QUALITY ASSURANCE PROJECT PLAN

Water Quality Modeling and Groundwater and Surface Monitoring
Georgia Department of Natural Resources
Environmental Protection Division
2023-27

Georgia Environmental Protection Division
Watershed Protection Branch
2 MLK, Jr., S.W., Suite 1470A, East Tower
Atlanta, Georgia 30334

WPMP-QAPP 4 rev 1
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USEPA Sections 106, 106 Supplemental Monitoring 104, 604 and 319 Monitoring

A. PROJECT MANAGEMENT

A1. Title and Approval Sheet

QUALITY ASSURANCE PROJECT PLAN

**WATER QUALITY MODELING AND
GROUNDWATER AND SURFACE MONITORING
GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
2023-27**

GAEPD Watershed Monitoring Manager: Elizabeth C. Booth **03/17/2023**
(Elizabeth Booth) (Date)

GAEPD Database/GIS Officer: Alyssa R. Peterson **03/17/2023**
(Alyssa Peterson) (Date)

GAEPD Quality Assurance Officer: Susan Salter **03/17/2023**
(Susan Salter) (Date)

USEPA Water Quality Monitoring Officer: Elizabeth Belk **04/10/2023**
(Elizabeth Belk) (Date)

FORWARD:

This document is the Quality Assurance Project Plan (QAPP) for the Georgia Environmental Protection Division (GAEPD) Surface Water Modeling and Monitoring Projects. This QAPP applies to the collection and assessment of groundwater and surface water quality data by GAEPD for a five-year period (2018-2022). Annual addendums to this QAPP shall be provided to U.S. Environmental Protection Agency (USEPA), Region IV and other users for any programmatic changes affecting the monitoring or modeling programs.

This five-year program QAPP shall be annually supplemented by project-specific water quality modeling and sampling plans that provide detailed information regarding individual project sampling design.

QAPP Format:

This QAPP has been prepared following the USEPA's requirements for Quality Assurance Project Plans (EPA QA/R-5, March 2001 and USEPA's Guidance for Quality Assurance Project Plans (EPA QA/G-5, December 2002).

Document Availability:

The 2023-27 QAPP is available in electronic format (pdf, CD and GAEPD website: https://epd.georgia.gov/watershed-protection-branch.

Electronic and paper copies of this QAPP are available upon request. Requests should be submitted to Susan Ruff at 470-938-3376, Susan.Ruff@dnr.ga.gov, or by mail at 2 MLK, Jr., Drive, S.W., Suite 1470, Atlanta, GA 30334.

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List of Acronyms

AMU	Ambient Monitoring Unit
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
cfs	Cubic feet per second
COC	Chain of Custody
COD	Chemical Oxygen Demand
CRD	Coastal Resources Division
CWA	Clean Water Act
CWW	Columbus Water Works
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DQO	Data Quality Objectives
EFDC	Environmental Fluid Dynamics Code
EPA	U.S. Environmental Protection Agency
EPD-RIV-1	GAEPD one dimensional hydrodynamic water quality model
GAEMN	Georgia Automated Environmental Monitoring Network
FMU	Facilities Monitoring Unit
GA DOSAG	GAEPD water quality model
GAEPD	Georgia Environmental Protection Division
GA ESTUARY	GAEPD water quality model
GAPDES	Georgia Pollution Discharge Elimination System Permit Database
GAWP	Georgia Association of Water Professionals
GIS	Geographic Information System
GOMAS	Georgia envirOnmental Monitoring and Assessment System Database
GPS	Global Positioning System
GRWA	Georgia Rural Water Association
GWWI	Georgia Water & Wastewater Institute
HSPF	Hydrologic Simulation Program FORTRAN
IBI	Index of Biotic Integrity
ISU	Intensive Surveys Unit
L	Liter
LSPC	Loading Simulation Program C++
LAS	Land Application System
LIMS	Laboratory Information Management Systems
MDL	Method Detection Limit
mg	milligram
MPN	Most Probable Number
MQO	Measurement Quality Objective
NCDC	National Climatic Data Center
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
% R	Percent Recovery
PET	Potential evapotranspiration
PL	Project Leader
PM	Project Manager
PIDs	Privately Owned & Institutional Developments
POTW	Publicly Owned Treatment Works
QAP	Quality Assurance Plan (Laboratory)
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QMP	Quality Management Plan
RBP	Rapid Bioassessment Protocol
RDC	Regional Development Centers
RDL	Reporting Detection Limit

