

# State of South Carolina Monitoring Strategy

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## SC DEPARTMENT of ENVIRONMENTAL SERVICES

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## A. Monitoring Program Strategy

**The State has a comprehensive monitoring program strategy that serves all water quality management needs and addresses all State water, including all waterbody types (e.g., streams, rivers, lakes, Great Lakes, reservoirs, estuaries, coastal areas, wetlands, and groundwater).** The monitoring program strategy is a long-term implementation plan and should include a timeline, not to exceed ten years, for completing implementation of the strategy. It is important that the strategy be comprehensive in scope and identify the technical issues and resource needs that are currently impediments to an adequate monitoring program.

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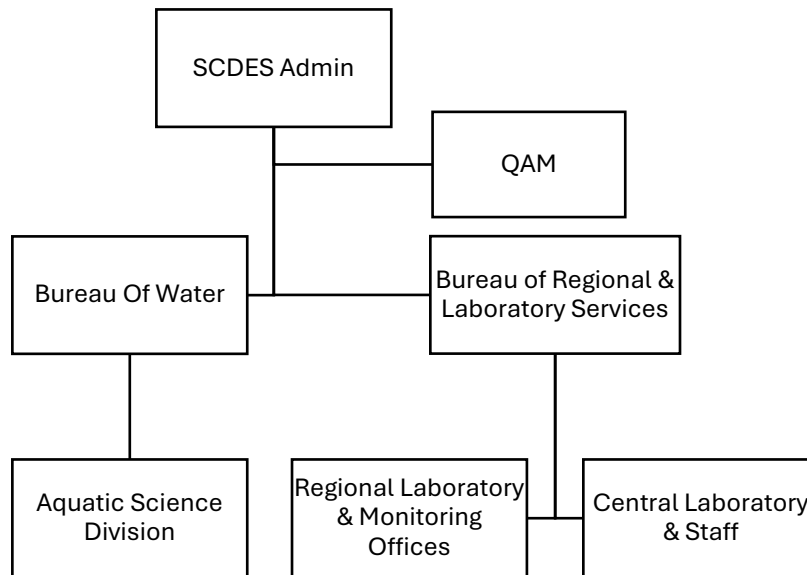


Figure 1. Ambient Surface Water Quality Monitoring Program Organization Chart

The elements of the South Carolina Department of Environmental Services (SCDES) Ambient Surface Water Quality Monitoring Program described in the Strategy follow the high-level organization indicated in Figure 1.

This monitoring strategy establishes the overall objectives for those key elements of the South Carolina Department of Environmental Services (SCDES) water quality monitoring program to achieve the goals of the South Carolina Pollution Control Act (PCA), the federal Clean Water Act (CWA), and implement applicable State and Federal regulations. Under the PCA and CWA, SCDES has been delegated certain

water quality monitoring responsibilities. These include water quality assessment, compliance monitoring, and program evaluation as needed to fulfill the requirements of the aforementioned Acts. This strategy also serves to document these monitoring activities within the framework presented in the EPA guidance *Elements of a State Water Monitoring and Assessment Program* (USEPA, 2003).

The core goal of the Ambient Surface Water Quality Monitoring Program is a water quality status surveillance and trends monitoring program. The resulting data generated by the activities described in this Monitoring Strategy are used by multiple South Carolina Department of Environmental Services (SCDES) programs to accomplish their specific requirements. Some internal examples include §303(d) and §305(b) assessment development, setting NPDES permit limits and compliance, TMDL development, and wasteload allocation modeling.

State administrators need to assess the quality of the aquatic environment so that they can make decisions concerning water program priorities and provide reports to the public on the state of the environment, important trends over time, and accomplishments. They also need to evaluate the effectiveness of control measures. Water quality monitoring data provide information needed to meet these needs. While there are different approaches and philosophies of water quality monitoring, monitoring is not an end in itself but is only a catalyst to spur decisions regarding achievable and desirable resource use alternatives. Monitoring alone does not achieve protection and restoration of water quality. Monitoring data serves as a tool to assess conditions, to suggest where corrective actions may be necessary, and evaluate the results of those actions. Monitoring data serves as the foundation for informing the Department's water quality decision-making responsibilities.

"Ambient monitoring" refers to monitoring of general surroundings, and includes the set of activities that provide chemical, physical, geological, and biological data about general conditions in the environment. For the purpose of this strategy, water quality monitoring is limited to those activities involved in the State implementation of the PCA and CWA in inland and coastal waters. "Compliance monitoring" is the collection and analysis of data needed for establishing environmental quality-based permit requirements and for assessing and enforcing compliance with permits. "Ambient and Compliance monitoring" both provide data necessary for addressing environmental quality-based assessments of ambient water related to point source and nonpoint source influences.

In general, the water quality monitoring activities need to answer key questions about the overall quality of waters in South Carolina, changes in water quality over time, where there are problem areas and areas needing additional protection, the level of protection needed, and the effectiveness of specific clean water projects and programs. However, monitoring is actually a multifaceted discipline with many

program areas conducting monitoring activities to fulfill specific objectives: fish tissue monitoring to develop, track, and update fish consumption advisories; ocean monitoring to issue timely beach swimming advisories; shellfish sanitation monitoring to determine the harvesting status of the numerous shellfish beds in the state; macroinvertebrate monitoring to determine the health of biological communities of specific waterbodies; ambient surface water monitoring to assess compliance with water quality standards and examine long-term trends at a variety of scales; ambient groundwater monitoring to assess water quality across the major aquifers of the state (currently suspended); National Pollutant Discharge Elimination System (NPDES) discharge monitoring to ensure facilities are in compliance with their permit limits; and special studies for more intensive investigation of specific issues.

Therefore, it is necessary to use these varied monitoring activities as the vehicle for a cohesive, inter-related approach to water quality management via these diverse types of data. It is through the monitoring programs that sample acquisition, data management and reporting, program needs, committed tasks, and other such Departmental functions all meet. Thus, it is at this natural point of confluence that much opportunity is afforded for integration of sometimes apparently non-related tasks or programs into a stepwise, interrelated approach to the protection of water quality in the State. A great deal of attention to each of those "facets" is required in order for the resulting data to be of the most benefit. As a result, many of the aforementioned programs collect additional samples as part of their activities for the analysis of constituents beyond those required to fulfill their specific objectives. For example, beyond the parameters that can be directly compared to numeric state water quality standards, the Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring program collects information on additional parameters that are used by the NPDES permit writers and the 303(d), Modeling and TMDL Section to define background conditions and to establish limits for what can safely be discharged by a wastewater treatment facility.

## B. Monitoring Objectives

**The State has identified monitoring objectives critical to the design of a monitoring program that is efficient and effective in generating data that serve its management decision needs.** EPA expects the State to develop a strategy and implement a monitoring program that reflects a full range of State water quality management objectives including, but not limited to, Clean Water Act goals.

Clean Water Act objectives include:

- Establishing, reviewing, and revising water quality standards (Section 303(c)).



- Determining water quality standards attainment (Section 305(b)).
- Identifying impaired waters (Section 303(d)).
- Identifying causes and sources of water quality impairments (Sections 303(d), 305(b)).
- Supporting the implementation of water management programs (Sections 303, 314, 319, 402, etc.).
- Supporting the evaluation of program effectiveness (Sections 303, 305, 402, 314, 319, etc.).

The State may have additional objectives for its own purposes.

In general, a monitoring program that meets the Clean Water Act objectives should be able to answer the following five questions:

- 1. What is the overall quality of waters in the State?**
- 2. To what extent is water quality changing over time?**
- 3. What are the problem areas and areas needing protection?**
- 4. What level of protection is needed?**
- 5. How effective are clean water projects and programs?**

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The information resulting from these monitoring activities are integrated and considered together in various decision-making processes. The incorporation of various data sources allows the Department to address broader objectives. Specific objectives of SCDES's water quality monitoring strategy include:

- Determining the overall quality of state waters
- Determining trends in water quality, both at the site-specific scale and statewide scale
- Determining water quality standards attainment
- Identifying impaired waters
- Identifying causes and sources of water quality impairments
- Protecting human health
- Establishing, reviewing, and revising water quality standards
- Supporting the implementation of water management programs
- Supporting the evaluation of program effectiveness
- Monitoring for Water Quality-Based Controls
- Monitoring for NPDES permit compliance and enforcement
- Making data readily available

Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring

The purpose of the Ambient Surface Water Physical, Chemical, Microbiological, & Algal

Discrete Monitoring Network is to provide a system of monitoring sites in flowing streams, reservoirs, and saltwaters, that are sampled in a way that produces well defined data reflecting physical and chemical conditions of the streams, reservoirs, and saltwaters in South Carolina. The data generated are utilized for: trend monitoring of water resources, the results of which are included in the §305(b) report to congress, reporting of waters that do not meet aquatic life uses to be included on the §303(d) list, assessment of the potential impacts of NPDES discharges into waters of the state, evaluation of impacts of catastrophic events such as oil spills, evaluation of the effects of nonpoint source impacts on State waters, evaluation of potential outstanding resource waters of the state, providing data for conservation agencies and programs.

#### Ambient Surface Water Physical & Chemical Continuous Monitoring

The purpose of Ambient Surface Water Physical & Chemical Continuous Monitoring is to investigate temporal, as well as spatial variation of specific parameters, in a way that produces well defined data reflecting physical and chemical relationships of the streams, reservoirs, and saltwaters in South Carolina.

#### Biological Monitoring

The biological monitoring network provides information that will allow for the detection and evaluation of changes in the stability of aquatic communities including macroinvertebrates, phytoplankton, and the analysis of fish tissue. The various activities falling under the biological monitoring program are detailed below.

#### Macroinvertebrate Bioassessment

The use of aquatic macroinvertebrates in environmental studies by SCDES began in 1974 (SCDES 1974, 1975). Since then the macroinvertebrate monitoring program has become an important part of the Agency and is utilized for: trend monitoring of streams and rivers, the results of which are included in the §305(b) report to congress, reporting of streams that do not meet aquatic life uses to be included on the §303(d) list, assessment of the potential impacts of NPDES discharges into waters of the state, evaluation of impacts of catastrophic events such as oil spills, evaluation of the effects of nonpoint source impacts on streams and rivers, evaluation of potential outstanding resource waters of the state, providing data for conservation agencies and programs, documenting biodiversity, and demonstrations for volunteer monitoring programs, school groups, 4H groups, and environmental festivals in the state of South Carolina. In addition, bioassessments help inform standards as the results are direct measures of aquatic life condition of waters of the Nation.

