and issue-specific monitoring addresses these types of enquiries within an affected receiving water. Coordination of efforts between FSD and MDEQ's regulatory programs (i.e., NPDES, NPS, Basin Management, TMDL, WLA, WQS, pollutants of special concern, NRDA, Emergency Response, RESTORE, National Fish and Wildlife Foundation (NFWF), etc.), along with the use of the SWMP, will assure appropriate detail in planning and implementation of these monitoring activities. These actions include short term monitoring strategies that are dynamic in nature and are narrow in scope. They are usually of a focused design to answer site-specific or parameter-specific questions (e.g. intensive synoptic surveys or screening-level monitoring as opposed to static routine monitoring). These activities/strategies dictate a responsive instead of a scheduled or probabilistic design. They offer an iterative process, by providing MDEQ with the ability to address surface water issues and concerns. Targeted site selection is the accepted practice for all of these activities, but the situation may evolve into using probabilistic site selection when appropriate. The following discussion provides detailed information on typical program support monitoring activities.

TMDL & WLA Programs

Each year, FSD in association with the TMDL branch, select waters that provide monitoring support for TMDL and WLA development. The number of sites vary from year to year and are dependent on the needs of the TMDL program and available resources. Parameters measured for the TMDL and WLA studies are dependent on the type of model to be developed. The list of parameters measured for these TMDL and WLA studies is located on Table 2 with the primary indicator being traditional physical, chemical, and biological parameters with the addition of diel dissolved oxygen and community metabolism measurements (i.e. light/dark bottle).

Water Quality Standards

MDEQ is required to review state water quality standards every three years. Monitoring activities provide data to support the water quality criteria development process, Use Attainability Analyses, and standards revisions. Sample locations, frequency, and parameters to address future program support needs will depend on project requirements and available resources.

Over the past years, MDEQ focused monitoring resources in rivers, streams, lakes, reservoirs, and coastal waters in support of numeric nutrient criteria development. This monitoring effort is ongoing and follows Mississippi's *Plan for Nutrient Criteria Development*. MDEQ submitted the original plan to USEPA Region IV on July 2010 and revised it again in May 2016. The purpose is to provide USEPA with a better understanding of Mississippi's approach to nutrient criteria development. The focus of this strategy is to develop nutrient criteria based primarily on the linkage between nutrient

concentrations and impairment of designated uses. The most recent version of the plan is located in [Mississippi's Plan for Nutrient Criteria Development](#) web page.

Pollutants of Special Concern Monitoring

Special monitoring activities to address levels of priority pollutants in water, fish/shellfish tissue, and sediment are done periodically and as needed by FSD in cooperation with other state and federal agencies. Examples of past studies of this type have included investigations for such contaminants as mercury, dioxin, and PCB's in water, sediment, and fish tissue. For future projects, sample locations, sample frequency, and measured parameters will depend on agency priorities and available resources.

Coastal Water Quality Improvement Program (CWQIP) – RESTORE) and NFWF

MDEQ's Office of Restoration leads the state's restoration efforts resulting from the *Deepwater Horizon* oil spill in 2010. The office uses a comprehensive approach to restoration integrating projects and leveraging funding sources to implement restoration projects that will restore and enhance the Gulf Coast's natural resources.

The office implements and manages projects from three main funding sources—NRDA, the RESTORE Act, and the NFWF Gulf Environmental Benefit Fund.

FSD currently assists with the monitoring and collection of data for the RESTORE and NFWF portions.

Coastal water quality issues are of great concern to the State and are a Gulf-wide priority. By addressing water quality degradation, this proposed program will make the greatest contribution to restoring and protecting coastal resources. The CWQIP supports the primary RESTORE Comprehensive Plan goal to restore water quality and quantity in the Mississippi Gulf Coast Region through the identification and implementation of various water quality improvement projects. To accomplish this goal, MS plans to apply regular bacterial monitoring that can:

- Identify areas of degradation for project implementation, and post-completion monitoring after project installation, and;
- Aid in understanding water quality dynamics in beach environments.

RESTORE

Monitoring to identify areas of degradation

A significant spatial and temporal monitoring effort is to take place to identify sources of bacterial loads into streams, bayous, and coastal waters. Sampling will occur for short periods to collect a representative data set of box culverts and upstream segments. Data rendered assists in determining: 1) bacterial presence and absence, and 2) if detected,

bacterial concentrations determined. All samples will additionally be processed for microbial source tracking to determine origin of derivation of enterococci (e.g., human, wildlife, or avian).

Post-Project Completion Monitoring

Bacteria monitoring for *Enterococcus sp.* will take place monthly at surrounding sites to determine if water quality is improving due to the infrastructures upgrades/repairs along the Mississippi Gulf Coast.

Monitoring to Understand Water Quality Dynamics

Several key questions require investigation to understand the dynamics of bacterial water quality concentrations and loads in the beach environment. A comprehensive set of beach monitoring data, turbidity, and other environmental variables will yield relational information. However, there is a need for fine scale spatial and temporal information to explain foundational questions about concentrations, timing of sample collection, influences, and the ecosystem processes of concentrations in the water column. The influence of sediment due to the interaction of mixing with water column, and sediment dynamics also require understanding.

Beaches are sometimes unsafe for recreational use due to elevated fecal contamination from combined sewer overflows, leaking septic systems, contaminated beach sand, pets, local wildlife, or nearby agricultural practices. Having a better understanding of the contamination sources can help mitigate the effects of the pollution or stop it from entering the water in the first place. This would decrease the risk of people exposed to fecal pollution and minimize the community costs associated with closing and reopening beaches. Microbial source tracking becomes useful to answer questions of source.

To begin seeking explanation to some of these dynamics questions, sampling has begun between Henderson Point and Pass Christian Harbor, and along the beach near Edgewater Drive. This program will occur in four unique sampling regimes:

- Spatial and temporal assessment,
- Rain event pipe sampling,
- 24-hr temporal assessment, and;
- Spatial sediment variation.

NFWF

Restoration work under the NFWF in the Mississippi Restoration Area will support projects that remedy harm to natural resources (e.g., habitats, species, etc.), and where there have been injury to, destruction of, or loss of use of those resources resulting from the oil spill. Projects will occur within reasonable proximity to where the impacts occurred.

Consistent with the terms of the plea agreements, funding priorities for NFWF projects include, but are not limited to, projects that contribute significantly to the following natural resource outcomes:

- Restore and maintain the ecological functions of landscape-scale coastal habitats, including barrier islands, beaches, and coastal marshes, and ensure their viability and resilience against existing and future threats;
- Restore and maintain the ecological integrity of priority coastal bays and estuaries, and;
- Replenish and protect living resources including oysters, red snapper and other reef fish, Gulf Coast bird populations, sea turtles, and marine mammals.

NRDA Monitoring

NRDA monitoring refers to environmental observations performed due to complaints, fish kills, hazardous waste remediation/mitigations, chemical spills, invasive species, and emergency response investigations in surface waters. These incidents can result from either point or non-point source pollution releases. Initial responding divisions of MDEQ may be FSD, Hazardous Waste, and/or Emergency Response. The three FSD regional offices are strategically located in the state to help meet this need and to provide closer and more rapid response to pollution incidents. Investigations may include collection of surface water, wastewater, groundwater, soil, sediment, fish, or tissue samples from the affected area. Analyses of the information and/or data collected during the initial response investigation can frequently trigger more intensive monitoring to better define water quality and public health impacts, and to support enforcement actions. Water bodies with recurrent complaints, invasive species, or prolonged contamination require additional scrutiny and require more extensive, long-term monitoring.

Sampling protocols for NRDA's are designed on a case-by-case basis, depending on the habitat type and environmental conditions at the site. The specific methodology, and parameters used to assess potential damage to the ecosystem depend on many factors. These include the volume of the spilled chemical, the toxicological profile of the material, characteristics of the water body and the surrounding terrain, and access among others.

Stressor Identification & Source Compliance

Stressor Identification (SI) analyses take place for waters with confirmed biological impairment. These types of analyses have proven to be very useful in the determination of potential stressors for sites identified as biologically impaired based on MBISQ benthic macroinvertebrate assessments. SI is a process and involves the consideration of both point and non-point pollution sources as well as other potential stressors. In general, the strategy used in identification of stressors through causal analysis is to logically eliminate improbable causes of stress and determine the most probable stressors. This happens by using strength of evidence to identify the most likely cause of impairment through a documented and consistent process. These SI analyses follow guidelines as outlined in the USEPA's *Stressor Identification Guidance Document* (USEPA 2000).

FSD uses SI analyses to identify the specific stressor(s) in state waters that are listed as impaired due to biological impairment on the state's §303(d) List of Impaired Waters. The effort involves an analysis of existing water quality data and other pertinent watershed data such as land use/land cover, hydrology data, permitted discharge data, and agriculture census data to identify stressors and potential sources of impairment. Ground truthing of study area characteristics also ensues to evaluate the quality of older geographical and spatial information. In addition, when resources allow, actual field monitoring follows on targeted §303(d) listed waters to fill data gaps using core and supplemental indicators. The data are also used in §305(b) assessment efforts for reporting of impairment cause(s) and/or source(s), to support both NPDES and NPS regulatory/management programs, and to direct future surface water monitoring program activities. The TMDL development process also relies on the information provided from the SI process for analysis.

Basin Management

The mission of the Basin Management Approach is to foster stewardship of Mississippi's water resources through collaborative watershed planning, education, protection, and restoration initiatives. To accomplish this, Mississippi divided its nine major river basins into four basin groups. Each basin group has a basin team comprised of state and federal agencies and local organizations. This team provides the opportunity for multiple levels of government and local stakeholders to coordinate their efforts. Together, basin team members help assess water quality, determine causes and sources of problems, and prioritize watersheds for water quality restoration and protection activities. The Basin Management Approach also encourages and provides the opportunity for basin team members to pool both technical and financial resources to address priority watersheds. FSD provides support via data collection, water quality assessments, and stressor identification studies for sites of interest.

Coastal Monitoring

Coastal Monitoring addresses comprehensive water quality status and trends management questions along with aquatic life use of nearshore estuarine/marine areas. Monitoring activities include water quality monitoring to support oyster reef fisheries/water quality modeling efforts, the identification of areas of concern, microbial source tracking, and post project (before and after infrastructure) completion monitoring.

- Is water quality getting better or worse over time?
- Is a water meeting its designated use(s)?

This monitoring effort will be of long-term duration and involve routine data collection that will help to make general statements about specific or broad scale questions (i.e., what are the main causes and sources of impairment of Mississippi's coastal waters). The majority of ambient monitoring involves targeted collections of data that assist in the detection of water quality trends, document beneficial use support and baseline conditions,

provide information for water quality standards refinement, and helps to estimate loading for specially selected water bodies throughout the state. Table 1 shows a summary of programs, sampling site quantities, frequencies and parameters.

Beach Monitoring

FSD collects weekly bacteria and water quality samples on a year round basis at 21 beach stations along the Mississippi Gulf Coast. The beach stations provide systematic water quality sampling at regular intervals for uniform parametric coverage to monitor water quality status and trends over a long-term period allowing MDEQ to evaluate water quality.