RL	Reporting Limit
RPD	Relative Percent Difference
SOPs	Standard Operating Procedures
SOW	Scope of Work
SQAP	Sampling Quality Assurance Plan
STATSGO	State Soil Geographic Database
STORET	STOrage and RETrieval Data System
TMDLs	Total Maximum Daily Loads
USLE	Universal Soil Loss Equation
USEPA	United States Environmental Protection Agency
USGS	United States Department of the Interior Geological Survey
WASP	Water Quality Analysis and Simulation Program
WCS	Watershed Characterization System
WLA	Wasteload Allocation
WPB	Watershed Protection Branch of the GAEPD
WPMP	Watershed Planning & Monitoring Program
WQ	Water Quality
WQS	Water Quality Standard
WQX	Water Quality Exchange
WRD	Wildlife Resources Division of the Georgia Department of Natural Resources
WRDB	Water Resources Database

A3. Distribution List

Copies of this document were distributed to the following individuals within the GAEPD. Additional copies were distributed to non-GAEPD agencies and individuals upon request (including other state and federal agencies, consultants, universities, etc.).

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A hard copy in paper format and in an electronic format on CD have been placed in the main file room in the Watershed Protection Branch office located at 2 MLK, Jr. Drive, S.W., Suite 1470, Atlanta, GA 30334, and all documents to be posted on the GAEPD internet site: https://epd.georgia.gov/watershed-protection-branch-technical-guidance.

A4. Program Description and Organization

The GAEPD Watershed Protection Branch (WPB) is responsible for implementing several programs in accordance with Federal requirements under the Clean Water Act (CWA). Among these are:

- Monitoring and Assessment of the State's Waters
- Water Quality Modeling to Determine Available Assimilative Capacity
- Development of Wasteload Allocations (WLAs)
- Development of Total Maximum Daily Loads (TMDLs)
- Coordination of TMDL Implementation Plan Development and Administration
- Wastewater NPDES and Land Application System (LAS) Permitting
- Storm-Water NPDES Program
- Water Withdrawal Permitting Program
- Non-Point Source (NPS) Program
- Grants Program Administration

Conducting water quality monitoring and modeling to support the determination of the State waterbodies' Assimilative Capacities and the development of Wasteload Allocations (WLAs), Total Maximum Daily Loads (TMDLs), and Water Quality Standards (WQS) for Georgia's rivers, lakes, estuaries, and wetlands is essential to the work performed by the WPB. The Watershed Planning & Monitoring Program (WPMP) within the WPB is taking the lead for the water quality modeling projects. Funding for the water quality modeling work is generated through Sections 106, 104(b)(3), and 604(b) watershed management and water quality modeling resources. The watershed, lake, and estuary modeling efforts may be performed through a contract.

Monitoring, assessment, and data management performed as part of these programs meet the ten basic elements of a State water-monitoring program outlined by the USEPA and the prerequisites of the CWA Section 106.

1. Monitoring Program Strategy: A long term monitoring strategy that serves the State's water quality management needs and addresses all state ground water and surface waters including rivers, streams, lakes, estuaries, and coastal waters.
2. Monitoring Objectives: Monitoring Objectives that are effective in generating data that serves the water quality management decision needs.
3. Monitoring Design: A monitoring design developed to select sample sites that fulfill the expectations of the monitoring objectives.
4. Core and Supplemental Water Quality Indicators: Core indicators selected to evaluate the designated use of the waterbody with supplemental indicators selected according to site-specific decision criteria.
5. Quality Assurance: Quality Management Plans and Quality Assurance Project Plans are developed and implemented to ensure the validity of monitoring and laboratory activities.
6. Data Management: An electronic data system for storage and retrieval of water quality data.
7. Data Analysis and Assessment: A methodology developed to analyze and assess all available and existing data for all waterbody types in the State with criteria adopted under the State's water quality standards.
8. Reporting: The State produces water quality reports and lists as required by federal regulations.

9. Programmatic Evaluation: The State conducts periodic reviews of its water quality monitoring program to determine how well the program serves its water quality decisions needs for all state waters and adjusts the program as needed.
10. General Support and Infrastructure Planning: Current and future resource needs are evaluated for full implementation of the water quality monitoring program strategy.