#### Fish Tissue Monitoring

The collection of fish for the purpose of tissue analysis is necessary to detect the presence and levels of heavy metals, pesticides, and toxic organic compounds in edible tissue that may concentrate through aquatic food chains and threaten the health of human consumers. Aquatic organisms may accumulate contaminants through gills and epithelial tissue directly from water and sediment (bioconcentration), a combination of bioconcentration and dietary sources (bioaccumulation), or a process by which the tissue concentrations increase as the contaminant passes up the food chain (biomagnification). Data collected is used to issue consumption advisories for the protection of public health when necessary.

### Chlorophyll & Cyanotoxin Monitoring

The purpose of chlorophyll and cyanotoxin monitoring is to provide baseline data in reservoirs and saltwaters, and assess compliance with water quality standards where applicable. The data generated are utilized for: trends monitoring of water resources, the results of which are included in the §305(b) report to congress, reporting of waters that do not meet aquatic life uses to be included on the §303(d) list, protecting human health, reviewing and revising water quality standards, and the evaluation of the effects of nonpoint source impacts on State waters.

Chlorophyll- $\alpha$  is a particularly useful biological indicator for assessing nutrient enrichment in water bodies and can aid in management decisions for protecting water resources. Chlorophyll- $\alpha$  can be used to assess current water quality in reservoirs and can provide a baseline of data to assist in identifying potential changes. Numeric nutrient criteria, including chlorophyll a concentration, are based on an ecoregional approach which considers the geographic location of the lakes within the state.

The harmful algal bloom (HAB) program was created in 2018 to investigate the effects that cyanotoxins have on human health and the environment. The program aims to: collect baseline data from cyanotoxin distribution in state reservoirs and estuaries, monitor drinking water intakes with histories of HABs and/or taste and odor issues, and issue recreational advisories for waterbodies that exceed SCDES's state standards. SCDES adopted the USEPA's recreational advisory criteria for Microcystins and Cylindrospermopsin in 2020.

Chlorophyll-a and cyanotoxin data are included in the §303(d) and §305(b) assessments.

### Section 319 Nonpoint Source Monitoring

Section 319 of the Clean Water Act deals with the control and reduction of nonpoint source pollutants and includes the award of annual grants to states from EPA. Through Section 319, the U.S. Environmental Protection Agency awards grant funding to states, territories and Tribes to implement their nonpoint source programs. NPS programs can include regulatory or nonregulatory programs,

technical assistance, financial assistance, education, training, technology transfer, watershed projects and monitoring to assess the success of specific NPS implementation projects. These grant funds are primarily used to implement watershed-based plans for impaired waters. SCDES passes a portion of its annual 319 grant to sub-recipients through a competitive process to implement recommended best management practices (BMPs). Implementation includes the installation of an array of structural and non-structural BMPs designed to reduce or prevent nonpoint source contributions within a watershed. The ultimate goal is to remove the impairment for the specific pollutant for which the plan was developed. Monitoring is a crucial component of determining the initial impairment as well as documenting potential water quality improvements resulting from such an implementation effort. Generally, SCDES conducts the monitoring as match to the funding awarded to the grantee.

At the federal level, EPA and the US Department of Agricultural Natural Resources Conservation Service (NRCS) have partnered together to direct funding in specific watersheds to improve water quality. The funds are a specific set-aside to the NRCS Environmental Quality Improvement Program (EQIP) and are known as the National Water Quality Initiative (NWQI). Working together, state NPS and state NRCS programs selected specific watersheds where extensive EQIP funds for agricultural BMPs would be directed.

### Ocean Water Monitoring

The objective of South Carolina's Ocean Water Monitoring program is to protect public health through the issuance of swimming advisories based on accurate, representative sampling.

### Shellfish Growing Area Water Quality Monitoring

South Carolina's Shellfish Growing Area Water Quality Monitoring program monitors approximately 580,176 acres of surface water with assigned classifications designated for the harvest of molluscan shellfish. These coastal waters are divided into 25 shellfish management areas with a total of 468 active monitoring stations. The objectives of the shellfish-monitoring network are to provide data that accurately reflect sanitary and environmental conditions of coastal shellfish and shellfish growing waters in South Carolina in order to:

- Ensure that the health of shellfish consumers is protected.
- Protect and maintain existing shellfish growing area water use; and
- Identify impaired waters suitable for restoration to appropriate use standards.

### Special Studies

Special studies provide immediate and in-depth investigations targeting specific environmental problems or involve practical research that leads to a better understanding of the water quality of the State of South Carolina. The data collected are summarized and reported at the conclusion of each study.

There is usually a specific need or problem identified in the initial study request. Specific water quality parameters or indicators are selected based on the specific issue being investigated.

An investigation of specific environmental problems may originate as an official request from staff from various sections of the Department, to support decision making on a variety of issues. Studies may also be initiated in response to requests by private citizens or special interest groups. Once an official request to carry out a specific task has been received, Aquatic Resource Monitoring staff designs, receives approval from the Quality Assurance Manager (QAM), and implements the study. The results of such studies are reported primarily to the originator of the study request.

In conducting practical research, Aquatic Resource Monitoring (ARM) generally relies on its own staff, as well as the scientific staff of other sections of the BOW. The ARM staff designs and implements, or coordinates such studies, if other groups are involved, and reports all findings to all interested parties.

Study plans for any special studies are submitted to the QAM for approval prior to sampling. All sampling and field analyses are performed according to the most current revisions of appropriate SCDES standard operating procedures for field and laboratory methods.

### Groundwater Monitoring

Ambient groundwater monitoring is currently suspended. In the mid-1980s, DHEC had groundwater 106 funding to investigate contamination and create an inventory of contamination sources in drinking water aquifers. The agency had a 5-year sampling rotation of all drinking water aquifers for ~50 parameters. Three rounds of sampling were conducted and resulted in a robust statewide profile of all the drinking waters aquifers. Given the timescale for groundwater transport, the state learned what they were going to from the program. The last sampling round was conducted in 2006 as state and federal funds decreased. Groundwater sampling was considered non-essential and cuts were made to the program.

## C. Monitoring Design

**The State has an approach and rationale for selection of monitoring designs and sample sites that best serve its monitoring objectives.** The State monitoring program

will likely integrate several monitoring designs (e.g., fixed station, intensive and screening-level monitoring, rotating basin, judgmental and probability design) to meet the full range of decision needs. The State monitoring design should include probability-based networks (at the watershed or state-level) that support statistically valid inferences about the condition of all State water types, over time. EPA expects the State to use the most efficient combination of monitoring designs to meet its objectives.

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Each Ambient monitoring component employs a sampling design specific to their individual programmatic needs. The resulting data serve to meet specific SCDES monitoring objectives and data needs.

### 1. Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring

The purpose of the Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring Network is to provide a system of monitoring sites that are sampled in a way that produces well defined data reflecting physical and chemical conditions of the streams, reservoirs, and saltwaters in South Carolina.

There are currently two primary components of the Surface Water Physical, Chemical, & Microbiological Monitoring Program, including ongoing fixed-location monitoring and statewide statistical survey monitoring; each is designed to provide data for water quality assessment of major water resource types at different spatial and temporal scales (Ambient Surface Water Quality Monitoring Program Quality Assurance Project Plan, SCDES, under development).

The fixed-location component of the monitoring network is comprised of Base Sites that are sampled once per month, year-round. Statistical Survey Monitoring Sites are sampled once per month for one year and are moved from year to year. These basic components are discussed in the following sections.

#### Base Sites

Base Sites are sampled monthly, year-round, over an extended period, and in a uniform manner to provide solid baseline data. Base Sites were chosen to target the most downstream access (pour point) of each of the National Watershed Boundary Dataset (WBD) 10- digit watershed units (WSU) in the state, as well as the major waterbody types, flowing streams, reservoirs, and saltwaters, that occur within these WSUs. There are currently 246 Base Sites. In some years, individual Base Sites may satisfy the requirements of Statistical Survey Monitoring Sites based on proximity to the random draw and are sampled monthly as part of that monitoring

component.

For example, when a WSU ends in a major reservoir, a Base Site is placed in the impounded area to represent reservoir conditions and another Base Site is generally placed in the main stream feeding that part of the reservoir which represents conditions in the free-flowing portion of the WSU. Similarly, in a primarily riverine WSU ending in saltwater areas at the coast, Base Sites may be placed in both the free-flowing freshwater portion as well as the saltwater area to represent conditions in both habitats. The result is consistent data from all WSUs in the state that can be used in tracking standards compliance and long-term trends.

### Statistical Survey Monitoring Sites

Statistical survey monitoring is a design in which the population of interest is sampled in a fashion that allows statements to be made about the whole population based on a subsample and produces an estimate of the accuracy of the assessment results. The advantage of the statistical survey sampling design is that statistically valid statements about water quality can be made about large areas based on a relatively small subsample. Statistical survey water quality data can be used to make inferences, with known confidence, about the condition of the water resources of the State.

A statewide statistical survey component, or random or probabilistic sampling design, is part of the Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring. Separate monitoring schemes have been developed for stream, lake/reservoir, and saltwater resources to represent the entirety of each resource type as described in the QAPP. Each year a new set of statistical survey sites is selected for each waterbody type. Site selection is done by SCDES staff. Although statements about resource conditions can theoretically be made based on data from a single year, the compilation of data from additional years increases the confidence and accuracy of statements about water quality. An additional advantage of the statistical survey approach is that it presents the opportunity for previously unsampled locations to be selected for data collection.

#### Streams

Approximately 30 statistical survey stream sites (RS) are sampled each year. Some of the statistical survey locations may correspond to existing fixed Base Sites. Each statistical survey site is sampled

monthly for one year and may be prioritized for a macroinvertebrate community and habitat analysis. Streams of different sizes may be more or less sensitive to different types of environmental perturbations. Because of this, three stream sizes have been specifically targeted to ensure they are represented in the selected statistical survey sites.

1. First Order streams, or headwater streams, are targeted because these represent streams with the least dilution capacity and therefore are most immediately impacted by adjacent land use activities and associated runoff. These streams may also serve as spawning areas for fish and refuge areas for young from larger aquatic predators.
2. Second and Third Order streams, are also streams with relatively small dilution capacity and represent important habitat for reproduction and survival of aquatic life. They may also reflect the direct impacts of major land use activities.
3. Fourth Order and larger streams include the major rivers of the State. In general, these streams have greater dilution capacity and are less affected by small-scale land use perturbations and may be heavily utilized for contact recreation.