MDEQ collaborates with the EPA Gulf of Mexico Program, Mississippi Department of Marine Resources, and the Mississippi State Department of Health to form a multi-agency Beach Monitoring Task Force. Both MDEQ and the Beach Monitoring Task Force rely on bacterial data collected under this program to assess health safety issues for users of Mississippi's recreational beaches and to provide beach advisories when needed. MDEQ issues beach advisories when *Enterococci* bacteria concentrations reach unsafe levels. Real-time water quality conditions are available to the public via the [Beach Monitoring Web page](#). This web site contains beach advisory status, location of monitored sites, data associated with those monitored locations, and a history of beach advisories for each station. Collections occur at all stations on a weekly basis, year-round. Resampling takes place should *Enterococci* bacteria levels exceed 104 colonies/100ml.

Coastal Assessment Program

In 2000, FSD participated in the USEPA's National Coastal Assessment (NCA) Program. FSD has since continued to implement a streamlined version of the plan to address the ambient monitoring issues of Mississippi's coastal waters. Through its Mississippi Coastal Assessment (MCA) program, FSD annually collects samples at 25 randomly selected sites and 12 static sites. Coastal assessment monitoring happens during the late summer index period (July-September). A probabilistic site selection methodology as defined by USEPA during the NCA program implementation randomly draws the sampling sites. At the end of a 5-year reporting period for §305(b) assessment, a total of 125 sites will have monitoring data that will be used to assess the ALUS for 100% of the coastal and estuarine waters in the state. Mississippi has developed a Mississippi Coastal Biotic Index (MCBI) that is specifically suited for Mississippi waters. In 2011, the Nutrient Priority Issue Team of the Gulf of Mexico Alliance (GOMA) developed and completed an additional gulf-wide index. FSD plans to use these indices along with existing MCA data to build upon and further refine its MCBI, and to assess ALUS in Mississippi gulf waters.

Table 1 Surface Water Monitoring Program Summary

Program	Schedule	J	F	M	A	M	J	J	A	S	O	N	D
<i>Ambient Monitoring**</i>													
Wadeable Streams (MBISQ) - Non Delta	Approximately 100 targeted sites in perennial streams sampled annually												
Wadeable Streams – Delta	Approximately 25-30 targeted sites on wadeable streams within Delta basin												
Lakes and Reservoirs	Approximately 30 publicly owned lakes > 100 acres will be selected for sampling during a two year period												
Fish Contaminants	Delta: 25 sites per year until threshold met Ambient: approximately 20 selected sites per year.												
Fixed Station Monitoring	Approximately 37 targeted historical network sites (10+ per regional office)												
Coastal Beach Monitoring	Total of 21 beach monitoring stations: stations sampled												
Bacteria Monitoring	Approximately 51 sites on Primary Contact Recreation waters sampled annually during contact (May-October) and non-contact (November-April) seasons in accordance with Mississippi’s WQS.												
Coastal Assessment	Approximately 25 probabilistic sites + 12 static sites sampled annually July through September; total of 125 sites will be sampled after 5-year monitoring cycle												

Mississippi Surface Water Monitoring Program Strategy 2022-2025

<i>Program Support Monitoring Activities</i>													
TMDL	Number of sites will vary year to year. Sampling is generally intensive in nature and is completed based on priority and available resources.												
WLA	Studies to be completed annually based on priority and available resources; each study may have multiple sampling locations												
Water Quality Criteria Development	Sampling is dependent on project requirements, may take place during any time of the year, and available resources												
Pollutants of Special Concern Monitoring	Sampling is dependent on project requirements, may take place during any time of the year, and available resources												
Natural Resource Damage Assessment	Sampling routine designed on case-by-case basis												
Coastal Water Quality Improvement Program	Sampling routine designed on case-by-case basis												

**All programs and consequently the number of sites done for each program are dependent on available resources and funding. In addition, the number of sites does not include the sampling requirements to meet QA/QC protocols (QA occurs at 10% of the sites are scheduled for QA sampling).

* NOTE: The monitoring programs listed above represent all MDEQ monitoring activities, not only those programs that are funded using §106 program grant funds. Most of monitoring activities listed above are funded using state funds.

Data Acquisition/Sharing with Other Monitoring Agencies

In addition to the ambient, program support, and coastal monitoring activities outlined in this strategy and implemented by MDEQ, there are other government agencies and institutions throughout Mississippi that conduct monitoring. MDEQ makes a considerable effort to identify, obtain records from, and work with the many other organizations collecting water quality data. This provides additional information for use in assessing state water bodies, and also reduces, if not eliminates, replication of services and ensures efficient use of MDEQ's limited surface water monitoring resources. Other monitoring organizations that provide data include: the USGS, the United States Army Corps of Engineers (USACE), the Tennessee Valley Authority (TVA), the USEPA, the National Oceanic and Atmospheric Administration, Mississippi Department of Marine Resources (MDMR), the Mississippi Band of Choctaw Indians, the University of Southern Mississippi – Gulf Coast Research Laboratory, the United States Department of Agriculture (USDA), the National Sedimentation Laboratory, the USDA Forest Service, the USDA Natural Resource and Conservation Service USDA (NRCS), the United States Fish and Wildlife Service (USFWS), the Mississippi Department of Wildlife, Fisheries, and Parks, other federal, state, and local agencies, research institutions, universities, and private groups.

Comments and input provided by these organizations assist MDEQ in study design, data collection, and data analysis modifications and coordination as needed for the SWMP work efforts. This data also complements and leverages activities of other state and federal agencies and serves to reduce or eliminate any duplication of effort and thus maximize limited data collection resources among agencies.

MDEQ also collaborates on special studies with significant federal partnerships such as with USGS (Delta work), USEPA (MS River), and the GOMA. These joint ventures not only assist our Federal partners (and in the case of GOMA, our sister states), but they also provide valuable knowledge that is used by MDEQ to ensure the generation of quality data.

Wetland Concerns

USEPA's National goal is ["no net loss of wetlands"](#); its additional intent is to move beyond that goal with a new commitment to increase the quantity and quality of wetlands nationwide.

The primary vehicle for wetland protection and regulation in the United States is §404 of the Federal Water Pollution Control Act and subsequent amendments of the CWA. However, wetlands are not directly mentioned in §404 as the language was interpreted to only include navigable waters to regulate dredging and filling. It was not until 1974 and 1975 in two court decisions, *United States v. Holland* and *Natural Resources Defense Council v. Calloway* that the interpretation of "waters" expanded to include wetlands. At that time, the USACE under Executive Order 11990 became responsible for wetland

protection in the United States. Regulation revisions now include consideration of coastal and freshwater wetlands. The USACE receives monitoring assistance from the USEPA, USFWS, National Marine Fisheries Service, and state agencies.

MDEQ works in conjunction with the USACE and the MDMR in proposed wetland alteration, §404 permitting, and administers the §401 Water Quality Certification Program which is the focus of wetland regulation and protection programs at the state level. It also evaluates proposals for their impact on wetlands, and may waive, issue with conditions, or deny a §401 certification. The federal §404 permit from the USACE is not issued until MDEQ gives a §401 certification. Although Mississippi administers the §401 certification program, it has no ambient monitoring program in place to determine whether the national goals are being attained. Currently, most states including Mississippi are not equipped to report on the integrity of their wetlands. Based on the current [inventory](#) of state and tribes who have a wetland plan in place, only 26 states and 19 tribes fulfill the four core elements needed for a full wetlands program; the limited amount of information available does not permit for National trend conclusions to be drawn. This will change as states begin to adopt wetland water quality standards and enhance their existing monitoring programs to more accurately assess designated use support in their wetlands (USEPA 2000).

In the summer of 2011, USEPA began the National Wetlands Condition Assessment. USEPA and the states worked with the USFWS to ensure that they effectively complemented the USFWS *Status and Trends* reports, which focused on the distribution of wetlands rather than their condition. Data and a final report for this cycle is available in the [National Wetland Condition Assessment 2011](#). A second phase of this assessment will begin in the near future.

In addition to assisting with this survey, MDEQ is developing monitoring plans that will allow for the evaluation of discharge from treated domestic wastewater to natural wetlands (as opposed to constructed wetlands) in Mississippi. These plans must be within the acceptable guidelines to the USEPA, and be consistent with applicable Mississippi water quality standards and regulations in downstream waters. Beginning with a set of demonstration projects, the monitoring plans will help in evaluating the discharge of treated domestic wastewater to Mississippi natural wetland systems. They will help to evaluate (1) the effect of this activity on the wetland system, (2) the overall performance of the wetland discharge system, and (3) compliance with water quality criteria in the downstream surface waters. The plans that are developed must provide sufficient data and information to assess all pertinent aspects of the demonstration projects. In addition, the plans must provide the necessary information to make future management decisions regarding this technology, and contribute valuable research for potential wetland water quality standards development.

Element 4: Core and Supplemental Indicators

To assess the overall health of water bodies and to address specific water quality questions, the SWMP utilizes a suite of indicators that may include physicochemical and/or biological

measures. Each indicator or parameter either measures a general or specific cause of pollution (i.e. nutrients, Dichloro-Diphenyl-Trichloroethane (DDT)) or measures a general or specific response to pollution (i.e., biological integrity, fish kills). The SWMP includes a core group of indicators that represents each applicable designated use of a water body (aquatic life support, contact recreation, fish consumption, shellfish consumption, and drinking water supply), and a supplemental group that is used on a site or project specific basis. These indicators include parameters for which numeric and/or narrative WQS criteria are established. Table 2 outlines the core group of indicators used in MDEQ's SWMP. While physicochemical parameter analyses may allow for the predictability of water quality condition(s), assessment based upon biological parameters allows for a measure of the effect(s). Mississippi uses macroinvertebrate assemblages as indicators of localized conditions due to limited migration patterns and the ability of macroinvertebrates to integrate the effects of short-term environmental changes with varying degrees of sensitivity.

The SWMP uses supplemental indicators collected by FSD for special studies to support MDEQ management and regulatory programs, and to address public interest needs. They address numerous water quality issues, and occur on an as-needed basis. Projects range from one-time limited parametric surveys to in-depth ecological assessments or synoptic surveys involving physical, chemical, bacteriological, biological, and/or fish tissue monitoring. Examples of special studies undertaken by FSD include:

- SI studies for biologically-impaired waters,
- Biological assessments for WLA/NRDA investigations below point source discharges and/or spills;
- Intensive surveys for TMDL modeling, NPS pollution monitoring before and after BMP implementation, and;
- Studies that involve specialized monitoring for public health/aquatic life concerns for specific pollutants such as dioxin, mercury, DDT, and bacteria.

Special studies include gathering water quality information in areas where data are limited or nonexistent, investigating known or suspected water quality problems below both point and nonpoint pollution sources, identifying or confirming stressors, and resolving public health issues. Indicators selected for use in these studies usually include a combination of both core and supplemental indicators.

Supplemental indicators are chosen based upon the identified impairment or problem, pollution sources potentially affecting the water body, historical data collected on the water body or facility, the type of water body, the designated use (i.e. aquatic life, contact recreation, etc.), time and resource limitations, laboratory capabilities, and staff expertise. Examples of supplemental indicators include Land Use/Land Cover, community metabolism (i.e. photosynthesis/respiration/sediment oxygen demand measurements), Biological Oxygen Demand Ultimate (BOD_u), sediment toxics, geomorphology, screening level rapid biological assessments, as well as other indicators utilized by other organizations that provide MDEQ data for use in assessments.