The responsibility for groundwater and surface water quality monitoring and assessment is a primary responsibility of the WPMP within the WPB. The WPMP coordinates the collection and delivery of samples by field offices in outlying GAEPD District offices and through joint funding agreements and contracts with the U.S. Geological Survey (USGS) and the Columbus Water Works (CWW). The Grants Unit within the WPB coordinates additional data collection by outside entities through the administration of 319(h) grants.

Funding for the water quality modeling and monitoring work performed for WPMP is through State and Federal Sections 106 and 604(b) grants water quality resources. The WPMP is the principal data user with the general public and other outside agencies as secondary users of the water quality data. Water quality data obtained through the monitoring efforts of the project(s) are used in the development of the 305(b)/303(d) reporting and assessment of State waters, TMDL development, WLA development, water quality modeling, basin planning activities, watershed assessment, TMDL Implementation Plan development, stream restoration and non-point source controls, and NPDES permit compliance. After being QA/QC'd, all monitoring data is input into GAEPD Georgia envirOnmental Monitoring and Assessment System (GOMAS) database and then uploaded to STORET via WQX and made available to the public. All data are provided to the USEPA, local agencies, universities, environmental groups, and private citizens upon request. A public interface for GOMAS was developed to allow citizens to query the database and download data. The interface includes a map of monitoring locations the public can use to search for data along with various fields by which to search for and filter data before download.

The QAPP is available for public review at any time on the GAEPD website. Any individuals, groups or agencies conducting Section 319(h) Grant-funded projects are advised by the GAEPD's Section 319(h) Grant Managers and the Water Quality Monitoring Unit Managers of GAEPD's web site posting of the State's Rules and Regulations governing collection of water quality samples and submittal of data to the GAEPD for consideration in the 305(b)/303(d) listing process. The web site includes links to the GAEPD's Quality Assurance Manual, Standard Operating Procedures (SOPs) for data collection, the Guidance Document for Submittal of Data to the GAEPD, and the Secretary of State's Laboratory Analytical Accreditation requirements. In addition, when making a Section 319(h) Grant application, the grantee is advised by GAEPD's Section 319 Grant Manager of the availability of the GAEPD's QAPP and the procedures contained within. Any academic, public, or private organization or group generating data for use in Georgia's assessment of water quality is required to comply with the provisions of this QAPP, sampling quality assurance plan requirements, and SOPs for water quality data collection.

The organizational aspects of the program provide the framework for conducting tasks. They can also facilitate project performance and adherence to quality control (QC) procedures and quality assurance (QA) requirements. Key project roles are filled by those persons responsible for ensuring the gathering of valid data and the routine assessment of the data for precision and accuracy, as well as the data users and the person(s) responsible for approving and accepting final products and deliverables. The program organization chart for water quality modeling is presented in Appendix A, which includes relationships, lines of communication among all participants and data users, and each of their responsibilities. The organizational chart for water quality data collection, analysis, and assessment is included in Appendix B. Table 1 below provides a more detailed description of the roles and responsibilities of staff involved in the planning, participation, and reporting activities for water quality modeling and monitoring projects initiated by the Georgia Department of Natural Resources (DNR).

Table 1. Program Roles and Responsibilities Related to Water Quality Modeling, Monitoring, and Data Use

Name	Project Role and Responsibility
Ania Truszczynski	Watershed Protection Branch Chief
Mark Tolbert	Manager of GAEPD's Laboratory Operations
Jeff Moore	GAEPD's Laboratory Quality Assurance Manager
Elizabeth Booth	Supervises Unit Coordinators and Project Manager Project Planning, Water Quality Standards Purchase Approval
Susan Salter	Monitoring & Assessment QA Officer 305(b)/303(d) Listing and Reporting Approval of Third-Party Sampling Quality Assurance Plans (SQAPs)
Reid Jackson	Supervises field staff, Project planning Unit QA/QC Officer Maintains Approved QAPP Report generation (Rivers/Streams/Estuaries) Staff Training
Cody Jones	Supervises field staff, Project planning Unit QA/QC Officer Maintains Approved QAPP Report generation (Rivers/Streams /Lakes) Staff Training
Shea Buettner	Supervises field staff, Project planning Report generation (Facilities) Staff Training
Alyssa Peterson	Data QC Officer, Database Manager Record Management GIS Management
Tyler Parsons	TMDL decisions and development Unit QA/QC Officer
Matthew Revel	Modeler TMDL development and Watershed Assessment review
Omar El-koussy	Modeler TMDL development and Watershed Assessment review
Vacant	Modeler TMDL development and Watershed Assessment review
Josh Welte	Wasteload Allocations and Watershed Planning documents Unit QA/QC Officer
Azarina Carmical	Modeler Wasteload Allocations development
Larry Guerra	Modeler Wasteload Allocations development
Pooja Jadhav	Modeler Wasteload Allocations development
Lucy Sun	Modeler Wasteload Allocations development