These different sizes do not occur in equal proportions in the state; therefore, an unequal weighting procedure is used in the site selection process to guarantee inclusion of all three sizes. Each year the design goal is 8 First Order stream sites, 10 Second and Third Order stream sites, and 12 Fourth Order and larger stream sites. Taken together and using the proper weighting factors, the random stream sites can be used to make statistically valid statements with 95% confidence about all stream resources of the State.

#### Lakes/Reservoirs

Approximately 30 statistical survey lake sites (RL) are sampled each year. Some of the statistical survey locations may correspond to existing fixed Base Sites. Each statistical survey site is sampled monthly for one year. Eligible lakes/reservoirs are restricted to “significant lakes”, which refers to those freshwater lakes/reservoirs with at least 40 acres surface area that offer unrestricted public access. The size of significant lakes/reservoirs varies; therefore, two size classes of lakes/reservoirs have been specifically targeted to ensure that the smaller lakes/reservoirs are represented in the selected statistical survey sites.



1. Major Lakes/Reservoirs- greater than 850 acres surface area.
2. Minor Lakes/Reservoirs- greater than 40 acres surface area, but less than or equal to 850 acres.

Each year there will be 20 Major Lake/Reservoir sites and 10 Minor Lake/Reservoir sites. Taken together and using the proper weighting factors, the statistical survey lake/reservoir sites can be used to make statistically valid statements with 95% confidence about all lake/reservoir resources of the State.

### Saltwaters

The coastal saltwater statistical survey monitoring scheme has been developed jointly by SCDES, Bureau of Water, and the South Carolina Department of Natural Resources (SCDNR) Marine Resources Research Institute (MRRI). This effort is known as the South Carolina Estuarine and Coastal Assessment Program (SCECAP, <https://www.dnr.sc.gov/marine/scecap/summary.html>).

SCECAP is an independent, collaborative program developed and conducted by SCDNR and SCDES. SCECAP was established many years prior to the National Aquatic Resource Surveys (NARS) and their National Coastal Condition Assessment (NCCA) program. SCEAP is based on the earlier EPA, NOAA, USDOJ, and USDA National Coastal Condition Report activities, which also served as the basis for the NCCA. The SCECAP monitoring sites are selected by SCDES in conjunction with SCDNR.

To ensure inclusion of a variety of saltwater ecosystems and habitats, the coastal saltwaters have been divided into two discrete categories (strata), Tidal Creeks and Open Water areas, based on a common GIS cover developed and utilized by both agencies and maintained by SCDES. Each year there will be 15 Tidal Creek (RT) sites, 15 Open Water (RO) sites. Some of the statistical survey locations may correspond to existing fixed Base Sites.

1. Tidal Creeks, identified as less than 100 meters wide on the GIS cover, serve as nursery areas for important marine species and are most immediately affected by upland land use activities and associated runoff.
2. Open Water areas, identified as greater than 100 meters wide on the GIS cover, represent larger saltwater rivers and sounds.

The sampling of the statistical survey coastal saltwater sites is a cooperative venture between SCDES and SCDNR-MRRI. The Sites are sampled monthly for one year by BRLS personnel from the assigned SCDES Field Laboratory Office. SCDNR-MRRI samples each site once annually for sediment chemistry, sediment physical characteristics, sediment toxicity, benthic infauna community composition, fish trawls, and personnel deploy multi-parameter datasondes for up to 25 hours. Aquatic Resource Monitoring personnel collect water samples in coordination with SCDNR-MRRI sampling crew.

The data generated by SCDNR are stored in their database. SCDES provides results necessary for the SCECAP assessment and reporting process to SCDNR who includes it in their database. SCDNR writes the draft SCECAP reports and SCDES provides critical review and edits. Currently no SCECAP data beyond those collected by SCDES are included in any Clean Water Act reporting requirements.

### Special Request Sites

Special Request Sites are temporary fixed-location sites that target locations of special interest to the Department related to specific data needs. Examples of site selection criteria for establishment of Special Request Sites include, but are not limited to:

1. Tracking the progress of specific remediation activities.
2. Gathering additional data in specific areas for the development of total Maximum Daily Loads (TMDLs).
3. Gathering data for Wasteload Allocation modeling needs.
4. Gathering data for establishing, reviewing, and revising water quality Standards.
5. Obtaining data necessary for setting NPDES permit limits.

Special Request Sites are also sampled monthly, year-round, over a finite period. Special Request Sites are reviewed each year to determine whether additional data are still needed, and additional Special Request Sites may be added based on emerging data needs.

## 2. [Ambient Surface Water Physical & Chemical Continuous Monitoring](#)

The purpose of Ambient Surface Water Physical & Chemical Continuous Monitoring is to investigate temporal, as well as spatial variation of specific parameters, in a way that produces well defined data reflecting physical and chemical relationships of the streams, reservoirs, and saltwaters in South Carolina.

Currently continuous monitoring is only conducted as part of special studies and the parameters included are specific to the individual study. Each individual study has an individual approved QAPP.

Continuous monitoring sampling sites are located in systems (reservoirs, streams, saltwaters) where discrete monthly sampling is insufficient for specific purposes. Monitoring sites are positioned to complement existing discrete monitoring locations and to fully characterize the system to the greatest extent possible. Continuous monitoring datasondes are deployed on buoys, or affixed to floating docks if available, at two-week intervals. Monitoring at a depth of 0.3 meters is continuous throughout the growing season (May 1 –October 31). The interval between measurements is determined based on specific data requirements and reasonable battery life between servicing. The deployment period for individual meters, or for a complete study, may be altered depending on physical constraints and the objectives of the study. These needs are documented in each special study QAPP.

## 3. [Macroinvertebrate Bioassessment](#)

Ambient stream macroinvertebrate bioassessments are currently focused on monitoring the condition of wadeable stream water quality statewide, but also include an array of large river sites. Emphasis is placed on building datasets with a long history of frequent sampling to allow for better resolution in the identification of water quality trends. Additionally, biological monitoring continues at statistical survey and special study stations statewide.

Sampling sites for macroinvertebrate bioassessments fall into three categories: fixed stations, special study stations, and statistical survey stations. Fixed stations were once sampled on a rotating schedule with approximately 80 stations completed per year. Due to this schedule, each site was typically sampled once every 5 years. Currently, 80 of these sites are being sampled every 3 years so that possible trends might be observed in greater resolution. The remaining fixed stations are sampled as often as resources allow. These fixed stations were established by professional

judgment. Criteria for site selection included watershed area, stream size, accessibility, and proximity to surface water quality stations. Generally, fixed site macroinvertebrate bioassessments are conducted on mid-order or larger flowing streams. The resulting data represent the present condition of these streams (Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling, SCDHEC, Technical Report No. 0914-17, <https://des.sc.gov/sites/des/files/media/document/Macroinvertebrate%20SOP%2C%20Final%20Complete%202017%281%29.pdf>).

Statistical survey station sampling occurs during the normal fixed station index period. These sites may fall anywhere in the state and because the selection process is random, these sites change from one year to the next. Collectively, data from the statistical survey sites provide an overview of conditions in the streams and rivers of the state.

Special studies are conducted as needed and are normally completed to evaluate potential perturbation from point source or non-point source events. Examples include chemical releases, oil spills, forestry activities, or development activities. These studies usually involve comparing an upstream control station with a station downstream of the potential impact. These studies can be a one-time event, or they may continue over a period of months or years.

#### 4. [Fish Tissue Monitoring](#)

Largemouth bass (*Micropterus salmoides*) and one other common game fish are sampled at approximately 60 freshwater sites each year. Fish tissue sites are established for lakes, rivers, and streams based on river miles or surface acreage. Generally, at least ten samples from each site are analyzed for mercury and up to two samples from each site will be analyzed for other heavy metals, pesticides, and polychlorinated biphenyls (PCBs). (Standard Operating Procedures for Fish and Shellfish Tissue Collection, SCDHEC, Technical Report No. 001-01 <https://des.sc.gov/sites/scdph/files/media/document/Fish%20and%20Shellfish%20Tissue%20Collection%20SOP.pdf>).

Through a cooperative effort, SCDNR-MRRI provides saltwater fish each year from saltwaters for tissue analysis. The target marine species are red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), and southern flounder (*Paralichthys lethostigma*). Emphasis will be placed on Upper and Lower Cape Romain, the Ashley River, Charleston Harbor, Winyah Bay, the ACE basin (Ashepoo, Combahee, and Edisto Rivers), and the Wando River. SCDNR also provides samples of swordfish (*Xiphias gladius*), wahoo (*Acanthocybium solandri*), common dolphinfish (*Coryphaena hippurus*), and tuna (*Thunnus sp.*) for tissue analysis, as

available.

Through a cooperative effort with other Southeastern coastal states, King mackerel (*Scomberomorus cavalla*) and Spanish mackerel (*Scomberomorus maculatus*) are collected from select fishing tournaments and SCDNR routine sampling. The resulting data are used to supplement the current advisories on mackerel. Tissue from select other saltwater species will be obtained as they become available.

## 5. [Chlorophyll & Cyanotoxin Monitoring](#)

Sites for chlorophyll- $\alpha$  monitoring are selected using an integrated approach to best characterize the quality status of the State's waters. This process includes selecting a variety of fixed Base Sites and Statistical Survey Monitoring Sites. Individual sites monitored for chlorophyll- $\alpha$  are designed to be representative of segments (e.g., saltwater) or areas (embayment of lake) of targeted water bodies. Collectively, monitored sites provide an overview of conditions in specific resource types (e.g., coastal saltwaters, lakes/reservoirs, etc.).

Chlorophyll- $\alpha$  samples are collected monthly, May through October, at the Lake Statistical Survey sites, Base Lake Sites, Special Request Lake Sites, Base Saltwater Sites and Saltwater Statistical Survey sites (Ambient Surface Water Quality Monitoring Program Quality Assurance Project Plan, SCDES, under development) and analyzed following the *Chlorophyll-a Laboratory Methods* Standard Operating Procedure (SCDES Bureau of Water, Aquatic Resource Monitoring, 2020).

Cyanotoxin samples are collected monthly, May through October, at Base Lake Sites, Special Request Lake Sites, and Base Saltwater Sites and analyzed following the *Determination of Total Microcystins and Cylindrospermopsin in Ambient Water* Standard Operating Procedure (SCDES Bureau of Water, Aquatic Resource Monitoring, 2020).

This includes Base Lake Sites and Statistical Survey Lake Sites sampled in a cooperative effort with the Santee Cooper Public Service Authority.