Table 2 Parameters for Major MDEQ Surface Water Monitoring Programs

Parameters		MBISQ Wadeable Streams	Wadeable Streams- Delta	Lakes and Reservoirs	Lakes Fish Tissue Monitoring	Fixed Station Monitoring	Coastal Beach Monitoring	Bacterial Monitoring	Coastal Assessment	Program Support ¹
General	Temperature	X	X	X	--	X	X	--	X	X
	pH	X	X	X	--	X	X	--	X	X
	Alkalinity	X	X	X	--	X	--	--	X	X
	Hardness	X	X	X	--	X	--	--	X	X
Oxygen Demand	Total Organic Carbon	X	X	X	--	X	X	--	X	X
	Biological Oxygen Demand	--	--	--	--	--	--	--	--	S
	Chemical Oxygen Demand	X	X	X	--	X	--	--	X	X
Dissolved Oxygen	Dissolved Oxygen	X	X	X	--	X	X	--	X	X
Water Clarity	Turbidity	X	X	X	--	X	X	--	X	X
	Total Suspended Solids	X	X	X	--	X	X	--	X	X
	Transparency	--	--	X	--	--	X	--	--	S
Dissolved Substances	Specific Conductance	X	X	X	--	X	X	--	X	X
	Total Dissolved Solids	X	X	X	--	X	X	--	X	X
	Salinity	S	--	X	--	S	X	--	X	S
	Chlorides	X	X	X	--	X	X	--	X	X
Nutrients	Nitrite + Nitrate	X	X	--	--	X	X	--	X	X
	TKN	X	X	X	--	X	X	--	X	X
	Ammonia	X	X	X	--	X	X	--	X	X
	Total Phosphorus	X	X	X	--	X	X	--	X	X
Toxics	Aluminum	--	--	S	--	X ²	--	--	--	--
	Arsenic	--	--	S	--	X ²	--	--	--	--
	Cadmium	--	--	S	--	X ²	--	--	--	--
	Chromium	--	--	S	--	X ³	--	--	--	--

Mississippi Surface Water Monitoring Program Strategy 2022-2025

	Parameters	MBISQ Wadeable Streams	Wadeable Streams-Delta	Lakes and Reservoirs	Lakes Fish Tissue Monitoring	Fixed Station Monitoring	Coastal Beach Monitoring	Bacterial Monitoring	Coastal Assessment	Program Support ¹
Toxics (cont.)	Copper	--	--	S	--	X ²	--	--	--	--
	Lead	--	--	S	--	X ²	--	--	--	--
	Manganese	--	--	S	--	X ²	--	--	--	--
	Mercury	--	--	S	--	X ²	--	--	--	--
	Nickel	--	--	S	--	X ²	--	--	--	--
	Selenium	--	--	S	S	X ²	--	--	--	--
	Zinc	--	--	S	--	X ²	--	--	--	--
	Phenols	--	--	S	--	X ²	--	--	--	--
Hydrological	Flow	X	X		--	--	--	--	--	--
Habitat	Habitat Assessment	X	X		--	--	--	--	X	--
	Sediment Particle Size	X	X		--	--	--	--	X	--
Pathogens	Fecal Coliform	--	--	S	--	--	X	X	--	S
	<i>Enterococci</i>	--	--	S	--	--	X	X	--	S ²
Pesticides	Hexachlorobenzene	--	--	S	X	--	--	--	--	S
	alpha BHC	--	--	S	X	--	--	--	--	S
	gamma BHC	--	--	S	X	--	--	--	--	S
	Aldrin	--	--	S	X	--	--	--	--	S
	Dieldrin	--	--	S	X	--	--	--	--	S
	Endrin	--	--	S	X	--	--	--	--	S
	Total DDT	--	--	S	X	--	--	--	--	S
	o,p-DDE	--	--	S	X	--	--	--	--	S
	p,p-DDE	--	--	S	X	--	--	--	--	S
	o,p-DDD	--	--	S	X	--	--	--	--	S
	p,p-DDD	--	--	S	X	--	--	--	--	S
	o,p-DDT	--	--	S	X	--	--	--	--	S
	p,p-DDT	--	--	S	X	--	--	--	--	S
	Toxaphene	--	--	S	X	--	--	--	--	S
	Methoxychlor	--	--	S	X	--	--	--	--	S
Total PCBs	--	--	S	X	--	--	--	--	S	
PCB 1221	--	--	S	X	--	--	--	--	S	
PCB 1232	--	--	S	X	--	--	--	--	S	

Mississippi Surface Water Monitoring Program Strategy 2022-2025

	Parameters	MBISQ Wadeable Streams	Wadeable Streams-Delta	Lakes and Reservoirs	Lakes Fish Tissue Monitoring	Fixed Station Monitoring	Coastal Beach Monitoring	Bacterial Monitoring	Coastal Assessment	Program Support ¹
Pesticides (cont.)	PCB 1248	--	--	S	X	--	--	--	--	S
	PCB 1254	--	--	S	X	--	--	--	--	S
	PCB 1260	--	--	S	X	--	--	--	--	S
	PCB 1262	--	--	S	X	--	--	--	--	S
	PCB 1016/1242	--	--	S	X	--	--	--	--	S
	Chlordane	--	--	S	X	--	--	--	--	S
	Pentachloro-phenol	--	--	S	X	--	--	--	--	S
	Arsenic	--	--	S	X	--	--	--	--	S
	Cadmium	--	--	S	X	--	--	--	--	S
	Chromium	--	--	S	X	--	--	--	--	S
	Copper	--	--	S	X	--	--	--	--	S
	Lead	--	--	S	X	--	--	--	--	S
Mercury	--	--	S	X	--	--	--	--	S	
Biological	Macro-invertebrates	X	X	--	--	--	--	--	X	S
Nutrient Response	Chlorophyll <i>a</i>	--	--	X	--	--	X	--	X	S
Objectives		ABCDEFGH		ABCEFGH					ABH	ACEF

Notes: X = core parameter S = supplemental parameter “--“= not applicable

¹ NPDES, permitting/compliance, Emergency Response, NPS, Basin Management, TMDL, WLA, WQS, and NRDA programs are project specific therefore the majority of the parameters are denoted as supplemental.

² CWIP collections are currently only addressing bacteria.

³ Fixed stations will be monitored for toxics quarterly. Quarterly toxics monitoring does not involve clean techniques.

Element 5: Quality Assurance

The ability to make meaningful and scientifically defensible statements about the condition of a water body depends directly on the quantity and quality of data collected, analyzed, and reported. It is imperative that the validity of the data is reliable and correct. This is necessary to demonstrate that all environmental data used for MDEQ management and regulatory purposes will be scientifically valid, defensible, and of known acceptable precision and accuracy. Data provided by other agencies, institutions, environmental groups, and individuals used by MDEQ for environmental decision-making must be of equal or better quality than MDEQ to make credible and realistic assessment decisions on the condition of the state's waters. Data needs to be of the highest quality and developed using Standard Operating Procedures (SOPs), and Quality Control (QC) recognized by state and USEPA Quality Assurance (QA) programs.

A strong quality assurance program is an absolute necessity for operation of an effective water quality monitoring program. Validation of data is the foundation of the entire analytical process, from the planning stages through sample collection, analysis, and dissemination of data. Emphasis on the importance of quality assurance and validity of results is crucial to all monitoring program activities undertaken or reviewed by the agency. All areas of environmental monitoring require rigorous adherence to the use of validated methods and repetitive quality control procedures.

The objectives of the QA/QC Program are:

- Structure the framework and design of SWMP activities so that MDEQ can minimize, isolate, and correct problems in either process or design that produce error and increase data variability and;
- Evaluate and report the quality of all data as well as the type and amount of uncertainty associated with the data.

Structuring the framework and design of SWMP activities includes the generation and implementation of Quality Assurance Project Plans (QAPPs) and Standard SOPs. QAPPs are developed, maintained, and reviewed to ensure the scientific defensibility of monitoring and laboratory activities, and to guarantee that the quality of all reported data is comprehensive and consistent. These plans outline the level of data quality that is appropriate for the specific uses of the data. USEPA Order 5360.1 requires USEPA-approved QAPPs for all projects and activities undertaken using USEPA funds that involve the collection and analysis of environmental data (40CFR 31.45). Although not required for routine state activities, Mississippi produces QAPPs for the scientific defensibility and quality assurance of each project. USEPA's *Requirements for Quality Assurance Project Plans* (USEPA 2001b) provides detailed guidance on how to write a QAPP. Topics include:

- Project Management,
- Data Generation and Acquisition,

- Assessment and Oversight, and;
- Data Validation and Usability.

In February 2018, MDEQ revised its *Quality Assurance Project Plan for the §106 Monitoring Network in the State Surface Water Monitoring and Assessment Program* (MDEQ 2018b). This QAPP presented the sampling, analytical, and quality control requirements for Mississippi's Surface Water Monitoring Programs conducted under §106 of the CWA. The QAPP requirements were designed to ensure that reproducible and defensible data were generated for use in water quality assessments, WQS development, TMDL development, §305(b) reporting, and §303(d) listings.

The essence of an effective quality assurance program is the routine and consistent use of rigorous SOPs. MDEQ has established an agency Quality Assurance Committee that oversees the development and implementation of MDEQ's Quality Management Plan (QMP). The QMP (MDEQ 2019) strives to ensure quality assurance/quality control consistently applies throughout the agency. For the SWMP, SOPs are developed, reviewed, and maintained for all data collection and analysis activities including field and laboratory procedures. These include the *Mississippi Department of Environmental Quality Master Standard Operating Procedures Compendium for Field Services* (Field Activities) (MDEQ 2020a) and *Mississippi Department of Environmental Quality Master Standard Operating Procedures Compendium for Field Services* (Analytical Services) (MDEQ 2018a). In general, all measurements are made by MDEQ using USEPA approved methods according to 40CFR 136. Samples are collected and analyzed within required holding times unless noted on reports and all proper sampling containers, preservation techniques, and transportation guidelines are employed.

Data quality evaluation involves establishing Data Quality Objectives (DQOs) that establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. MDEQ utilizes USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* – USEPA QA/G-4 (USEPA 2006) for development of project DQOs. This process fully meets all aspects of the USEPA Order 5360.1 A2, 2000, that establishes a Quality System for MDEQ and others funded by USEPA.

During the process, scrutinization occurs with each step of the monitoring and assessment quality control activities. Actions include:

- System and Performance Audits of Field and Laboratory Activities,
- Inspection and Calibration of Equipment,
- Duplicate and Repeat Sampling,
- Laboratory Blanks and Spiked Samples,
- Sorted Biological Sample Re-checks,
- Taxonomic Re-identifications, and;
- Data Entry and Analysis Rechecks.

The implementation of MDEQ's Quality Management System, as well as the development and use of QAPPs and SOPs, results in the generation of scientifically defensible data capable of supporting MDEQ management decisions.

Element 6: Data Management

The dissemination of accurate information is the most important objective of a monitoring program. To meet this need, MDEQ has designated OPC FSD's WQAB to serve as the clearinghouse for information on all MDEQ SWMP activities. In this capacity, the WQAB works with MDEQ's Data Integration Division (DID) to oversee the compilation of all SWMP data. They centralize these data and any associated reports for ready access, and facilitate data entry into and retrieval from MDEQ computer databases. The WQAB is currently working closely with DID to enhance and update the databases that houses all MDEQ surface water quality data. Having a central repository for monitoring data provides ready access to MDEQ staff, federal and state agencies, and the public. It also helps WQAB by providing a tool to facilitate water quality assessments, and to generate water quality summary reports. Two such reports are the state's §305(b) Water Quality Report to Congress (MDEQ 2020b), which involves the reporting and evaluation of all surface water monitoring data collected in the state and the §303(d) List of Impaired Water Bodies identified through the §305(b) assessment process.