Name	Project Role and Responsibility
Vacant	Modeler Wasteload Allocations development
Vacant	Field staff Benthic Assessment/WQ Monitoring – Atlanta Regional Office
Vacant	Field staff Fish Tissue Projects/WQ monitoring and assessment – Atlanta Regional Office
Bridget Thiel	Field staff WQ monitoring and assessment – Atlanta Regional Office
Carmen Pyles	Field staff WQ monitoring and assessment – Atlanta Regional Office
Vacant	Field staff WQ monitoring and assessment – Atlanta Regional Office
Emily Losasso	Field staff WQ monitoring and assessment - Cartersville Region Office
Jordan Whiteman	Field staff WQ monitoring and assessment – Cartersville Region Office
Eric Peeler	Field staff WQ monitoring and assessment – Cartersville Region Office
Benjamin Hutton	Field staff WQ monitoring and assessment – Augusta Region Office
Allison Morris	Field staff WQ monitoring and assessment – Augusta Region Office
Clayton Adams	Field staff WQ monitoring and assessment – Brunswick Regional office
Ryan Carter	Field staff WQ monitoring and assessment – Brunswick Regional office
Sarah Dubose	Field staff WQ monitoring and assessment – Brunswick Regional office
Vacant	Field staff WQ monitoring and assessment – Tifton Regional Office
Travis West	Field staff WQ monitoring and assessment – Tifton Regional Office
Alexia Dunn	Field staff WQ monitoring and assessment – Tifton Regional Office
Chip Scroggs	Field staff Ground Water monitoring and assessment – Atlanta Regional Office
Tony Chumbley	Field staff Ground Water monitoring and assessment – Atlanta Regional Office
Steve Wiedl	Supervises Wetland staff Wetlands Monitoring – Atlanta Regional Office
Devin Thiery	Field staff Wetlands Monitoring – Atlanta Regional Office
Vacant	Field staff Wetlands Monitoring – Atlanta Regional Office
Bradley Smith	Field staff Wetlands Monitoring – Brunswick Regional Office
Cody Gilbert	Field staff Facilities Compliance Sampling & Evaluation
Kevin Blair	Field staff Facilities Compliance Sampling & Evaluation
Joy Hinkle	319(h) Grant Coordinator

Name	Project Role and Responsibility
	Administration of grant funded outside data collection

WPMP is responsible for developing the data quality objectives for final use of the data. This QAPP provides general descriptions of the work to be performed to support the development of water quality models, the standards to be met, and the procedures that are used to ensure that the modeling results are scientifically valid and defensible, and that uncertainty has been reduced to a known and practical minimum. In addition, this QAPP addresses the use of data collected by GAEPD, USGS, and other entities for various purposes. The water quality modeling work does not require the collection of primary data. If it is determined during the data evaluation effort and after consultation with the GAEPD Project Manager that the collection of primary data is required, that collection will be covered by this QAPP. The GAEPD will be responsible for implementing quality assurance and quality control (QA/QC) procedures for their field sampling and laboratory analytical activities according to established GAEPD protocols. This QAPP describes the methods and procedures that will be used by the GAEPD and their contractors to ensure the quality, accuracy, precision, and completeness of the data collected and analyzed and describes the data quality objectives for the data's final use. Any outside organization that submits data to GAEPD for assessment purposes will be required to adhere to the conditions of this QAPP. Any project-specific sampling project will be required to submit sampling plans (SQAP) to be approved by the Monitoring & Assessment QA Officer. Data submitted by outside organizations for 305(b)/303(d) listing decisions that were collected under an approved SQAP will be reviewed and put into GOMAS by the Monitoring & Assessment QA Officer and uploaded to WQX by the Database Manager. The effort to input this data into GOMAS is an ongoing process since it has to be done by hand. EPD plans to develop templates to send to outside organizations with approved SQAPs to input their data that will make upload to GOMAS easier.