Additional sites may be sampled for chlorophyll- $\alpha$  and cyanotoxins from May-October based on previous issues with algal blooms and/or taste and odor issues. These sites are selected before the sampling season based on survey responses from drinking water providers/operators and/or lake owners.

## 6. [Section 319 Nonpoint Source Monitoring](#)

NPS monitoring includes both biological investigations and water quality

assessments. Data collected is used for various purposes including identifying waters not fully meeting designated uses due to NPS pollution, addressing waters currently listed on the §303(d) list, assisting in enforcement investigations, and assessing the effectiveness of BMPs in agricultural, silvicultural, and residential areas.

Because watershed plans are developed based on SCDES water quality monitoring sites, project success must also be based on data collected from those sites. SCDES uses Section 319 Grant funds to pay for the staff and analysis costs related to this monitoring effort. Often there are sites of interest within the project areas that are not active throughout the duration of the project period as part of the Ambient Surface Water Physical, Chemical, & Microbiological Monitoring Network. In these instances, staff in ARM Section are responsible for data collection at these sites. SCDES has committed to EPA that all 319-funded implementation projects will be monitored at the associated water quality monitoring site(s) for the life of the project, plus a minimum of two additional years. The NPS program is also committed to monitoring in at least one implementation watershed identified by the NRCS NWQI program. The data collected are also used to develop reports on water quality improvement and success stories for annual submission to EPA.

## 7. [Ocean Water Monitoring](#)

The objective of South Carolina's Ocean Water Monitoring program is to protect public health through the issuance of swimming advisories based on accurate, representative sampling.

Tier 1 beaches are accessible beaches that have a high or medium likelihood of a bacteria event occurring, such as stormwater outfalls, and are highly used. Tier 2 beaches are accessible beaches with a medium or low risk of a bacteria event occurring (no known possible pollution source) and have a medium or low use.

Sampling sites are located along the beachfront based on public access points. Additional sites are located near problem areas such as swashes and storm drain outfalls. Each site location has been recorded with global positioning systems (GPS) technology and mapped. Samples are collected at knee depth (approximately two feet) to best represent the area where recreation normally occurs. See Appendix E for sample site locations at the time of this publication. As swimming season approaches some modification to sample sites may be made.

Table 1. Ocean Water Monitoring design

|                                        |                                            | Tier 1                                                                                                                                                                                                                                   | Tier 2                                                |
|----------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| A. When to Conduct Basic Sampling      |                                            | May 1 - October 1 Once per week Random tidal stages                                                                                                                                                                                      | May 1 - October 1 Twice per month Random tidal stages |
| B. When to Conduct Additional Sampling | Rainfall events                            | N/A                                                                                                                                                                                                                                      | N/A                                                   |
|                                        | After a water quality standard is exceeded | If any sample exceeds the action level a repeat sample will be taken within 24 hours of result notification, except where a permanent advisory sign is in place.                                                                         |                                                       |
|                                        | After a sewage spill or pollution event    | Sampling will be conducted as soon as possible following a sewage spill or other pollution event. At the region manager's discretion, beaches will be preemptively placed under advisory until satisfactory sample results are received. |                                                       |
|                                        | Reopening after advisory or closure        | Additional samples shall be taken following an advisory until sample results fall below the action level and advisory is lifted.                                                                                                         |                                                       |

Further information regarding the monitoring design and sample site selection criteria can be found in *South Carolina Beach Monitoring Program Quality Assurance Project Plan*, Appendix B.

## 8. [Shellfish Growing Area Water Quality Monitoring](#)

The shellfish-monitoring program provides the data that are used in conducting a comprehensive evaluation of each shellfish growing area. Evaluations of growing areas, which meet National Shellfish Sanitation Program (NSSP) requirements for Triennial Reviews, are conducted annually. Routine bacteriological monitoring and subsequent laboratory analyses of water quality from strategically located sample sites are conducted monthly. Monitoring is based on a systematic random sampling methodology in which coastal shellfish growing area surface waters are sampled in accordance with a pre-established schedule, thereby assuring that a statistically representative cross-section of meteorological, hydrographic, and/or pollution events will be included in the data set.

Monitoring sites are established at locations representative of variable water quality within non-Prohibited classified shellfish areas. Locations are sited with the intent of determining compliance with existing State shellfish regulation water quality standards. Individual monitoring sites are typically

representative of a water reach extending in the directions of tidal flow to the closest adjacent monitoring sites. Resulting laboratory analyses detail physical and bacteriological data that are used to classify shellfish growing waters. All standards, monitoring methodology, and laboratory analyses comply with guidance set forth in the National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish 2023 Revision, <https://www.fda.gov/media/181370/download?attachment>. Areas closed to the harvesting of shellfish are posted with signs indicting the potential for serious illness from consuming shellfish harvested within these areas and outlining penalties for harvest violations.

The monitoring network also serves to update sanitary-related data from each shellfish area to ensure that conditions that existed during the prior review period still prevail; that the harvest classification is correct; and ultimately that shellfish are harvested only from growing areas that meet or exceed established standards for shellfish growing waters.

For more information see the Shellfish Monitoring Program overview at <https://des.sc.gov/programs/bureau-water/aquatic-science/shellfish-monitoring-program-overview>.

## D. Core and Supplemental Water Quality Indicators

**Because limited resources affect the design of water quality monitoring programs, the State should use a tiered approach to monitoring that includes a core set of baseline indicators selected to represent each applicable designated use, plus supplemental indicators selected according to site-specific or project-specific decision criteria [1, 2].** Using this tiered approach, the State should be able to make the best use of its resources to meet water quality decision needs, including assessing water quality standards attainment and designated use support, identifying needed changes to water quality standards, describing causes and sources of impairments, developing water quality-based source controls, and assessing whether physical, chemical, and biological integrity are supported.

The monitoring strategy should define a **core** set of indicators (e.g., water quality parameters) for each water resource type that include physical/habitat, chemical/toxicological, and biological/ecological endpoints as appropriate, that reflect designated uses, and that can be used routinely to assess attainment with applicable water quality standards throughout the State.

The strategy should also describe a process for identifying **supplemental** indicators to monitor when there is a reasonable expectation that a specific pollutant may be present in



a watershed, when core indicators indicate impairment, or to support a special study such as screening for potential pollutants of concern.

Each program has identified the Core parameters necessary to address their primary programmatic goals. Supplemental indicators generally are informative but not required to meet the primary programmatic goals.

Core and Supplemental indicators may be added as new standards are developed, new parameters of special interest are identified, or new programmatic goals are developed.

Table 2. Core and Supplemental Indicators - Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring

Collected at all Base Sites and Statistical Survey Sites.

|                        | <b>Aquatic Life Use Support</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Recreational Use Support</b>                                                                                                       |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Core Indicators</b> | <p><b>All sites:</b><br/>           Water Temperature<br/>           Dissolved Oxygen<br/>           pH<br/>           Turbidity<br/>           Ammonia Nitrogen<br/>           Cadmium<br/>           Chromium<br/>           Copper<br/>           Lead<br/>           Mercury<br/>           Nickel<br/>           Zinc</p> <p><b>Additional indicator at all freshwater sites:</b><br/>           Hardness</p> <p><b>Additional indicator at all freshwater stream sites:</b><br/>           Total Suspended Solids</p> <p><b>Additional indicators for all lake sites:</b><br/>           Chlorophyll-a<br/>           Microcystin<br/>           Total Nitrogen<br/>               (Nitrate/Nitrite Nitrogen + Total Kjeldahl Nitrogen)<br/>           Total Phosphorus</p> | <p><b>All freshwater sites:</b><br/> <i>E. coli</i> Bacteria</p> <p><b>All saltwater sites:</b><br/> <i>Enterococcus</i> Bacteria</p> |

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                     |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                                       | <p><b>Additional indicator for all saltwater sites:</b><br/>Salinity</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                     |
| <p><b>Supplemental Indicators</b></p> | <p><b>All Sites:</b><br/>Air Temperature<br/>Depth of Sample Collection<br/>Five-Day Biochemical Oxygen Demand<br/>Nitrate/Nitrite Nitrogen<br/>Total Kjeldahl Nitrogen Total Phosphorus<br/>Iron<br/>Manganese</p> <p><b>Select Sites:</b><br/>Alkalinity<br/>Total Suspended Solids</p> <p><b>Additional indicators for lakes:</b><br/>Transparency (Secchi depth)</p> <p><b>Additional indicators at saltwater sites:</b><br/>Tide Stage<br/>Specific Conductance<br/>Salinity</p> <p><b>All Sites:</b><br/>Other chemicals of concern in water column or sediment</p> | <p><b>All Sites:</b><br/>Other chemicals of concern in water column or sediment</p> |

Special Request sites and §319 sites are generally sampled for the indicators listed in Table 2, or a subset, based on the specific data needs for the specific project.

Similarly Ambient Surface Water Physical & Chemical Continuous Monitoring indicators are specific to the individual project. Such special studies require a separate project specific QAPP.

Table 3. Core and Supplemental Indicators - Macroinvertebrate Bioassessment

|                                |                                                                                           |
|--------------------------------|-------------------------------------------------------------------------------------------|
| <b>Core Indicators</b>         | Macroinvertebrate community condition                                                     |
| <b>Supplemental Indicators</b> | Habitat Assessment<br>Water Temperature<br>Dissolved Oxygen<br>pH<br>Specific Conductance |

Table 4. Core and Supplemental Indicators - Fish Tissue Monitoring

|                                |                                               |
|--------------------------------|-----------------------------------------------|
| <b>Core Indicators</b>         | Mercury in fish tissue                        |
| <b>Supplemental Indicators</b> | PCBs in fish tissue at select sites as needed |

Table 5. Core and Supplemental Indicators - Ocean Water Monitoring

|                        |                              |
|------------------------|------------------------------|
| <b>Core Indicators</b> | <i>Enterococcus</i> bacteria |
|------------------------|------------------------------|

Table 6. Core and Supplemental Indicators - Shellfish Growing Area Water Quality Monitoring

|                                |                                                                                                                                                                                                                             |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Core Indicators</b>         | Fecal Coliform Bacteria                                                                                                                                                                                                     |
| <b>Supplemental Indicators</b> | Date & Time<br>Weather Conditions<br>Tidal Stage<br>Water Temperature<br>Air Temperature<br>Wind Direction<br>Salinity<br>Other – radionuclides or other sources of poisonous or deleterious substances in the growing area |

## E. Quality Assurance

**Quality Management Plans and Quality Assurance Project Plans are developed, maintained, and peer reviewed in accordance with EPA policy to ensure the scientific validity of monitoring and laboratory activities.**

### Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring

All sampling procedures and analyses are performed under the SCDES Quality System which is described in the USEPA approved Quality Management Plan for SCDES under the supervision of the Quality Assurance Manager (QAM). All SCDES Ambient Surface Water Quality Monitoring Program samples are collected by, and field measurements conducted by, BRLS personnel from the corresponding SCDES Field Laboratory District Office or ARM personnel from the Central Office in accordance with the SCDES Quality Management Plan, Table 7. All sample collection procedures and field measurements follow the most current revisions of SCDES’s *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, *SCDES Quality Management Plan, Level 100 Quality SOP series*, and *Level 200 Surface Water SOP series* listed in Table 7. All laboratory analyses are performed according to the most current revisions of SCDES’s *Procedures and Quality Control Manual for Chemistry Laboratories* and the *Laboratory Procedures Manual for Environmental Microbiology*, and Chlorophyll and Cyanotoxin SOPs listed in Table 7.