Surface water monitoring forms capture the necessary information needed to facilitate accurate data entry of all physical, chemical, and biological data. Upon sample arrival at the OPC laboratory, staff initiate the sample login process by signing these forms and their accompanying chain-of-custody forms. OPC personnel keep copies of the original form as completed in the field. This data gets entered into the Laboratory Information Management System (LIMS); LIMS is a laboratory sample tracking software used to follow OPC laboratory samples from sample receipt, through sample handling, processing, and laboratory analyses. LIMS incorporates each analytical result as it is completed. After all analyses are completed and QA checks and validation documented, all field, lab and surface water data are then entered into enSPIRE or the Environmental Data Management System (EDMS). Listed below are the current tools available for data management.

- enSPIRE – permanent in-house MDEQ water quality storage and retrieval system for all SWMP data, developed in ORACLE and with data flow to USEPA's WQX;
- EDMS – application for storage, analyses and assessment of biological data;
- ADB – assessment database stores of assessment decisions,
- Assessment Surface Water Portal for Information and (ASPIRE) – Application that will eventually replace ADB.

MDEQ submits ambient water chemistry data from enSPIRE via the Central Data Exchange node to WQX on an annual basis. MDEQ continues to enhance enSPIRE as funding allows. When the enhancements are complete, it is the intent of MDEQ to continue to upload water chemistry/bacteria data to WQX, and to populate the database with

biological (e.g. benthic community) and fish tissue data. It is MDEQ's goal to add sediment chemistry, fish community, and habitat assessment (data that is already in the Water Assessment Data Entry system (WADES) and/or EDMS).

Data compatibility (formatting) and metadata deficiencies remain as data management issues. Continued refinement of MDEQ's biological database, EDMS, in the ORACLE integrated database system is necessary to allow better reporting and querying ability of MDEQ's biological data. Resolution of these data migration problems and refinement of the databases is ongoing (this component is also in Element 9). Other contributing factors such as the development of a unified consistent convention for monitoring station location code designation is an ongoing process; it is difficult to rename/update existing codes while generating new codes.

From 1965 until 1998, the STORage and RETrieval or STORET database was EPA's nationally consistent framework for water quality data management. As technology improved, Modern STORET allowed states to take advantage of new technological tools by providing a simpler method to upload data. Further enhancement occurred in 2009 when EPA developed a new simpler WQX framework for uploading data (Iowa's Water Ambient Monitoring Program 2001; Frequent Questions Water Quality Exchange (WQX) n.d.).

MDEQ's historical water chemistry and bacteria data from 1998-2009 can be obtained from the USEPA's [Water Quality Portal](#) or from MDEQ and are available upon request from the [public records officer](#). In 2010, MDEQ began to upload Mississippi data through [WQX](#). MDEQ water quality data are available directly from MDEQ and available electronically to USEPA, other state and federal agencies, and the public as needed for required reporting and on an individual request basis.

Storage of water quality assessment information utilized in §305(b) and §303(d) reporting is accomplished in MDEQ's version of the ADB system from which data are then uploaded bi-annually to the USEPA National Assessment Database for national reporting. These data include information on individual water body use support, the types of data used in assessment, causes and sources of impairment as applicable, and geographical indexing information on the water body segment or assessment unit as defined using the 1:100,000 NHD. The ADB is scheduled to be replaced by the next assessment reporting cycle.

Element 7: Data Analysis/Assessment

Surface water quality data analyses and assessments are technical reviews of physical, chemical, bacteriological, and/or biological monitoring data, as well as other information that determine the quality of surface water resources. Analysis and assessment of surface water quality in Mississippi happens through comparison of surface water monitoring data and information. It establishes biological reference conditions, and chemical, physical, and bacteriological water quality criteria for Mississippi waters. The CWA, §305(b) requires each state to describe the quality of their water resources in a report for the USEPA,

Congress, and the public on a biennial basis. The MDEQ, as the lead agency for environmental protection in Mississippi, is the state agency responsible for generating this report. The §305(b) water quality assessment process is designed to determine whether water quality conditions in water bodies are either Attaining their designated use(s); or Not Attaining their designated use(s).

All data, in keeping with the requirements and guidelines contained herein, regardless of its source, undergoes evaluation and is put to use in making formal assessments of the quality of the state’s waters. Monitoring data and information used when assessing state waters may include chemical, physical, bacteriological, toxicological, and/or biological (e.g., macroinvertebrate, fish, and algal community measurements) data. In addition to using MDEQ-generated data, MDEQ solicits and considers all readily available data and information within the assessment window collected by other Federal, State, local agencies/organizations, and the public. MDEQ’s Basin Management Approach facilitates the data solicitation effort.

The water quality assessment process begins with the collection and compilation of the available data followed by the analysis of water quality data and information to determine the quality of the state’s surface water resources. Mississippi’s surface waters function in various ways; uses include drinking water, food processing, shell fishing, recreation, fishing, and aquatic life support. Water bodies are designated and assigned various use classifications by MDEQ in the state’s Water Quality Standards ([11 Miss. Admin. Code Pt. 6, Ch. 2](#)) (Table 3). Designation is dependent on the use(s) of the water body as identified by the public and other entities. The use classifications and associated USEPA designated uses for water quality assessment purposes recognized by the State of Mississippi are as follows:

Table 3 Surface Water Use Classification

Use Classification	USEPA Associated Designated Use
Public Water Supply	Drinking Water Supply
Recreation	Contact Recreation
Fish and Wildlife	Aquatic Life Use, Fish Consumption, Secondary Contact Recreation
Shellfish Harvesting	Shellfish Consumption
Ephemeral	None

Most of Mississippi’s waters fall into the Fish and Wildlife classification, but there are other designations to consider as well. Designations come about based on the use(s) of the water body as identified by MDEQ, the public, and other entities. A complete description of the Mississippi’s water body use classifications and water quality standards can be found in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ 2007).

Mississippi’s WQS specify the appropriate levels for which various water quality parameters or indicators support a water body’s designated use(s). Each use assessed for a

water body is determined to be either “Attaining” or “Not Attaining” in accordance with the applicable water quality standards and EPA guidelines for assessments pursuant to §305(b).

After assessing attainment status of the water body’s designated use(s), each water body is set into an assessment unit that defines the length of the reach assessed and is placed into one of five assessment categories as per EPA guidance. These categories are shown in Table 4.

Table 4 Assessment Categories

Assessment Categories	Definitions of Categories
1	Attaining all uses
2	Attaining some uses but there is insufficient data to determine if remaining designated uses are met
3	Insufficient data to determine whether any designated uses are met
4	Not attaining a use but a TMDL is not needed
4A	TMDL has been completed
4B	other required control measures will result in attainment of WQS
4C	impairment or threat not caused by a pollutant
5	Not attaining a use and a TMDL is needed

Where data and information of appropriate quality and quantity indicate non-attainment of a designated use or uses and a Total Maximum Daily Load (TMDL) is needed for an assessed water body (Category 5), the water body pollutant combination will be placed on Mississippi’s 2016 §303(d) List of Impaired Water Bodies.

Consolidated Assessment and Listing Methodology (CALM)

Within the water quality assessment process, a certain degree of uncertainty is inherent with any assessment decision. The accuracy of data analysis is directly dependent on study design, data quantity, data quality, and the accuracy and rigor of the methods used in collection, laboratory analysis, and the assessment methodology process itself. Data generated by MDEQ, other agencies, and individuals should be of the quality necessary to make credible and realistic assessment decisions on the condition of the state’s waters. To achieve the goals of the CWA, and specifically §305(b) assessment and §303(d) listing, it is necessary to have requirements and guidelines for how water quality data are collected, analyzed, and assessed. A consistent and scientifically defensible assessment methodology provides the mechanism to enable and support sound decision-making. USEPA has developed, with state and public input, a national guidance document for the §305(b) assessment and §303(d) listing process. This *Consolidated Assessment and Listing*

Methodology toward a Compendium of Best Practices (USEPA 2002) document provides a framework for states to record and report how they collect and use water quality data and information for their §305(b) reporting and §303(d) listing process. Beginning in 2002, MDEQ began developing and distributing a Mississippi CALM document for each §305(b) assessment and §303(d) listing cycle. The purpose of this document is to specify MDEQ's data requirements and assessment guidelines used for the applicable §305(b) assessment and §303(d) listing cycle. The most recent document, entitled *Mississippi CALM (Consolidated Assessment and Listing Methodology) 2020 Assessment and Listing Cycle* (MDEQ 2020c), is [here](#).

Data are required to be of a specified quality, and are collected, using established sampling and analytical protocols and SOPs recognized by the state and USEPA QA program plans. MDEQ utilizes these guidelines for data quality, data quantity, and data assessment in the §305(b) assessment and §303(d) listing process. These guidelines are appropriate to rivers, streams, lakes, and the coastal waters of Mississippi.

Element 8: Reporting

MDEQ's primary reporting mechanism for SWMP data is through the §305(b) Water Quality Assessment Report. All MDEQ SWMP data, as well as data solicited from and provided by other agencies, institutions, and private entities that conduct monitoring in the state, are considered for assessment. The §305(b) Report is required of each state by §305(b) of the CWA on a biennial basis. MDEQ's most recent report, *State of Mississippi Water Quality Assessment 2020 Section 305(b) Report* (MDEQ 2020b) is available to the public via MDEQ at [2020 MS §305\(b\) report](#). In addition to the §305(b) Report, MDEQ provides a list of all impaired water bodies where TMDLs have not been completed pursuant to §303(d) of the CWA. The §303(d) List of Impaired Waters identifies the pollutant causing the impairment in a water body, when known. If the impairment is unknown, a stressor(s) identification process begins to identify the cause; if appropriate, the water body is included to the list. Dependent on identification results, the state assigns a priority for development of a TMDL based on the severity of the pollution and the sensitivity of the uses to be made of the waters. Once a water body is included on the state's list of impaired waters, it stays there until the state has developed a TMDL and EPA approves it. When the TMDL has been completed or monitoring data show that the water body is no longer impaired, the water body is taken off the §303(d) list. Mississippi's §303(d) List is also available [here](#).

Since 2002, MDEQ has been moving closer towards integrated §305(b)/§303(d) reporting as recommended by USEPA in their guidance document, *2002 Integrated Water Quality Monitoring and Assessment Report Guidance* (USEPA 2001a). MDEQ will continue to support consistency in the development and submission of §305(b) reports and §303(d) Lists.

MDEQ also reports on SWMP activities and water quality issues through various other USEPA required reports. These include annual reporting of monitoring activities and

individual projects for various USEPA CWA grants, i.e. §106(e), §205(j), §319, §406(b), and surface water programs (i.e. WQS, TMDL, NPDES, NPS, Basin Approach, Ambient Monitoring, etc.). Data reporting is provided in project/program-specific technical reports, brochures, posters, oral presentation, newspaper articles, MDEQ's website and via data upload to national databases (i.e. USEPA's WQX) and occurs for the purpose of stakeholder outreach, education, public information, and to meet other federal grant and/or state legislative requirements. Mississippi transfers its data and information regarding its recreational beach closure notifications to the USEPA BEACH (Beaches Environmental Assessment and Coastal Health) Beach Advisory and Closing Online Notification (BEACON) system to meet the Agency's requirement to provide and to the public a database of pollution occurrences for coastal recreation waters. In addition, MDEQ responds to direct individual requests from phone, web, or personal inquiries for water quality data and information.