A5. Problem Definition/Background

As part of funding agreements between the State and the USEPA, Georgia agrees to model and monitor the waters of the state and report findings to the USEPA, as well as other customers and stakeholders, to support the goals of the CWA. The CWA defines as its objective:

"…to restore and maintain the chemical, physical, and biological integrity of the Nation's waters, and, where attainable, to achieve a level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water."

The GAEPD is the water quality management agency designated to implement the provisions of the CWA within the State of Georgia. The responsibilities of the GAEPD under the CWA are to improve and protect water quality in the State. GAEPD and/or their contractor(s) are responsible for developing analytical modeling tools for performing resource assessments of the assimilative capacity and TMDL of selected water bodies. GAEPD and/or its contractor(s) develop computer modeling tools for watersheds, streams and rivers, estuaries, and lakes. The results of this work are used by GAEPD in support of regulatory and permitting activity and by regional water planning councils in the refinement of their Water Development and Conservation Plans in support of the Georgia Comprehensive Statewide Water Management Plan.

GAEPD's water quality monitoring program is intended to provide a measure of progress toward meeting the goals established in the CWA and Georgia's Water Quality Control Act. This is achieved by determining the use-attainment status of surface waters in the State.

To accomplish this purpose, data are collected and assessed to:

- Assess the condition of the State's waters.
- Identify areas potentially in violation of Georgia's numerical or narrative water quality standards.
- Identify causes and sources of water quality problems.
- Document areas with potential human health threats from elevated bacteria levels.
- Screen fish in selected waterbodies for fish tissue contaminants (metals, PCBs, and organo-chlorine pesticides) to provide for public health risk assessment.
- Over the long term, collect water quality data to enable the determination of trends in parameter concentrations and/or loads.
- Gauge compliance with NPDES permit limits.
- Document baseline conditions prior to a potential impact or as a reference stream for downstream uses or other sites within the same eco-region and/or watershed.
- Assess water quality improvements based on site remediation, implementation of Best Management Practices, and other restoration strategies.
- Identify proper water use classifications, including anti-degradation policy implementation.
- Identify natural reference conditions on an eco-region basis for refinement of water quality standards.

Water quality data collected is compared to criteria and standards set forth in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, and the Level IV eco-regional reference conditions.

Table 2. Project Decision Statement and Actions

Decision Statement	Actions To Be Taken
Assess the condition of the State's waters	Compare monitoring results to Water Quality Rules and Regulations, Chapter 391-3-6-.03, water quality criteria and regional reference data to determine if waters are supporting their designated uses. Publish biennial 305(b) report.
Identify problem areas with parameter values that exceed Georgia's numerical or narrative water quality standards. Identify causes and sources of water quality problems.	Include in the 303(d) List of Waters.
Document areas with potential human health threats from elevated bacteria levels or fish tissue contamination.	Notify public of water contact or fish consumption advisory at waterbodies that pose a threat to human health.
Monitor 303(d) listed waters	Refine 303(d) List.
Monitor major and minor NPDES Permitted facility discharges to State waters	Compare results to NPDES Permit effluent limitations. Issue notice of violation if limits exceeded.
Prioritize TMDL development and collect appropriate data.	Develop TMDL by developing analytical modeling tools
Identify natural reference conditions on an eco-region basis for refinement of water quality standards. (Monitor Level IV eco-regional reference sites).	Data used to refine water quality criteria and eco-regional water quality expectations.
Identify waterbody use classifications.	Assign use classification to all monitored waterbodies in the watershed group. Identify tier status for waters where regulatory decisions are needed.

A6. Project/ Task Description and Schedule

Modeling

Major modeling activities include the assemblage of water quality databases, and the development and calibration of watershed, riverine, and lake hydrodynamic and water quality models. Each activity has inherent QC requirements and requires oversight by a trained staff person. The activities can be divided into several tasks, each requiring management and QC oversight by qualified personnel. The modeling subtasks 1 through 6 are addressed in this QAPP.

Task 1: Quality Assurance Project Plan

All modeling work is expected to adhere to a high standard of quality. This QAPP has been developed to cover all modeling activities and addresses both technical quality and practicable/operational quality. The QAPP was prepared following EPA Guidance as appropriate.