These are living documents and any reference to a specific document refers to the most current updated version.

Table 7. Quality Assurance and Standard Operating Procedures Documents

| SOP Document                                                                                                                                                                                             | Revision Date            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| South Carolina Department of Health and Environmental Control, Environmental Affairs. Quality Management Plan                                                                                            | Revision 2.2, 5/12/2023. |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 100 – EA QMP Components             | Revision 1.1, 12/17/2019 |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 101 – Control of Nonconforming Work | Revision 1.1, 12/17/2019 |

| SOP Document                                                                                                                                                                                                                                                                    | Revision Date            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 102 - Field Competency, Proficiency, and Corrective Action                                                 | Revision 1.1, 12/19/2019 |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 104 - Field Equipment Traceability, Maintenance, and Calibration                                           | Revision 1.1, 12/17/2019 |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 105 - Field Sampling Quality Control                                                                       | Revision 1.1, 12/18/2019 |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 106 - Standard Office Cleaning Procedures                                                                  | Revision 1.1, 12/18/2019 |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 107 - Standard Field Cleaning Procedures                                                                   | Revision 1.1, 12/19/2019 |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 108- Sample Containers, Preservation, and Maximum Holding Times for Chemistry and Microbiological Analyses | Revision 1.0, 12/01/2019 |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 109 – Field Data Review and Verification                                                                   | Revision 1.0, 01/02/2020 |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 200 - Ambient Surface Water Sampling                                                                       | Revision 1.1, 1/2/2020   |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 201 - Field Temperature Measurement in Surface Water                                                       | Revision 1.0, 05/01/2018 |

| SOP Document                                                                                                                                                                                                                                                                                                                                                      | Revision Date                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 202 - Field Dissolved Oxygen Measurement in Surface Water                                                                                                                                    | Revision 1.0, 05/01/2018       |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 203 - Field pH Measurement in Surface Water                                                                                                                                                  | Revision 1.0, 05/01/2018       |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 204 - Field Specific Conductance Measurement in Surface Water                                                                                                                                | Revision 1.0, 05/01/2018       |
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services. Field Quality Plan (Standard Operating Procedures), BEHSPROC 205 - Multi-Parameter Field Measurements in Surface Water                                                                                                                                    | Revision 1.0, 05/01/2018       |
| South Carolina Department of Health and Environmental Control, Analytical and Radiological Services Division – <i>Procedures and Quality Control Manual for Chemistry Laboratories</i>                                                                                                                                                                            | Revision by individual Section |
| South Carolina Department of Health and Environmental Control, Analytical and Radiological Services Division – <i>Procedures and Quality Control Manual for Microbiology Laboratories</i>                                                                                                                                                                         | Revision by individual Section |
| <a href="https://dhecnet.dhec.sc.gov/eqc/envserv/sopqamannual.htm">South Carolina Department of Health and Environmental Control. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.</a><br><a href="https://dhecnet.dhec.sc.gov/eqc/envserv/sopqamannual.htm">https://dhecnet.dhec.sc.gov/eqc/envserv/sopqamannual.htm</a> | No Revision Date               |
| South Carolina Department of Health and Environmental Control, Bureau of Water, Division of Water Monitoring, Assessment, and Protection. Standard Operating Procedure for Continuous Monitoring of Ambient Surface Water                                                                                                                                         | Version: February 2018         |
| South Carolina Department of Health and Environmental Control, Bureau of Water. Chlorophyll A Laboratory Methods                                                                                                                                                                                                                                                  | Revision 6.0,<br>May 20, 2024  |
| South Carolina Department of Health and Environmental Control, Bureau of Water. Algal Bloom and Cyanotoxin Field Collection Standard Operating Procedures.                                                                                                                                                                                                        | February 23, 2021              |

| SOP Document                                                                                                                                                | Revision Date                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| South Carolina Department of Health and Environmental Control, Bureau of Water. Determination of Total Microcystins and Cylindrospermopsin in Ambient Water | Revision 2.0, February 28, 2022 |

### Ambient Surface Water Physical & Chemical Continuous Monitoring

All continuous monitoring procedures and data analyses are performed in accordance with the Bureau of Water’s, *Standard Operating Procedure for Continuous Monitoring of Ambient Surface Water*.

Calibration, verification, and validation criteria for continuous monitoring data are listed in the SOP. Failure to meet these criteria during instrument calibration and verification requires that the calibration be performed again, and it may include troubleshooting the datasonde in accordance with the manufacturer’s specific guidance. Post-deployment verification occurs prior to cleaning and maintaining the datasonde. If verification fails the first time, the datasonde is cleaned and the verification is performed again.

Post processing of the data may be performed according to the *Standard Operating Procedure for Continuous Monitoring of Ambient Surface Water*. The data may still be used if it meets the Maximum Allowable Limits for Data Adjustment listed in SOP and if it meets data quality objectives.

Table 8. Ambient Surface Water Physical & Chemical Continuous Monitoring SOP

| SOP Document                                                                                                                                                                                                              | Revision Date          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| South Carolina Department of Health and Environmental Control, Bureau of Water, Division of Water Monitoring, Assessment, and Protection. Standard Operating Procedure for Continuous Monitoring of Ambient Surface Water | Version: February 2018 |

### Macroinvertebrate Bioassessment

All sampling procedures and analyses are performed under the SCDES Quality System which is described in the USEPA approved *Quality Management Plan for S.C. DHEC*, under the supervision of the Quality Assurance Manager (QAM). All procedures will follow the most current revision of SCDES’s *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Sections 8, 14, and 19, and *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling*, Technical Report No. 0914-17.

Table 9. Macroinvertebrate Bioassessment SOP

| SOP Document                                                                                                                                                                                          | Revision Date                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| South Carolina Department of Health and Environmental Control, Bureau of Water, Division of Water Pollution Control. Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling | Technical Report No. 0914-17 |

Fish Tissue Monitoring

All sampling procedures and analyses are performed under the SCDES Quality System which is described in the USEPA approved *Quality Management Plan for S.C. DHEC*, under the supervision of the Quality Assurance Manager (QAM). All procedures will follow the most current revision of SCDES’s *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Sections 8, 14, and 19. All laboratory analyses are performed according to the most current revision of SCDES’s *Procedures and Quality Control Manual for Chemistry Laboratories*.

Table 10. Fish Tissue Monitoring SOP

| SOP Document                                                                                                                                                                                                    | Revision Date               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| South Carolina Department of Health and Environmental Control, Bureau of Water, Division of Water Monitoring, Assessment, and Protection. Standard Operating Procedure for Fish and Shellfish Tissue Collection | Technical Report No. 003-01 |

Chlorophyll & Cyanotoxin Monitoring

All sampling procedures and analyses are performed under the SCDES Quality System which is described in the most current USEPA approved *Quality Management Plan for S.C. DHEC*, under the supervision of the Quality Assurance Manager (QAM). All procedures follow SCDES *Technical Report 06609-15* and the standard operating procedures of *Chlorophyll-a Laboratory Methods and Determination of Total Microcystins and Cylindrospermopsin in Ambient Water*, Table 7.

Section 319 Nonpoint Source Monitoring

All sampling procedures and analyses are performed under the SCDES Quality System which is described in the USEPA approved Quality Management Plan for SCDES under the supervision of the Quality Assurance Manager (QAM). All SCDES field personnel follow the most current revision of SCDES’s *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, *SCDES Quality Management Plan, Level 100 Quality SOP series*, and *Level 200 Surface Water SOP series* as appropriate. All laboratory



analyses are completed in accordance with SCDES *Procedures and Quality Control Manual for Chemistry Laboratories* and *Laboratory Procedures Manual for Environmental Microbiology*, Table 2. Macroinvertebrate sampling is performed following *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling*, Technical Report No. 0914-17, Table 9.

Ocean Water Monitoring

All sampling procedures and analyses are performed in accordance with the *South Carolina Beach Monitoring Program Quality Assurance Project Plan* and BEHSPROC701 - Standard Operating Procedure Ocean Water Sampling.

Table 11. Ocean Water Monitoring SOP

| SOP Document                                                                                                                                                               | Revision Date                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| South Carolina Department of Health and Environmental Control, Bureau of Environmental Health Services.<br>BEHSPROC701 - Standard Operating Procedure Ocean Water Sampling | Revision 1.2,<br>October 07, 2020 |

Shellfish Growing Area Water Quality Monitoring

Shellfish Sanitation Program monitoring complies with most current revision of SCDES’s *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Section 8.10, and all laboratory analyses are conducted by ARESD according to the most current revision of SCDES’s *Laboratory Procedures Manual for Environmental Microbiology*.

## F. Data Management

**The State uses an accessible electronic data system for water quality, fish tissue, toxicity, sediment chemistry, habitat, and biological data (following appropriate metadata and State/Federal geo-locational standards) with timely data entry and public access.**

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Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring

Routine ambient surface water physical, chemical, microbiological, and algal samples are collected by Regional BRLS or Aquatic Resource Monitoring personnel. Some specific analyses are conducted in the Regional Laboratories, others by the Central Laboratory, and algal samples by Aquatic Resource Monitoring staff.

Appropriate physical, hardcopy Chain-Of-Custody (COC)/analytical request sheets are filled out by the individual making the field measurements and collecting the samples. These COC/analytical request sheets are delivered to the appropriate Regional Laboratory along with the samples.

Results for analyses conducted in the Regional Laboratories are entered into LIMS and reported on the appropriate hardcopy COC/analytical request sheets released by the sample custodian for the region. The physical COC/analytical request sheets are sent to the ARES in Columbia and are then sent to the appropriate program areas, Figure 2.

Samples for analysis in the Central Laboratory are shipped from the Regional Laboratories via State Courier, along with copies of the COC/analytical request sheets.

All Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring Chain-Of-Custody/analytical request sheets are received by Aquatic Resource Monitoring Section from the Data Management Section, BRLS, both in hardcopy and electronic copy PDF form. The field data recorded on the COC/analytical request sheets are reviewed by ARM staff, verified, edited if necessary, and stored into the IMAP database.

IMAP is an internal tool used by Regional staff to schedule, track, and ensure proper sample collection for each monitoring site, and as the internal intermediate data repository before the data are pushed to WQX and eventually to the National Water Quality Monitoring Council's Water Quality Portal water quality database at <https://www.waterqualitydata.us/>.

IMAP is also linked to LIMS for the purpose of identifying data to be uploaded to WQX. IMAP checks LIMS nightly to identify analytical results released by the lab each day and the newly released results are uploaded to IMAP.

The Aquatic Resource Monitoring Section performs a 100 percent review of all field data in IMAP to ensure quality assurance of the data.

The data are uploaded to the National Water Quality Monitoring Council's Water Quality Portal water quality database at <https://www.waterqualitydata.us/> as staff time permits, at least annually. Data sheets are kept on file in the Aquatic Resource Monitoring.

IMAP is also used by the Beach Monitoring Program to enter beach sampling data and to track swimming advisories.

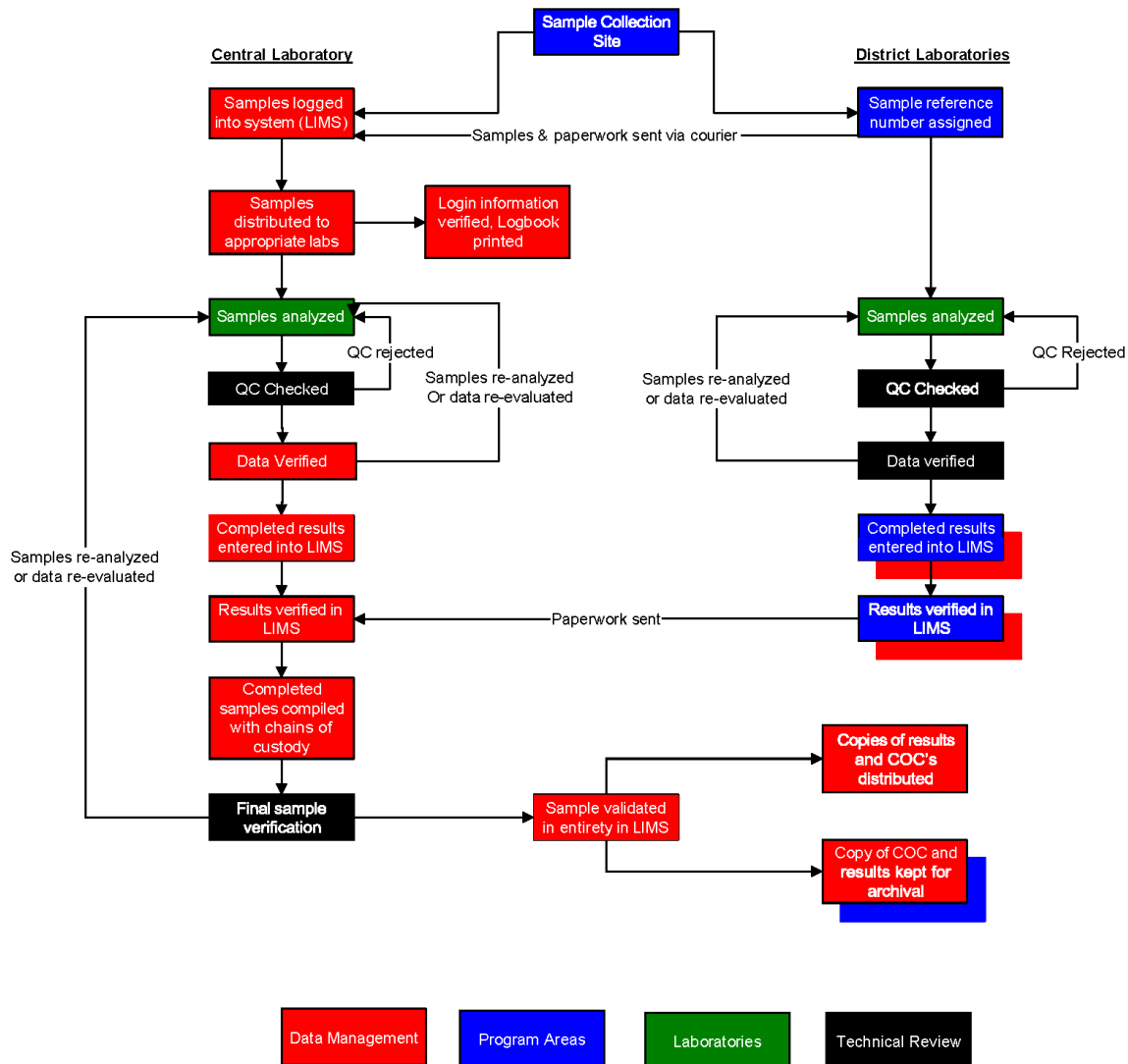


Figure 2. Ambient Discrete Monitoring Data Flow Within BRLS

### Ambient Surface Water Physical & Chemical Continuous Monitoring

Ambient surface water continuous monitoring activities are conducted as part of special surface water studies aimed at site-specific numeric nutrient and chlorophyll-a criteria development. These data are produced in accordance with a project-specific QAPP and are managed by the study's project manager. Data are retrieved from the instrument immediately in the field or upon returning to the laboratory. Raw data files are transferred to a project-specific SCDES SharePoint site and are then downloaded to a project-specific SCDES server folder. These raw

data files and a final processed data file are stored on the SCDES server in a project-specific folder which is backed-up nightly. Physical logbooks noting calibration and end-deployment verification are maintained by the project manager in perpetuity. A digital logbook is also housed in perpetuity on the project-specific SCDES SharePoint site. Summaries of these data are also provided in the final report requirement for each project.

#### Macroinvertebrate Bioassessment

Habitat and p-chem data are recorded on a habitat form in the field, and p-chem data is also recorded in Field Logbook. Macroinvertebrate IDs are recorded on bench sheets in lab. Macroinvertebrate, habitat, and p-chem data are entered manually into an in-house Microsoft Access dedicated macroinvertebrate database maintained by ARMS macroinvertebrate samplers. The database itself is not publicly available, but all data within is available by request through the Freedom of Information Act.

#### Fish Tissue Monitoring

After samples are collected, all data sheets are kept on file in the Aquatic Resource Monitoring Section until sample analysis is completed. Fish tissue results are entered into an in-house Excel database and hard copies are filed and kept by the ARMS on site. The tissue data are currently being entered and stored in a separate database that will be uploaded to WQX and National Water Quality Monitoring Council's Water Quality Portal water quality database at <https://www.waterqualitydata.us/>.

#### Chlorophyll & Cyanotoxin Monitoring

Chlorophyll- $\alpha$  and cyanotoxin data are placed in National Water Quality Monitoring Council's Water Quality Portal water quality database at <https://www.waterqualitydata.us/> where it is directly accessible by the general public. At a minimum, chlorophyll- $\alpha$  and cyanotoxin data are entered into the Water Quality Portal annually.

#### Section 319 Nonpoint Source Monitoring

Routine Section 319 Nonpoint Source Monitoring stream grab samples are collected by the Section 319 Sampling Program Coordinator within the Aquatic Resource Monitoring Section. Sample analyses are conducted by the Regional Laboratories or by the Central Laboratory. Data management for Section 319 Nonpoint Source Monitoring follows Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring protocols described above.

Macroinvertebrate bioassessment sampling and data management for Section 319

Nonpoint Source Monitoring follows the same protocols as the Macroinvertebrate Bioassessment program described above.

### Ocean Water Monitoring

Copies of the completed Ocean Water Quality Sampling Data forms (DHEC 2508) are entered into IMAP by the Program Coordinator in Central Office. A hard copy of the form is maintained by the Field Laboratory and the original is sent to the Central Office. Data sheets are kept for three years per the retention schedule. At the end of the beach season, all data are distributed to the EPA. Data are also available to the public by request and on the beach access website <http://gis.dhec.sc.gov/beachaccess/>.

### Shellfish Growing Area Water Quality Monitoring

Shellfish growing area water quality data are stored in WQX. Individual data collected subsequent to the mid-1990s are available through FOI request in an electronic format. All monitoring sites are represented in a digital coverage located on the Department's GIS server.

## G. Data Analysis/Assessment

**The State has a methodology for assessing attainment of water quality standards based on analysis of various types of data (chemical, physical, biological, land use) from various sources, for all waterbody types and all State waters.**

### Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring

The SCDES solicitation of data, data sources, data analysis and assessment methodology used to make attainment decisions about State waters is included as part of the Integrated Report, specifically Part I: Listing of Impaired Waters. Further discussion of the assessment and listing methods can be found in Appendix H: Assessment Methodology. The Integrated Report is submitted to EPA on even numbered years for review and approval. The most recent version is published in the most current version of the *State of South Carolina Integrated Report Part I: Listing of Impaired Waters* which can be found on the SCDES website at <https://des.sc.gov/programs/bureau-water/south-carolina-303d-list-impaired-waters-tmdls>.

### Ambient Surface Water Physical & Chemical Continuous Monitoring

Currently, continuous monitoring is only conducted as part of special studies. Each

individual study has a project-specific approved QAPP which outlines continuous monitoring objectives. Continuous monitoring spread sheet data produced as part of special studies are stored in project-specific folders on the SCDES server. These data are summarized in a final report which is generally a project requirement. These reports receive SCDES Technical Report numbers and are uploaded to the SCDES website. Continuous monitoring data are not assessed as part of agency 303d reporting requirements. These data generally support watershed, hydrodynamic, and water quality modeling efforts to derive TMDLs and/or site-specific numeric nutrient and chlorophyll-a water quality criteria.

### Macroinvertebrate Bioassessment

Macroinvertebrate bioassessment data are utilized in the SCDES Integrated Report assessment to make aquatic life use attainment decisions about State streams. These assessment decisions are discussed in the Integrated Report Assessment Methodology, Appendix H, The Integrated report is submitted to EPA on even numbered years for review and approval. The most recent is published in the current version of the *State of South Carolina Integrated Report Part I: Listing of Impaired Waters* which can be found on the SCDES website at <https://des.sc.gov/programs/bureau-water/south-carolina-303d-list-impaired-waters-tmdls>.