Element 9: Program Evaluation

Continuous evaluation of the effectiveness of the surface water monitoring strategy in meeting its design objectives is an iterative process. MDEQ encourages and actively conducts periodic evaluation of its monitoring programs, not only through participation with USEPA Region 4 in annual state mid-year reviews of the water program, but also with external and internal sources. As part of the state Fiscal Year Water Pollution Control Program Assistance Agreement with USEPA, the state and USEPA develop annual water program work plans setting the mutual state/USEPA agenda for the state's water pollution programs and environmental yearly goals. The work plan outlines the specific commitments and milestones of MDEQ. Mid-year/end-of-year reviews done by USEPA also evaluate the completion status of each commitment. Water quality monitoring is one of the program elements, and the evaluation includes status reviews of the agency's surface water monitoring strategy, §305(b) reporting, QA/QC program, SOP development, WQX data submittal, funding/resource constraints, and changing/new priorities or emerging problems.

This SWMP strategy provides a mechanism to outline the state's monitoring and assessment program and summarizes the results of the programmatic evaluation in determining how well MDEQ is adhering to each of the ten elements of USEPA's State Monitoring and Assessment Program. This strategy review also helps to substantiate changes or modifications that may be necessary to assimilate, and defines how they are incorporated into future monitoring cycles. It also helps to identify resource needs for the state to accomplish monitoring and assessment goals. Every three years, the monitoring strategy undergoes a full revision. The goal is for MDEQ is to implement a comprehensive monitoring program by 2025 that addresses all recommendations outlined in the *Elements of a State Water Monitoring and Assessment Program* (USEPA 2003) guidance pending adequate resources. Meeting this goal is subject to available state and federal budget constraints coupled with staffing availability and accessibility.

To address state monitoring and surface water quality management needs, MDEQ has and will continue to form Technical Advisory Groups (TAGs). TAGs will consist of members

from academia, other state and federal agencies, as well as local stakeholders. Their purpose will be to assist MDEQ with study plan and methodology development, and to participate in the decision-making process that will determine future activities for various special and/or high priority projects. Some TAG's currently working with MDEQ include the Mississippi Fish Tissue Advisory Task Force, the Mississippi Beach Monitoring Task Force, and the Mississippi Nutrient Task Force. Each TAG is composed of representatives that have expertise in the subject matter of concern. As projects progress, TAGs solicit assistance from experts to aid in the development of a project. Feedback from the TAGs is necessary for future modifications and refinement of MDEQ SWMP activities.

Internal feedback and annual workload planning is also done within MDEQ between OPC FSD and the other OPC programs that are supported by SWMP activities. Directives from these programs steer and guide SWMP priorities and workloads and may result in changes in methodology. As an example, the evolution of §305(b) assessment and §303(d) listing process provided the impetus to develop new SWMP biological monitoring and assessment tools, more stringent QA/QC procedures, improved data migration, and increased bacteria sampling frequency to meet increasingly rigorous data sufficiency needs for assessment purposes.

Another necessary component of Mississippi's Surface Water Monitoring strategy process is the development and incorporation of DQOs that are project specific and vary based upon project requirements. DQOs are necessary to delineate and clarify study objectives, define the appropriate type of data needed, and specify tolerable levels of potential decision errors that employ the basis for establishing the quality and quantity of data needed to support decisions. This process insures that the data collected for the characterization of environmental processes and conditions are of the appropriate type and quality for their intended use and defined expectations. The DQO process utilizes systematic planning that incorporates the scientific method that includes concepts of objectivity of approach and acceptability of results. The development of DQOs is a seven-step iterative approach using systematic planning and statistical hypothesis testing to differentiate between two or more clearly defined alternatives as established by USEPA for all USEPA organizations and those organizations funded by USEPA.

Program Accomplishments

Results of the evaluation process for the SWMPs in recent years have revealed both significant accomplishments and areas/data issues needing improvement. Recent accomplishments by MDEQ in the surface water monitoring program as indicated from MDEQ internal reviews are as follows:

- MDEQ recalibrated the MBISQ, a state-specific adaptation of an Index of Biotic Integrity (IBI) for wadeable streams in 2016.
- MDEQ initiated work efforts using multi-agency workgroups to develop appropriate biological monitoring and assessment methodologies for addressing complex water bodies in wadeable streams within the Mississippi Alluvial Plain.
- MDEQ made significant progress toward developing nutrient criteria for Mississippi lakes, estuaries, and streams through the formation of a multi-agency task force and initiation of intensive monitoring programs for these waters to fill data gaps. These monitoring programs are complete and data analysis is underway.
- MDEQ conducted extensive SWMP monitoring activities in Mississippi waters that increase monitoring coverage, filled data gaps, and added additional support to USEPA and the state's water quality programs. These activities include work on the Coastal Beach Monitoring Network, Fish Tissue Monitoring Program for mercury and pesticides, numerous site-specific intensive surveys for TMDL/WLA studies, §303(d) confirmation, NPS project monitoring, evaluation of ephemeral stream classification, SI cation analyses, NRDA activities, and continued MBISQ monitoring.
- MDEQ initiated the MCA network in 2008 as a successor to the USEPA NCA program. This monitoring provides annual probabilistic monitoring data for status and trends assessment. In addition to the probabilistic component, MDEQ also monitors a set of static sites within the network for status and trends information.
- MDEQ re-established ambient lakes monitoring in 2009.
- MDEQ dedicated considerable resources to improving QA/QC throughout its monitoring programs and projects. QAPPs developed and submitted by MDEQ to USEPA for approval continue to get positive comments. MDEQ's commitment to this critical component of monitoring helps ensure that state data analysis and assessment decisions are defensible.
- MDEQ continues to meet CWA regulatory reporting commitments required by USEPA. This is supported by the SWMP through submission of the §305(b) Report, §303(d) List, the Surface Water Monitoring Strategy, Beach Monitoring data collection and Beach Closure notifications. In addition MDEQ, and has begun an upgrade to the MDEQ SWMP database.
- MDEQ developed the Mississippi Coastal Benthic Index MCBI as an IBI for coastal waters.

- MDEQ developed the Mississippi Delta Benthic Index MDBI as an IBI that specifically addresses Mississippi Alluvial Plain waters.
- MDEQ developed an in house EDMS.
- MDEQ developed an in house ASPIRE.
- MDEQ created a Coastal Monitoring Branch on October 2015 to address the greatly expanding monitoring activities within coastal waters. Programs include but are not limited to water quality monitoring to support oyster reef fisheries/water quality modeling efforts funded by NFWF, identification of trouble areas and microbial source tracking for high bacteria counts adversely affecting coastal watersheds, and monitoring after infrastructure repairs/improvements to track improvements to water quality.
- MDEQ completed the addition of a Coastal Monitoring Laboratory in April 2021. This laboratory is located in the Bolton Building in Biloxi, MS. It will house the Coastal Monitoring Branch who will be responsible for analyzing all beach monitoring and CWQIP samples
- MDEQ along with MDMR initiated work on a Strategic Plan for Harmful Algal Blooms Monitoring and Health Advisory Notification. The plan is still undergoing development.

Recommended Improvements

Requirements of a comprehensive monitoring strategy include identification of problem areas and data gaps that need addressing for the strategy to better serve the agency's water quality decision needs. Four basic issues that have a direct impact on the degree of problems and data gaps in the SWMP are:

- The workload and complexity of monitoring and assessment projects and activities,
- The available personnel resources devoted to the monitoring and assessment activities,
- The priorities and management barriers that dictate how resources are applied to the wide variety of monitoring needs, and;
- The available financial resources devoted to monitoring and assessment activities.

Resolution of the issues listed below are attainable with adequate budget, resources, sound planning, and effective management of the available resources. Some areas of the SWMP identified as needing improvement are:

- The routine statewide fixed network component of the SWMP re-instituted in 2006 is a subset of the historical monitoring locations. This element continues to evolve and expand but is limited by budgetary and staffing constraints.
- To have a functioning index of biotic integrity for the MS Alluvial Plain (DBISQ)

- Presently, only a small percentage of the state's water resources are being assessed for §305(b) reporting. This low percentage of assessed waters is not a fair depiction of the amount of effort and resources expended by MDEQ to monitor the state's surface water resources. It is more a result of limited resources (money and labor) to cover the quantity of surface waters in the state. There is an unfulfilled need for adequate monitoring and assessment approaches to address all waters to achieve USEPA's goal of comprehensive assessment. The implementation of new monitoring design strategies (e.g. probabilistic surveys) in addition to targeted designs would help to achieve comprehensive coverage of Mississippi's surface waters. Currently, the demand for targeted approaches to meet specific program needs outweigh the need for more probabilistic designs. Therefore, all available monitoring capacity is devoted to meeting Surface Water Program needs.
- A mechanism for incorporating additional sampling of biologically impaired water bodies for use with the SI process is necessary. Water bodies identified as needing more information based on the compelling evidence data review as part of the §305(b) assessment process (but that do not meet CALM data sufficiency requirements) also need monitoring.
- Currently, some SWMP components (fixed station monitoring, NPS project monitoring, nutrient reduction project monitoring, intensive surveys, etc.) have data collection activities that do not completely meet CALM requirements. As a result, some data are not used in the §305(b) process from these activities. Modification of these monitoring activities could provide a better mesh with CALM requirements and decrease/eliminate the current inability to use these data for §305(b) and assessment purposes. This would also provide maximum efficiency in utilization of SWMP monitoring resources to meet varying needs.
- Data management problems (data compatibility and metadata deficiencies) exist between the state's integrated surface water ORACLE database system ADB, enSPIRE and LIMS. Continued refinement of MDEQ's biological database EDMS, and assessment's ASPIRE, needs to occur to allow for better reporting and querying ability of MDEQ data. In addition, database solutions should be developed for tracking TMDL and §303(d) listings.
- Constant pursual of future database replacements must continue to improve flow of assessment data internally as well as to EPA's ATTAINS.
- Continued enhancement of the enSPIRE system is a requirement to address project planning needs, electronic data assessment support, and electronic capture of field data/measurements. Resolution of these issues is essential to eliminate limitations to data sharing, reporting, and data analysis capabilities. The planned enhancements to the surface water database should alleviate some of these problems.
- As indicated in Element 1, MDEQ needs to expand its SWMP to include a component for wetlands.

Element 10: General Support and Infrastructure Planning

General Support

The MDEQ OPC Laboratory and the Coastal Monitoring Laboratory provide laboratory support for the SWMP. Under the supervision of the OPC FSD, the labs perform a wide array of water quality analyses including nutrients, minerals, demands, trace metals, pesticide residue, volatile and semi-volatile organics, microbiological testing, and biological determinations. Chemists perform analyses on a variety of sample matrices, including water, wastewater, leachate, soil, sediment, chemical wastes, and fish tissue.

Biological determinations routinely performed by the laboratory staff include sampling and analyses of fish tissue and benthic macroinvertebrate community. Analyses of the structure and function of the benthic community help to evaluate water quality conditions. The lab staff prepares and analyzes fish tissue samples for the presence of pesticides and heavy metals. The lab also analyzes and phytoplankton for Chlorophyll *a* to estimate algal productivity.

Chemical Laboratory instruments include Inductively Coupled Plasma - Mass Spectrometry, Direct Mercury Analyzer, Cold Vapor Mercury Analyzer (low level), 1 Gas Chromatograph/Electron Capture Detector, four Gas Chromatographs/Mass Spectrometers, one Gas Chromatograph/Triple Quadrupole Mass Spectrometer, Gel Permeation Chromatograph, Accelerated Solvent Extractor, three Flow Injection Auto Analyzers, and a Total Organic Carbon Analyzer. The microbiology lab located in Biloxi has recently added a quantitative polymerase chain reaction instrument to its inventory. Both labs have improved data handling and information technology capabilities by installing LIMS.

All the FSD locations connect to each other and to MDEQ main offices in Jackson via a Wide Area Network.

Infrastructure Planning

MDEQ endeavors to identify current and future monitoring needs, as well as, accurately determine the resources necessary to accomplish monitoring. This happens through workload planning meetings and periodic comprehensive surface water program staffing needs analyses. In these efforts, needs are identified for staff level of effort (planning, data collection, analysis, data management, assessment, QA/QC, and training), necessary funding, and laboratory resources to support all SWMP monitoring activities. MDEQ places a high priority on training, both technical and personnel development, and actively supports travel to scientific meetings, virtual meeting, training courses, and workshops (subject to budget limitations). In addition, training opportunities are available within MDEQ from internal staff as well as from outside vendors to provide relevant training for needs pertinent to MDEQ activities and professional development.

Funding has been and will continue to be a major factor limiting MDEQ from fully accomplishing all elements within this SWMP and all of the associated monitoring.

Insufficient funding hinders retention and hiring of qualified staff and prohibits the creation of new positions to handle the ever-increasing workload. In recent years, state funding has steadily decreased, and current federal funding is decreasing as well. Budget limitations causing reduced hiring capabilities are a pervasive issue, especially within FSD. At this time, the biology portion of the FSD Laboratory is three full-time positions short. In addition, considering the increased workload within WQAB coupled with increased data management and reporting requirements, this group within FSD needs at least six FTEs just to continue functioning at the current workload. With increased staffing needs caused by amplified workload demands for present and future SWMP monitoring activities, creative funding options, and incentives to hire and retain technical staff is crucial. Reduced funding also severely restricts equipment purchases and the ability of staff to travel to scientific meetings and training sessions. These are the primary cost-saving measures used during times of serious budget shortfalls. While MDEQ monitoring and analytical equipment is generally adequate to meet current needs there is a growing concern that vital instruments are becoming obsolete, and too expensive to maintain. These instruments will be difficult to replace under budget restrictions, and this will begin to affect the quality of data.

Due in part to limited resources, MDEQ has identified other government agencies and institutions throughout the state that perform monitoring activities (see the list given in the *Data Acquisition/Sharing with Other Monitoring Agencies* (page 24) section of this document). This interagency cooperation helps to maximize efficiency and agency resource utilization in monitoring of the state's water resources. As cooperators in MDEQ's Basin Approach, these agencies serve on Mississippi Basin Approach teams, which often involves the allocation of resources from one or more state or federal agencies to resolve an issue of importance. MDEQ has also developed a strong relationship with state colleges and universities and sometimes contracts with these entities for assistance. Information and monitoring data provided by these organizations supplement MDEQ data and help MDEQ achieve objectives of this SWMP strategy.

Interstate cooperation, when feasible, is also encouraged by MDEQ's upper management. MDEQ frequently collaborates with the Alabama Department of Environmental Management, TVA, the Florida Department of Environmental Protection, and the GOMA on studies or programs that mutually benefit all the concerned parties.

MDEQ is spending a significant amount of time and effort on water quality monitoring. However, a substantial funding gap will exist if MDEQ is to fulfill USEPA requirements and guidance. A workload assessment identifies the need for approximately 50 Full Time Employees (FTEs) in FSD devoted to field monitoring activities alone to support increased monitoring needs. The existing resources available are vastly inadequate to achieve the desired workload objectives. Table 5 lists the additional monitoring initiatives that should be pursued with associated fiscal expenditures and resource needs. These initiatives, resources and monies are *in addition to* currently ongoing and funded monitoring efforts. Furthermore, given the condition of the state's budget, these initiatives cannot be undertaken unless USEPA makes a long-term commitment to their funding.

Table 5 Estimated Additional Annual Funding Needs

Program	FTE Needs¹	Funding Needs²	Effect of Not Funding
WLA Verification/Model Calibration Studies	0.50	\$59,028,48	Monitoring is required to continue support of WLA and Model Calibration studies on an as needed basis for Standards, Modeling and TMDL Branch.
Monitoring to Support Stressor Identification Studies	0.17	\$19,676.16	Program will not become operational unless additional staff are hired. Monitoring needed to fill data gaps for identification of stressors for biologically impaired waters.
Monitoring to Conduct §305(b)/CALM Monitoring List Status Confirmation	4.00	\$944,455.68	Program will not become operational unless additional staff are hired. Necessary to meet CALM recommendation for additional monitoring to confirm/verify potential impairment of waters from compelling evidence review. Monitoring possibly accomplished if part of basin network if restored.
Mississippi Alluvial Plain (Delta) IBI (Program Support)	3.00	\$1,062,521.64	Necessary to continue progress towards development of biological monitoring program for delta streams.
Ambient Monitoring (MBISQ and Program Support)	15.00	\$13,281,408.00	Necessary to continue progress towards development of biological monitoring program for MS streams (targeted design and index maintenance and recalibration).
Addition of Probabilistic Design to MBISQ Program	2.25	\$1,195,326.72	Necessary to collect data that needed to assess 100% of the non-Delta wadeable stream resource for the state.
Macroinvertebrate Taxonomy	4.00	\$944,455.68	Necessary to support ambient monitoring, MBISQ and other programs
Ambient Estuarine Monitoring	4.00	\$944,455.68	Program due for restoration in 2005 further delayed.
Probabilistic Design for Non-wadeable Streams and Rivers	1.50	\$177,085.44	Necessary to collect data that can be used to assess 100% of the non-wadeable stream/river resource for the state
Bacteriological Monitoring for lakes and Reservoirs	3.00	\$531,256.32	Necessary to implement recreational monitoring for lakes and reservoirs designated as primary contact recreational waters (especially those with public bathing beaches).

Table 5 (cont.) Estimated Additional Annual Funding Needs

Program	FTE Needs¹	Funding Needs²	Effect of Not Funding
Wetlands Monitoring	1.00	\$236,113.92	A wetland monitoring component cannot be developed for MDEQ's SWMP until a substantial amount of additional long-term funding is received.
Staff to Support Assessment and Data Management/Reporting	6.00	\$2,125,025.28	Staff need to adequately support current workload
Ambient Fish Program	3.00	\$1,062,612.64	Program is limited to 20 sites statewide per year due to limited work force.
Ambient Lakes	3.00	\$1,062,612.64	Necessary to support ambient lake program
Total	50.42		\$23,645,825.28

¹Includes field, laboratory and analytical personnel necessary to complete program

²Includes salaries, training, travel, equipment, and laboratory analysis

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Appendix A

Contained within Appendix A are tables outlining all of MDEQ's current ambient and program support monitoring efforts, frequency and duration of monitoring under each component, and maximum capacity currently available under existing staffing and funding constrictions. Table A-1 provides a timeline for the monitoring efforts scheduled for CY 2022-25. Completion of all the monitoring components is dependent on staffing levels and availability of funding.

Please note, the number of sites scheduled for monitoring per program does not reflect the additional data collection needed to meet QA/QC protocols of a QAPP. Replicate and duplicate sample requirements generally require an additional sampling at 10% of the sites. In addition, the annual monitoring activities outlined above represent all monitoring scheduled for MDEQ not just those programs that are funded using federal §106 grant funds. State funding pays for the majority of the monitoring.

TableA-1. Surface Water Monitoring Program Summary

Program	Schedule	J	F	M	A	M	J	J	A	S	O	N	D
<i>Ambient Monitoring**</i>													
Wadeable Streams (MBISQ) - Non Delta	Approximately 100 targeted sites in perennial streams sampled annually												
Wadeable Streams – Delta	Approximately 25-30 targeted sites on wadeable streams within Delta basin												
Lakes and Reservoirs	Approximately 30 publicly owned lakes > 100 acres will be selected for sampling during a two year period												
Fish Contaminants	Delta: 25 sites per year until threshold met Ambient: approximately 20 selected sites per year.												
Fixed Station Monitoring	Approximately 37 targeted historical network sites (10+ per regional office)												
Coastal Beach Monitoring	Total of 21 beach monitoring stations: stations sampled												
Bacteria Monitoring	Approximately 51 sites on Primary Contact Recreation waters sampled annually during contact (May-October) and non-contact (November-April) seasons in accordance with Mississippi’s WQS.												
Coastal Assessment	Approximately 25 probabilistic sites + 12 static sites sampled annually July through September; total of 125 sites will be sampled after 5-year monitoring cycle												

Mississippi Surface Water Monitoring Program Strategy 2022-2025

<i>Program Support Monitoring Activities</i>													
TMDL	Number of sites will vary year to year. Sampling is generally intensive in nature and is completed based on priority and available resources.												
WLA	Studies to be completed annually based on priority and available resources; each study may have multiple sampling locations												
Water Quality Criteria Development	Sampling is dependent on project requirements, may take place during any time of the year, and available resources												
Pollutants of Special Concern Monitoring	Sampling is dependent on project requirements, may take place during any time of the year, and available resources												
Natural Resource Damage Assessment	Sampling routine designed on case-by-case basis												
Coastal Water Quality Improvement Program	Sampling routine designed on case-by-case basis												

**All programs and consequently the number of sites done for each program are dependent on available resources and funding. In addition, the number of sites does not include the sampling requirements to meet QA/QC protocols (QA occurs at 10% of the sites are scheduled for QA sampling).

* NOTE: The monitoring programs listed above represent all MDEQ monitoring activities, not only those programs that are funded using §106 program grant funds. Most of monitoring activities listed above are funded using state funds

Table A- 2: Potential Lake and Reservoir Sampling Sites

Sample Name	Location Type	County	HUC	Hydroname
Sardis Lake	Large Reservoir	Panola	08030201	Little Tallahatchie River Above Sardis Dam
Ross Barnett Reservoir	Large Reservoir	Madison, Rankin	03180002	Pearl River Above Strong River
Grenada Lake	Large Reservoir	Grenada	08030205	Yalobusha River Above Grenada Dam
Enid Lake	Large Reservoir	Yalobusha	08030203	Yocona River Above Enid Dam
Arkabutla Lake	Large Reservoir	Tate, Desoto	08030204	Coldwater River Below Arkabutla Dam
Columbus Lake	Reservoir	Lowndes	03160101	Upper Tombigbee River
Bay Springs Lake	Large Reservoir	Prentiss, Tishomingo	03160101	Upper Tombigbee River
Pickwick Lake (MS Portion is 4453)	Large Reservoir	Tishomingo	03160101	Upper Tombigbee River
Eagle Lake	Oxbow	Warren	08030209	Deer Creek - Steele Bayou
Okatibbee Lake	Large Reservoir	Lauderdale	03170001	Chunky River-Okatibbee Creek
Aberdeen Lake (Tenn-Tom Waterway)	Reservoir	Monroe	03160101	Upper Tombigbee River
Tunica Cutoff	Oxbow	Tunica	08020100	MS River Above Lake Beulah
Lake Washington	Oxbow	Washington	08030209	Deer Creek - Steele Bayou
Lake Mary	Oxbow	Wilkinson	08060206	Buffalo River
Moon Lake	Oxbow	Coahoma	08030204	Coldwater River Below Arkabutla Dam
Hard Cash Lake	Oxbow	Humphreys	08030206	Upper Yazoo River
Pool B (Tenn-Tom Waterway)	Reservoir	Monroe, Itawamba	03160101	Upper Tombigbee River
Pool D (Tenn-Tom Waterway)	Reservoir	Itawamba	03160101	Upper Tombigbee River
Lake Lee	Oxbow	Washington	08030100	MS River Above Vicksburg
Lake Ferguson	Oxbow	Washington	08030100	MS River Above Vicksburg
Desoto Lake	Oxbow	Coahoma	08020100	MS River Above Lake Beulah