### Fish Tissue Monitoring

A risk-based approach is used by SCDES to evaluate contaminant concentrations in fish tissue and to issue consumption advisories in affected waterbodies. This approach compares the average daily exposure dose to the reference dose (RfD). Using these relationships, fish tissue data are interpreted by determining the consumption rates that would not likely pose a health threat to adult males and nonpregnant adult females. Because an acceptable RfD for developmental neurotoxicity has not been developed and because scientific studies suggest that exposure before birth may have adverse effects the health of infants, pregnant women, infants, and children are advised to avoid consumption of fish from any waterbody where an advisory has been issued.

Fish tissue data are utilized in the SCDES Integrated Report assessment to make aquatic life use attainment decisions about State waters. These assessment decisions are discussed in the Integrated Report Assessment Methodology, Appendix H, The Integrated report is submitted to EPA on even numbered years for review and approval. The most recent is published in the current version of the *State of South Carolina Integrated Report Part I: Listing of Impaired Waters* which can be found on the SCDES website at <https://des.sc.gov/programs/bureau-water/south-carolina-303d-list-impaired-waters-tmdls>.

### Chlorophyll & Cyanotoxin Monitoring

Chlorophyll- $\alpha$  and cyanotoxin data are utilized in the SCDES Integrated Report assessment to make aquatic life and recreational use attainment decisions about State reservoirs. These assessment decisions are discussed in the Integrated Report Assessment Methodology, Appendix H. The Integrated report is submitted to EPA on even numbered years for review and approval. The most recent is published in the current version of the *State of South Carolina Integrated Report Part I: Listing of Impaired Waters* which can be found on the SCDES website at <https://des.sc.gov/programs/bureau-water/south-carolina-303d-list-impaired-waters-tmdl>.

### Section 319 Nonpoint Source Monitoring

Section 319 Grant Nonpoint Source Monitoring data is assessed annually to identify changes in water quality which may result from current or completed implementation efforts. Data is collected from the beginning of the project until at least two years after project completion and assessed for parameters relevant to the project focus. Assessments are utilized to monitor progress and success of Section 319 Grant implementation projects and, ultimately, support evaluation of water quality improvement of §303(d) impaired sites. These evaluations are detailed in the Nonpoint Source Program Annual Report and submitted to EPA.

### Ocean Water Monitoring

Swimming advisories are issued based on a single sample limit of 500 Enterococci/100 mL or a single sample exceeding 104 Enterococci/100 mL followed by a repeat sample exceeding 104 Enterococci/100 mL. An advisory may also be issued with the first sample greater than 104 Enterococci/100 mL if there is a potential source of bacteria nearby, such as a swash or stormwater drainage pipe. When an extreme weather event, such as a hurricane, tropical storm, or torrential rain occurs, a general advisory may be issued without current sampling data. It is known that significant rainfall within a 24-hour period causes elevated bacteria counts that exceed the advisory action levels at some stations. Data assessment procedures can be found in the *South Carolina Beach Monitoring Program Quality Assurance Project Plan* Appendices D and E.

### Shellfish Growing Area Water Quality Monitoring

S.C Regulation 61-47, Shellfish, has established a fecal coliform standard (geometric mean not to exceed 14 fc mpn/100ml and the estimated 90th percentile value not to exceed 43 mpn/100ml) for waters classified as Approved. Sites are monitored on a monthly basis, with monitoring scheduled in advance so as to be random with

respect to tide and weather conditions. Data collected over a consecutive, thirty-six-month period is used in determining compliance. A minimum of thirty samples is required to be collected from each monitoring site for classification. This standard and methodology fully complies with National Shellfish Sanitation Program Model Ordinance guidance criteria. All shellfish waters receive one of the following harvest classifications: Approved, Conditionally Approved, Restricted, Conditionally Restricted, or Prohibited.

## H. Reporting

**The State produces timely and complete water quality reports and lists.** The Clean Water Act requires the State to provide certain reports and lists, including those listed below. EPA encourages consolidation of reports wherever possible.

- The Section 305(b) water quality inventory report, which includes Section 314 Lakes Assessments, characterizes the condition and quality trends of monitored waters within the State and is due on April 1 of even-numbered years. This is the primary State monitoring program report to EPA and draws upon information from the Clean Lakes program, nonpoint source program, TMDLs, and other national, State, and local assessments.
- The Section 303(d) list identifies all impaired waters based on existing and readily available information. The list is also due on April 1 of even-numbered years.
- Section 406 of the Clean Water Act, as amended by the Beaches Environmental Assessment and Coastal Health Act of 2000, requires States with Section 406 grants to submit information on monitoring and notification programs for coastal recreation waters.

### Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring

Data generated by the Ambient Surface Water Physical, Chemical, Microbiological, & Algal Discrete Monitoring Program are used routinely in the preparation of the biennial Integrated Report, which addresses the CWA §303(d), §305(b), and §314 reporting requirements. These reports are available on the SCDES website <https://des.sc.gov/programs/bureau-water/south-carolina-303d-list-impaired-waters-tmdls>. CWA §303(d) and §305(b) assessment results are reported to EPA's ATTAINS.

These data are available both internally and publicly and may be used by other program areas for various purposes, including triennial water quality standards reviews, use attainability analyses (UAAs), standards revisions, water quality-based



effluent limits (WQBELs) in permits, total maximum daily loads (TMDLs), nonpoint source programs, and other watershed plans.

### Ambient Surface Water Physical & Chemical Continuous Monitoring

Continuous monitoring data are reported in the final report for which the data was collected.

### Macroinvertebrate Bioassessment

Macroinvertebrate community assessment conclusions are shared within the Aquatic Resource Monitoring for consideration in the development of assessments pursuant to §303(d) and §305(b) of the Clean Water Act.

### Fish Tissue Monitoring

Fish tissue monitoring results are forwarded to the Aquatic Resource Monitoring Section for continued incorporation into existing fish consumption advisories. These results are utilized in assessments for §303(d) of the Clean Water Act. Advisories are communicated to the public through the SCDES Fish Consumption Advisory website, as well as physical advisory signs at most public boat landings.

### Chlorophyll & Cyanotoxin Monitoring

Chlorophyll-a and cyanotoxin assessment conclusions are forwarded to Aquatic Resource Monitoring for consideration in the preparation of the biennial Integrated Report, which addresses Clean Water Act §303(d), §305(b), and §314 reporting requirements. These reports are available on the SCDES website.

Statewide cyanotoxin monitoring sites, as well as current swimming advisories and watches, can be viewed at [GIS Harmful Algal Bloom Monitoring App](#). Simply click on a highlighted waterbody to learn more about advisories/watches at that location or use the search feature to locate specific waterbodies on the map.

### Section 319 Nonpoint Source Monitoring

Water quality data for Section 319 Grant project areas is used to identify water quality improvements and project successes to ultimately be reported to the EPA Nonpoint Source Program. A success story that demonstrates measurable water quality improvement or other programmatic successes as a result of Section 319 Grant implementation is developed and submitted to EPA annually. Additionally, water quality improvements are reported in the Grants Reporting and Tracking System (GRTS) for EPA review, included in the SC Nonpoint Source Program Annual Report, and shared with partner organizations including NRCS NWQI program.

## Ocean Water Monitoring

In the event of an advisory, signs will be posted at conspicuous areas on the affected beach, if needed. Some sampling sites are permanently advised. Beach advisory signs include a statement that explains that swimming is not advised due to high bacteria levels in the water, but that wading, fishing, and shell collecting do not pose a risk, and it also lists contact information.

Advisories are also available through the SCDES Beach Monitoring website and beach access website. SCDES and local partners developed CheckMyBeach.com to educate and direct people to actively check advisories online. For beaches not participating in CheckMyBeach.com, the local media outlets are contacted via press release. A copy of the advisory is sent by electronic mail to the program coordinator and the respective coastal regional office (Myrtle Beach, Beaufort, and Charleston). All advisory data are distributed to the EPA annually, at a minimum. Further information regarding reporting is available in the *South Carolina Beach Monitoring Program Quality Assurance Project Plan*, Section A9 and Appendix C.

## Shellfish Growing Area Water Quality Monitoring

The Shellfish Sanitation Program produces annual reports for each of the twenty-five shellfish management areas documenting their harvesting classification status. Physical signs reflecting each area's classification status are posted in each designated harvesting area. These reports are routinely distributed to the United States Food and Drug Administration, the South Carolina Department of Natural Resources, the Department's Office of Coastal Resource Management, and the Department's Bureau of Water – Aquatic Science Division. All reports are updated annually and are available for viewing on the Department's Shellfish Sanitation Program webpage located at <https://des.sc.gov/programs/bureau-water/aquatic-science/shellfish-monitoring-program-overview/shellfish-monitoring-station-reports>.

## I. Programmatic Evaluation

**The State, in consultation with its EPA Region, conducts periodic reviews of each aspect of its monitoring program to determine how well the program serves its water quality decision needs for all State waters, including all waterbody types.** This evaluation will take into consideration the effects of funding shortfalls on a State's implementation of its monitoring program strategy.

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The South Carolina ambient monitoring strategy as described in this document represents a comprehensive approach to address the goals and objectives discussed in Section A. Monitoring Program Strategy. The Strategy is reviewed annually and as part of that process each program represented in the Strategy conducts a thorough review of their continuing monitoring activities and is updated as needed. This review includes an evaluation of new initiatives and emerging issues and provides the opportunity to incorporate changes to the monitoring activities to ensure that those are addressed.

SCDES, in consultation with EPA Region 4, conducts periodic reviews of each aspect of its monitoring program to determine how well the programs serve its water quality decision needs for all State waters, including all waterbody types. This involves evaluating the monitoring program to determine how well each of the elements is addressed and determining how needed changes and additions are incorporated into future monitoring cycles.

## J. General Support and Infrastructure Planning

**The State identifies current and future monitoring resources it needs to fully implement its monitoring program strategy.**

*Staff and Training*

*Laboratory Resources*

*Funding*

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### Wetlands Monitoring

SCDES has not traditionally conducted ambient monitoring in wetlands, nor do we maintain a network of wetlands sites that are routinely visited and sampled for traditional water quality parameters such as dissolved oxygen, bacteria, nutrients, metals, and organics. However, we have conducted limited monitoring of wetlands and have required limited compliance monitoring by permittees.