Mississippi Surface Water Monitoring Program Strategy 2022-2025

Sample Name	Location Type	County	HUC	Hydroname
Bee Lake	Oxbow	Holmes	08030206	Upper Yazoo River
Pool C (Tenn Tom Waterway)	Reservoir	Itawamba	03160101	Upper Tombigbee River
Horn Lake	Oxbow	Desoto	08010211	Horn Lake Creek
Lake Bolivar	Oxbow	Bolivar	08030209	Deer Creek - Steele Bayou
Wolf Lake/Broad Lake	Oxbow	Yazoo, Humphreys	08030206	Upper Yazoo River
Lake Bogue Homo	Reservoir	Jones	03170005	Lower Leaf River
Lake Beulah	Oxbow	Bolivar	08020100	MS River Above Lake Beulah
Dalewood Shore Lake	Reservoir	Lauderdale	03160202	Sucarnoochee River
Bluff Lake	Reservoir	Noxubee	03160108	Noxubee River
Lake Whittington	Oxbow	Bolivar	08030100	MS River Above Vicksburg
Lake Chotard	Oxbow	Warren, Issaquena	08030100	MS River Above Vicksburg
Roebuck Lake	Oxbow	Leflore	08030206	Upper Yazoo River
Horseshoe Lake	Oxbow	Holmes	08030206	Upper Yazoo River
Pool E (Tenn-Tom Waterway)	Reservoir	Prentiss	03160101	Upper Tombigbee River
Buzzard Bayou Lake	Oxbow	Tallahatchie	08030202	Tallahatchie River
Pool A (Tenn-Tom Waterway)	Reservoir	Monroe	03160101	Upper Tombigbee River
Flint Creek Reservoir	Reservoir	Stone	03170007	Black And Red Creeks
Little Black Creek Reservoir (Little Black Creek Water Park)	Reservoir	Lamar	03170007	Black And Red Creeks
Wasp Lake	Oxbow	Humphreys	08030206	Upper Yazoo River
Tchula Lake	Oxbow	Holmes	08030206	Upper Yazoo River
Archusa Creek Water Park	Reservoir	Clarke	06030005	Yellow Creek
Aliceville Lake (Tenn-Tom Waterway)	Reservoir	Noxubee	03160106	Middle Tombigbee River
Loakfoma Lake	Reservoir	Noxubee	03160108	Noxubee River
Swan Lake	Oxbow	Coahoma	08030207	Bogue Phalia River

Mississippi Surface Water Monitoring Program Strategy 2022-2025

Sample Name	Location Type	County	HUC	Hydroname
Flower Lake	Oxbow	Tunica	08020100	MS River Above Lake Beulah
Beaverdam Lake	Oxbow	Tunica	08030204	Coldwater River Below Arkabutla Dam
Maynor Creek Water Park	Reservoir	Wayne	03170002	Upper Chickasawhay River
Dump Lake	Oxbow	Yazoo	08030206	Upper Yazoo River
Gilliard Lake	Lake	Wilkinson	08060205	Homochitto River
Oktibbeha County Lake	Reservoir	Oktibbeha	03160104	Tibbee River
Sky Lake	Oxbow	Humphreys	08030206	Upper Yazoo River
Horseshoe Lake (Stovall Lake)	Oxbow	Coahoma	08030207	Bogue Phalia River
Grassy Lake	Oxbow	Tallahatchie	08030202	Tallahatchie River
Flatland Lake	Lake	Jefferson	08060204	Coles Creek
Dawson, Lake	Oxbow	Sunflower	08030207	Bogue Phalia River
Halpino Lake	Oxbow	Warren	08030100	MS River Above Vicksburg
Lower Lake	Lake	Panola	08030201	Little Tallahatchie River Above Sardis Dam
Lake George	Oxbow	Yazoo	08030207	Bogue Phalia River
Anchor Lake	Reservoir	Pearl River	03180004	Lower Pearl River
Town Cr. Structure #6	Reservoir	Lee	03160102	Town Creek
Conservation League L. (Lake Charlie Capps)	Reservoir	Bolivar	08030207	Bogue Phalia River
Long Creek Reservoir	Reservoir	Lauderdale	03170002	Upper Chickasawhay River
LT-7-1 (Chewalla Reservoir)	Reservoir	Marshall	08030201	Little Tallahatchie River Above Sardis Dam
Square Lake	Lake	Coahoma	08020100	MS River Above Lake Beulah
Fields Lake	Oxbow	Adams	08060204	Coles Creek
Hennington Lake	Reservoir	Lamar	03170007	Black And Red Creeks
Crystal Lake	Cut-off of Pearl River	Rankin	03180002	Pearl River Above Strong River
Little Eagle Lake	Oxbow	Humphreys	08030206	Upper Yazoo River
Lake Hide-A-Way	Reservoir	Pearl River	03180004	Lower Pearl River

Mississippi Surface Water Monitoring Program Strategy 2022-2025

Sample Name	Location Type	County	HUC	Hydroname
Mossy Lake	Oxbow	Leflore	08030206	Upper Yazoo River
Bailey Lake	Reservoir	Lauderdale	03160202	Sucarnoochee River
Swan Lake	Oxbow	Tallahatchie	08030202	Tallahatchie River
Cypress Lake	Oxbow	Issaquena	08030209	Deer Creek - Steele Bayou
Tennessee Lake	Oxbow	Issaquena	08030100	MS River Above Vicksburg
Lake Cavalier	Reservoir	Madison	08060202	Lower Big Black River
Lake Lorman	Reservoir	Madison	08060202	Lower Big Black River
Holmes Lake	Oxbow	Jefferson	08060204	Coles Creek
Pinchback Lake	Oxbow	Holmes	08030206	Upper Yazoo River
Lake Jackson	Oxbow	Washington	08030209	Deer Creek - Steele Bayou
Lake Mohawk	Reservoir	Tippah	08010207	Hatchie River
Lake Copiah	Reservoir	Copiah	08060203	Bayou Pierre
Sixmile Lake (Upper Sixmile Lake)	Oxbow	Leflore	08030205	Yalobusha River Above Grenada Dam
Walnut Lake	Oxbow	Tunica	08030204	Coldwater River Below Arkabutla Dam
Big Lake	Oxbow	Wilkinson	08060100	MS River Below Vicksburg
Henry, Lake	Oxbow	Leflore	08030207	Bogue Phalia River
Chiwapa Reservoir Structure #1	Reservoir	Pontotoc	03160102	Town Creek
Butler Lake	Reservoir	Adams	08060204	Coles Creek
Bailey Lake	Reservoir	Carroll	08030205	Yalobusha River Above Grenada Dam
Cypress Lake	Oxbow	Warren	08060100	MS River Below Vicksburg
Sixmile Lake	Oxbow	Leflore, Sunflower	08030206	Upper Yazoo River
Bonita Reservoir (#2 Dam)	Reservoir	Lauderdale	03170001	Chunky River-Okatibbee Creek
Woodland Lake	Reservoir	DeSoto	08030204	Coldwater River Below Arkabutla Dam
Artonish Lake	Oxbow	Wilkinson	08060206	Buffalo River
LT-7-3 (Big Snow Lake)	Reservoir	Benton	08030201	Little Tallahatchie River Above Sardis Dam

Mississippi Surface Water Monitoring Program Strategy 2022-2025

Sample Name	Location Type	County	HUC	Hydroname
Dixie Springs Lake	Reservoir	Pike	03180005	Bogue Chitto River
Hurricane Lake	Reservoir	Lincoln	08060205	Homochitto River
Lake LaRue	Reservoir	Hinds	03180002	Pearl River Above Strong River
Suffer Brake	Oxbow	Tallahatchie	08030202	Tallahatchie River
Beaver Lake	Reservoir	Lamar	03170007	Black And Red Creeks
Long Lake	Oxbow	Sunflower	08030207	Bogue Phalia River
Hampton Lake	Oxbow	Tallahatchie	08030205	Yalobusha River Above Grenada Dam
Gee Lake	Reservoir	Carroll	08030206	Upper Yazoo River
Fitler Lake	Oxbow	Issaquena	08030100	MS River Above Vicksburg
Long Brake	Oxbow	Tallahatchie	08030205	Yalobusha River Above Grenada Dam
Clarks Lake	Reservoir	Lincoln	03180003	Middle Pearl River
Beaver Lake	Reservoir	Smith	03180002	Pearl River Above Strong River
Deer Lake	Oxbow	Washington	08030209	Deer Creek - Steele Bayou
Sixmile Lake	Oxbow	Tunica	08030204	Coldwater River Below Arkabutla Dam
Fivemile Lake	Oxbow	Issaquena	08030209	Deer Creek - Steele Bayou
LT-7-2(Little Snow Lake)	Reservoir	Benton	08030201	Little Tallahatchie River Above Sardis Dam
Thornburg Lake	Oxbow	Adams	08060204	Coles Creek
Sanders Lake	Reservoir	Carroll	08030206	Upper Yazoo River

Notes:

Lakes and reservoirs listed are all non-fertilized. Industrial cooling ponds or tidally influenced lakes are not included in these sampling locations.

Table A- 3: Ambient Fixed Station Networks

enSPIRE #	Site Name	Latitude	Longitude	Site Description
07290650	BAYOU PIERRE	32.01800	-90.87719	NEAR WILLOWS AT WILLOW ROAD 1.7 MILES SE OF WILLOWS
03592100	BEAR CREEK	34.63433	-88.15411	NEAR TISHOMINGO AT HWY 30 4 MILES EAST OF TISHOMINGO
112D59	BERNARD BAYOU	30.40670	-89.02723	AT HANDSBORO AT HANDSBORO BRIDGE
07290000	BIG BLACK RIVER	32.34778	-90.69725	NEAR BOVINA AT HWY 80 BRIDGE 2.5 MILES EAST OF BOVINA
113A58	BIG BYWY DITCH	33.45654	-89.36658	AT CHESTER TOMNOLEN RD
07288500	BIG SUNFLOWER RIVER	33.54722	-90.54336	AT SUNFLOWER AT SUNFLOWER RD 1 MILES WEST OF HWY 49 IN SUNFLOWER
112B79	BILOXI RIVER	30.48500	-89.02867	NEAR WOOLMARKET AY HWY 605
111B64	BLACK CREEK	30.92319	-88.97283	NEAR FAIRLY BRIDGE LANDING
02490900	BOGUE CHITTO	31.02297	-90.20894	NEAR LEHR AT DILLONS BRIDGE RD 1.1 MILES WEST OF LEHR
02439400	BUTTAHATCHEE RIVER	33.79017	-88.31533	NEAR ABERDEEN AT BARTAHATCHIE RD 13.7 MILES SE OF ABERDEEN
PA420	CHICKASAWHAY CREEK	32.59114	-88.78511	NEAR KLONDIKE AT HWY 495
113G05	CHICKASAWHAY CREEK	32.65672	-88.77462	NEAR LIBERTY AT LIBERTY ROAD
02478500	CHICKASAWHAY RIVER	31.15008	-88.54758	AT LEAKESVILLE AT HWY 63 0.1 MILE SW OF LEAKSVILLE
02477000	CHICKASAWHAY RIVER	32.17581	-88.81964	AT ENTERPRISE AT HWY 513
02479560	ESCATAWPA RIVER	30.81192	-88.45864	NEAR AGRICOLA AT COUNTY ROAD 612, HOWELL BRIDGE NW OF HOWELL
NI034	HATCHIE RIVER	34.97208	-88.79173	NEAR LONE PINE AT CR 755 BRIDGE
07292500	HOMOCHITTO RIVER	31.32381	-91.10844	AT ROSETTA AT HWY 33 1 MILE NW OF ROSETTA
NI018	HORN LAKE CREEK	34.98454	-90.06081	NEAR SOUTHAVEN OFF HORN LAKE ROAD
02481660	JOURDAN RIVER	30.38686	-89.44108	NEAR KILN AT HWY 43 2 MILES SOUTH OF KILN
07268000	LITTLE TALLAHATCHIE RIVER	34.48233	-89.22433	AT ETTA AT HWY 30
02443000	LUXAPALLILA CREEK	33.56042	-88.31531	AT STEENS AT STEENS/GUNSHOOT RD 0.2 MILES SW OF STEENS