When SCDES issues a Water Quality Certification for unavoidable impacts to wetlands, the Certification will often have a requirement for compensatory mitigation provided through a mitigation bank or a permittee responsible mitigation site. Both types of sites generally have monitoring requirements to demonstrate success. Typical monitoring consists of requiring each compensation site to be evaluated on a site-specific basis and, if needed, hydrological and vegetative monitoring is required to show the creation, restoration, or enhancement of an area's hydrology or vegetation. Additionally, certain 401 Water Quality Certifications require wetlands

compliance monitoring to ensure that the predicted impacts are within expected ranges.

Further, SCDES has issued NPDES permits to several wastewater treatment plants where wetlands are the final receiving water. To determine if there are detrimental effects of the wastewater on the wetlands, SCDES imposes monitoring of the wetland through special conditions of the NPDES permit. Typically, this monitoring consists of ground and surface water quality, vegetation, and hydrological parameters, which are measured bi-annually and reported in an annual report, based on site-specific considerations.

If the State were to implement an ambient monitoring program for wetlands, it would be important to have wetlands water quality standards in place. Perhaps a more difficult obstacle is the resources required to maintain an ambient wetland monitoring program. For this to occur SCDES would need additional trained staff to conduct wetland monitoring and assess data.

### **SCDES Bioassessment Review**

During the Bioassessment Program Review conducted by the Midwest Biodiversity Institute (MBI, 2022) there were several notable recommendations:

- The need for the assessment of an additional biological assemblage in flowing streams.
- The development of a network of regional reference sites in South Carolina to initially supplement and eventually replace the current reliance on the North Carolina Department of Environmental Quality reference sites and reference condition.
- The need for a biological community assessment applicable to saltwater habitat.

### **Periphyton Monitoring**

SCDES is currently developing a periphyton monitoring program to serve as a second stream bioassessment program. The state currently utilizes the macroinvertebrate program as its sole means of assessing biological integrity in streams. The majority of states in EPA Region 4 utilize at minimum two biological assessment programs. The periphyton monitoring program will also facilitate development of numeric nutrient criteria for streams and rivers. These program goals would improve South Carolina's ability to effectively implement its monitoring strategy and meet EPA recommendations.

**Staff and Training:** Additional resources and training are anticipated after program development and needs are identified. Currently, one SCDES employee is allocated to the

periphyton program. As the monitoring program expands, funding for additional staff may be required. The agency is working to develop in-house taxonomy expertise for diatoms. The periphyton employee will attend training opportunities as schedules and budgeting allows.

Laboratory Resources: SCDES currently has one microscope that is sufficient for diatom assessment work. With the increased use, a schedule for regular maintenance will be required for this microscope. This will involve contracted services from microscope specialists.

Laboratory Resources: Additional funding for DNA analysis would expedite diatom taxonomic identification. The agency may also consider contracting consultants for taxonomic support to facilitate program expansion.

Funding: It is anticipated that the periphyton program will receive state funds in addition to or in place of Section 106 grants.

#### Establishing Macroinvertebrate Reference Sites for South Carolina

Macroinvertebrate sites in minimally developed watersheds are being looked at as candidates to establish as reference sites. In addition, SCDNR fish reference sites are being looked at to determine any of them that would be suitable as macroinvertebrate reference sites.

#### Incorporation of SCDNR SCECAP Benthic Index of Integrity

The South Carolina Estuarine and Coastal Assessment Program (SCECAP) has used a Benthic Index of Biological Integrity (B-IBI) since its inception in 1999. The B-IBI was developed specifically for South Carolina coastal waters (Van Dolah et al, 1999).

Discussions have recently begun with SCDNR about the use of the SCECAP B-IBI data as a biological condition assessment by SCDES for §303(d) and §305(b) reporting purposes.

SCDNR supports this approach, but before SCDES takes such action they want to review the 25 years' worth of SCECAP data and confirm their confidence in the validity of the current index cutpoints, as the use of this index for Clean Water Act reporting may have significant consequences on future growth and development along the South Carolina coast.

### **Additional Programmatic Development**

#### Sediment Monitoring

Aquatic sediments represent a historical record of chronic conditions existing in the water column. Pollutants bind to particulate organic matter in the water column and settle to the bottom where they become part of the sediment "record". Many pollutants may be

components of point source discharges, but may be discharged in a discontinuous manner, or at such low concentrations that water column sampling for them is impractical. Some pollutants are also common in nonpoint source runoff, reaching waterways only after a heavy rainfall, and therefore may be missed in the routine water column samples. As a result of this process of sedimentation, contaminant concentrations originating from irregular and highly variable sources are recorded in the sediment. The sediment concentrations at a particular location do not vary as rapidly with time as do the water column concentrations. Thus, the sediment record may be read at a later time not directly related to the actual discharge. By their nature reservoirs act as settling basins for materials entering the reservoir watershed directly from point source discharges or indirectly via nonpoint source runoff from the land surface. Therefore, it is not unusual for reservoir sediment concentrations to be higher than sediment concentrations found in streams.

SCDES sediment monitoring was discontinued following the budget cuts of 2009. As infrastructure development continues, changes in land use have the potential to introduce new and emerging contaminants. The risks posed by the introduction of these contaminants to State surface waters supports the need to restart sediment monitoring. Although there are no State or federal sediment quality standards, data may be compared to the EPA Ecological Risk Assessment (ERA) sediment guidelines published in Region 4 Ecological Risk Assessment Supplemental Guidance (2018). This guidance was developed by the U.S. Environmental Protection Agency (EPA) Region 4 Superfund Division's Scientific Support Section (SSS) risk assessment staff to update and replace all Region 4 Ecological Risk Assessment Supplemental Guidance and to supplement Agency guidance documents on site-specific Ecological Risk Assessment: Guidelines for Ecological Risk Assessment (GERA; EPA, 1998) published by the Risk Assessment Forum which provides agency-wide guidance. This supplemental guidance clarifies the National ERAGS guidance as interpreted and applied to Region 4.

This supplemental guidance provides direction but does not constitute rulemaking by the Agency. The intent of this guidance is to aid in the development of high-quality risk assessments consistent with the expectations of the SSS in its oversight role.

#### Alternative Analytical Methods for Total Nitrogen and Total Phosphorus

EPA recommends nutrient criteria for all waterbody types that includes total phosphorus (TP) and total nitrogen (TN).

Currently the only way to derive a total nitrogen value using 40 CFR 136 EPA approved methods, currently in use by the SCDES laboratory is as the sum of NO<sub>2</sub>/NO<sub>3</sub> and TKN. This approximation is imperfect and inexact since each individual parameter has reporting limits and often one or both results may be reported as below the reporting limit. Also, media interference in saltwater frequently results in laboratory error reporting for important nutrient parameters, including TP and especially the individual component

parameters used to calculate TN.

This hinders the development of meaningful nutrient criteria for saltwater. Even in freshwater systems, the individual component parameters used to calculate TN may be reported as below the reporting limit. Ideally to effectively develop scientifically defensible State TN standards a direct measure of total nitrogen is needed.

SCDES needs routine analyses for ambient monitoring to directly measure and quantify total nitrogen and phosphorus in all waters for nutrient standards development and subsequent standards attainment assessment.

EPA’s National Aquatic Survey program (NARS) doesn’t even use 40 CFR 136 EPA approved methods for TN. The EPA NARS program uses a performance-based approach that defines a set of laboratory method performance requirements for data quality as shown below.

**NCCA 2020 Total Nitrogen & Phosphorus Laboratory Method Performance Requirements**

PARAMETER	UNITS	POTENTIAL RANGE OF SAMPLES <sup>1</sup>	METHOD DETECTION LIMIT OBJECTIVE <sup>2</sup>	TRANSITION VALUE <sup>3</sup>	PRECISION OBJECTIVE <sup>4</sup>	ACCURACY OBJECTIVE <sup>5</sup>
Total Nitrogen (TN)	mg N/L	0.1 to 90	0.01	0.10	± 0.01 or ±10%	± 0.01 or ±10%
Total Phosphorous (TP) and Ortho-Phosphate	mg P/L	0 to 22 (as TP)	0.002	0.02	± 0.002 Or ±10%	± 0.002 Or ±10%

1 Estimated from samples analyzed at the EPA Western Ecological Division-Corvallis laboratory between 1999 and 2005

2 The method detection limit is determined as a one-sided 99% confidence interval from repeated measurements of a low-level standard across several calibration curves.

3 Value for which absolute (lower concentrations) vs. relative (higher concentrations) objectives for precision and accuracy are used.

4 For duplicate samples, precision is estimated as the pooled standard deviation (calculated as the root-mean square) of all samples at the lower concentration range, and as the pooled percent relative standard deviation of all samples at the higher concentration range. For standard samples, precision is estimated as the standard deviation of repeated measurements across batches at the lower concentration range, and as percent relative standard deviation of repeated measurements across batches at the higher concentration range. For pH precision, the looser criteria applies to mid-range samples. For NCCA, that is less of a concern than the ability to measure more acidic or basic samples accurately and precisely.

5 Accuracy is estimated as the difference between the measured (across batches) and target values of performance evaluation and/or internal reference samples at the lower concentration range, and as the percent difference at the higher concentration range.

## NCCA 2020 Total Nitrogen & Phosphorus Analytical Methods Used by Central Laboratory, EPA ORD-Corvallis)

ANALYTE	SUMMARY OF METHOD <sup>1</sup>	REFERENCES <sup>2</sup>	WRS SOP <sup>3</sup>
Total nitrogen (TN)	Persulfate Digestion; FIA Automated Colorimetric Analysis (Cadmium Reduction, sulfanilamide)	EPA 353.2 (modified) APHA 4500-N-C (modified) ASTM WK31786 U.S. EPA (1987) Lachat 10-107-04-1-C (modified)	WRS 34A.5 (April 2011)
Total phosphorus (TP) and ortho-Phosphate	Persulfate Digestion; Automated Colorimetric Analysis (molybdate, ascorbic acid)	APHA 4500-P-E USGS I-4650-03 U.S. EPA (1987) Lachat 115-01-1-B (modified)	WRS 34A.5 (April 2011)

<sup>1</sup> FIA=Flow injection analysis. AAS=Atomic Absorption Spectrometry

<sup>2</sup> U.S. EPA, 1987. *Handbook of Methods for Acid Deposition Studies: Laboratory Analyses for Surface Water Chemistry*. EPA/600/4-87/026. U.S. Environmental Protection Agency, Office of Research and Development, Washington D.C. APHA= American Public Health Association (*Standard Methods*). ASTM=American Society of Testing and Materials.

<sup>3</sup> WRS= Willamette Research Station. References are to laboratory SOP being used at central laboratory. Available upon request from the EPA HQ Laboratory Review Coordinator.

## K. References

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