Mississippi Surface Water Monitoring Program Strategy 2022-2025

113B83	MIDDLE BYWY CREEK	33.42208	-89.26398	NEAR BYWY 100M UPSTREAM OF NATCHEZ TRACE PARKWAY
111D30	MIDDLE BYWY CREEK	33.43147	-89.29491	NEAR ACKERMAN UPSTREAM OF BYWY ROAD
112B59	MUDDY CREEK	33.36458	-90.73333	AT BOVINA 75M UPSTREAM OF TUCKER RD
02476600	OKATIBBEE CREEK	32.29861	-88.75361	AT ARUNDEL AT ARUNDEL ROAD 0.6 MILES SE OF ARUNDEL
02472820	OKATOMA CREEK	31.56292	-90.87719	AT SEMINARY AT HWY 590 0.1 MILE WEST OF SEMINARY
02482000	PEARL RIVER	32.79928	-88.15411	AT EDINBURG AT HWY 16
02486500	PEARL RIVER	32.17658	-89.02723	AT BYRAM AT OLD SWINGING BRIDGE ON FLORENCE BYRAM RD
02479300	RED CREEK	30.73614	-90.69725	AT VESTRY AT READ RD 0.5 MILE NORTH OF VESTRY
PL373	STRONG RIVER	31.97800	-89.36658	AT D'LO WATER PARK
07375280	TANGIPAHOA RIVER	31.01208	-90.54336	AT OSYKA AT HWY 584 0.1 MILE NE OF OSYKA
02436500	TOWN CREEK	34.05917	-89.02867	NEAR NETTLETON AT HWY 45
07029311	TUSCUMBIA RIVER CANAL	34.94659	-88.61134	NEAR CORINTH AT SMITH BRIDGE RD
07029300	TUSCUMBIA RIVER CANAL	34.93094	-90.20894	NEAR CORINTH AT HWY 72 BRIDGE 5 MILES WEST OF CORINTH
111B59	TUXACHANIE CREEK	30.52521	-88.31533	NEAR WHITE PLAINS AT HIGHWAY 15
111B60	WOLF RIVER	30.39326	-88.78511	NEAR LONG BEACH AT BELLS FERRY ROAD
07287120	YAZOO RIVER	33.38639	-88.77462	NEAR SHELL BLUFF/SIDON AT CR 511 3.5 MILES WSW OF SIDON

Table A- 4: Bacterial Monitoring Stations*Ambient Fixed Bacterial Monitoring Stations*

Station	Site Name	Description	Longitude	Latitude	County
7290265	Bayou Pierre	at Smyrna at Old Port Gibson road	-90.49775	31.87006	Copiah
7290650	Bayou Pierre	near Willows at Willow Road 1.7 miles SE of Willows	-90.87719	32.01800	Claiborne
111B54	Bayou Pierre	at Carlisle road near Carlisle	-90.78422	32.00555	Claiborne
SI045	Bayou Pierre	near Port Gibson at Anthony St (Old Mill Rd)	-91.00733	31.98614	Claiborne
2477230	Chickasawhay River	at Desoto at CR 690 bridge 1 mile E of Desoto	-88.70406	31.97217	Clarke
111B55	Chickasawhay River	at Shubuta on Hwy 145	-88.68995	31.84890	Clarke
2475700	Chunky River	at Enterprise at Hwy 11	-88.82514	32.19192	Clarke
7376685	East Fork Amite River	near Gillsburg at Lindsey Bridge road 8.5 miles W of Gillsburg	-90.79431	31.02131	Amite
111B57	Homochitto River	near Bude at Burris road	-90.78944	31.49270	Franklin
7290680	Little Bayou Pierre	near Hermanville at Sawmill road	-90.83553	31.90583	Claiborne
111B65	Pearl River	near Hopewell at Hopewell road	-90.18993	31.95514	Simpson
113G21	Pearl River	near Rockport at Lower Rockport road	-90.14223	31.79133	Copiah
PL373	Strong River	at D'lo at Hwy 149	-89.89678	31.97800	Simpson
7376763	West Fork Amite River	near street at Powell road	-90.85306	31.02444	Amite
2439400	Buttahatchee River	near Aberdeen at Bartahatchie road 13.7 miles SE of Aberdeen	-88.31533	33.79017	Monroe
111B62	Little Tallahatchie River	at Belmont road near Sardis	-89.88214	34.38718	Panola
113B83	Middle Bywy Creek	near Bywy 100m upstream of Natchez Trace Parkway	-89.26398	33.42208	Choctaw
YZ600	Skuna River Canal	near Skuna at CR 245	-89.45719	33.95106	Calhoun
111B63	Beaver Dam Creek	near Wiggins at Ashe Nursery road	-89.13105	30.98493	Perry
2479170	Black Creek	near Vestry at Hwy 57	-88.76267	30.78000	George
111A68	Black Creek	at Ashe Nursery road bridge	-89.17958	31.05152	Forrest
111B56	Black Creek	at Camp Dantzler at Churchwell road	-89.29654	31.11510	Forrest
111B64	Black Creek	near Fairly Bridge Landing	-88.97283	30.92319	Perry

Mississippi Surface Water Monitoring Program Strategy 2022-2025

Station	Site Name	Description	Longitude	Latitude	County
2490900	Bogue Chitto River	near Lehr at Dillons Bridge road 1.1 miles W of Lehr	-90.20894	31.02297	Walthall
111B66	Bogue Chitto River	at Walker bridge at Hwy 48	-90.25172	31.11714	Walthall
2472500	Bowie Creek	near Hattiesburg at Hwy 49 10 miles NW of Hattiesburg	-89.41500	31.42556	Forrest
2472880	Bowie River	at Rawls Springs at Peps Point road	-89.36556	31.39556	Forrest
2477492	Chickasawhay River	near Waynesboro at Waynesboro-Shubuta road/Old Hwy 84 bridge 1.0 mile NW of Waynesboro	-88.67038	31.69477	Wayne
2481660	Jourdan River	near Kiln at Hwy 43 2 miles S of Kiln	-89.44108	30.38686	Hancock
2474680	Leaf River	near New Augusta at Wingate road bridge 1.5 miles N of Wingate	-88.99111	31.22583	Perry
113G50	Magees Creek	at Lexie at Lexie road	-90.16302	31.07224	Walthall
PA284	Okatoma Creek	at Lux at Lucy road	-89.40608	31.44333	Covington
2481299	Old Fort Bayou	at Ocean Springs at Washington Street/Hwy 609 bridge	-88.82792	30.41981	Jackson
2486500	Pearl River	at Byram at Old Swinging Bridge on Florence Byram road	-90.24331	32.17660	Rankin
2479310	Pascagoula River	near Wade at Wade-Vancleave road at Graham Ferry 5 miles NE Of Vancleave	-88.64103	30.61092	Jackson
2489500	Pearl River	near Bogalusa, LA at Hwy 26 1.5 miles E of Bogalusa, LA	-89.82097	30.79261	Pearl River
2492668	Pearl River	at Pearlington at Hwy 90 1 mile SW of Pearlington	-89.61461	30.23897	Hancock
2479230	Red Creek	near Beatrice at Old Hwy 15	-88.91286	30.77336	Stone
2479300	Red Creek	at Vestry at Read road 0.5 mile N of Vestry	-88.78119	30.73614	George
111C03	Rotten Bayou	at bridge on Kiln-DeLise road	-89.34458	30.41942	Hancock
111C04	Rotten Bayou	Rotten Bayou at Nolan House	-89.38645	30.39813	Hancock
113A59	Sandy Run	at Okalona School road bridge	-89.38769	31.20730	Lamar
111F68	Sellers Creek	100m upstream of Dixie Ave.	-89.88347	31.95966	Simpson
PL374	Strong River	near Georgetown at Bridgeport road	-90.09333	31.84581	Simpson
2480350	Tchoutacabouffa River	near Woolmarket at CC road 2 miles N of Latimer	-88.88522	30.56014	Harrison
111B58	Tchoutacabouffa River	at D'iberville at Hwy 15 bridge	-88.90859	30.45972	Harrison

Mississippi Surface Water Monitoring Program Strategy 2022-2025

Station	Site Name	Description	Longitude	Latitude	County
2481240	Turkey Creek	near Long Beach at Canal Road bridge 2.5 miles N of Long Beach	-89.13667	30.39806	Harrison
2481252	Turkey Creek	at Gulfport at (Airport Rd) Creosote road	-89.07028	30.42381	Harrison
CS221	Turkey Creek	at Gulfport at Old Hwy 49 bridge	-89.09478	30.41239	Harrison
111B59	Tuxachanie Creek	near White Plains at Hwy 15	-88.92405	30.52521	Harrison
111B60	Wolf River	near Long Beach at Bells Ferry road	-89.20655	30.39326	Harrison
CS065	Wolf River	near Sellers at Hwy 53	-89.33939	30.59481	Harrison

Ambient Beach Bacterial Monitoring Stations

Station_	Locale Name	County
640BBYB01	Front Beach	Jackson
640BBYB02	Shearwater Beach	Jackson
640MSDB01	Buccaneer State Park Beach	Hancock
640MSDB02	Waveland Beach	Hancock
640MSDB03	Bay St Louis Beach	Hancock
640MSDB04	Pass Christian West Beach	Harrison
640MSDB05	Pass Christian Central Beach	Harrison
640MSDB06	Pass Christian East Beach	Harrison
640MSDB07	Long Beach	Harrison
640MSDB08	Gulfport West Beach	Harrison
640MSDB09	Gulfport Harbor Beach	Harrisons
640MSDB10	Gulfport Central Beach	Harrison
640MSDB10B	Courthouse Road Beach	Harrison
640MSDB11	Gulfport East Beach	Harrison
640MSDB11A	Edgewater Beach	Harrison
640MSDB12A	Biloxi West Central Beach	Harrison
640MSDB14	Biloxi East Beach	Harrison
640MSDB17	Pascagoula Beach West	Jackson
640MSDB18	Pascagoula Beach East	Jackson
640MSDB19	Lakeshore Beach	Jackson
640MSDB20	Biloxi East Central Beach	Jackson