Task 2: Data Compilation and Management

The models require historic data of various types for either model input or model calibration. The data types described in this section are general in nature and are needed for most model applications. Other model specific data requirements will be described later.

In general, GAEPD or their contractor shall identify sources, collect available data, and develop digital databases and accompanying geographic information system (GIS) map coverages for the data categories described in this and following tasks. Data should be collected for a specified time period. All numerical databases used for models are developed using the Water Resources Database (WRDB) software (or its successor), which is available from GAEPD and can be found at the following website: http://www.wrdb.com/. A description of the data categories follows:

- Water Quality Data: GAEPD, USGS, NPDES permittees, and other entities operating under an approved data management plan have monitored water quality for a variety of water bodies at various locations in Georgia.

- Flow Data: The USGS has monitored streamflow at a variety of locations. The flow data may be used to derive flow statistics such as 7Q10.

- Watershed Assessment Data: GAEPD has required some municipalities to perform watershed assessments for the watersheds in their jurisdictions. These watershed assessments include initial and long-term water quality monitoring programs.

- Facility NPDES Monitoring Data: Municipal and industrial wastewater treatment facilities with National Pollutant Discharge Elimination System (NPDES) permits have monitoring data that includes effluent flow and quality. These data are often recorded daily and summarized monthly. Note that in some cases, it will be necessary to obtain information from facilities located in other states.

- Water Withdrawal Data: Municipal and industrial facilities that operate water withdrawals have data on their withdrawal rates. These data are often recorded daily and summarized monthly. Note that in some cases, it will be necessary to obtain information from facilities located in other states.

- Heat Load Data: Heat load data for power plants and other facilities will have to be compiled. These data will include both flow and temperature discharge data. These data may not be available in NPDES compliance reports, so an alternative method may have to be developed for estimating heat loads.

- Meteorological Data: Several organizations including the National Climatic Data Center (NCDC) and UGA's Georgia Automated Environmental Monitoring Network (GAEMN) have meteorological data at a number of locations. Typical meteorological data parameters include precipitation, air temperature, dew point temperature, barometric pressure, solar radiation, relative humidity, and wind speed.

These data are collected in various time intervals including 15-minute, hourly, or daily.

GAEPD and/or their contractor shall identify the available data, retrieve the data, and develop a database containing these data using WRDB or other relevant databases. Coordination with other states may be necessary.

All the data types described above have a location associated with them that can be used to create GIS coverages. GAEPD and/or their contractor will develop and maintain GIS coverages for each data type that includes the location and other descriptive information for the site using GIS software. The software needs to be compatible with ArcGIS developed by Environmental Systems Research Institute (ESRI).

Task 3: Watershed Modeling

When necessary, as a part of the process of determining the assimilative capacity for rivers, lakes, or estuaries, GAEPD and/or their contractor shall develop watershed models. Watershed models will be developed for the appropriate scale to answer model questions posed. The watershed models will be designed to perform a continuous simulation for flow and water quality for a set time period (often ten years). Watershed models can be developed using the Watershed Characterization System (WCS) Sediment Tool that incorporates the Universal Soil Loss Equation (USLE), Hydrologic Simulation Program Fortran (HSPF), or the Loading Simulation Program in C++ (LSPC).

For each of the watersheds, the existing annual sediment load can be estimated using the USLE. The USLE predicts the average annual soil loss caused by sheet and rill erosion. Soil loss from sheet and rill erosion is mainly due to detachment of soil particles during rainfall events. It is the major source of soil loss from crop production and animal grazing areas, logging areas, mine sites, unpaved roads, and construction sites. The equation used for estimating average annual soil erosion is:

$$A = RKLSCP$$

Where:

A = average annual soil loss, in tons/acre
R = rainfall erosivity index
K = soil erodibility factor
LS = topographic factor
  L = slope length
  S = slope
C = cropping factor
P = conservation practice factor

The Environmental Protection Agency (EPA) Regions 3 and 4 developed LSPC for preparing TMDLs. It utilizes the hydrologic core program of HSPF with a custom interface of the Mining Data Analysis System (MDAS) and modifications for non-mining applications such as nutrient and pathogen modeling.

Each watershed model will be divided into modeling sub-basins based on hydrologic criteria to be represented as a series of hydraulically connected sub-watersheds in which the watershed model will calculate surface water runoff and the advective transport of constituents using historic precipitation data. Watershed models may also include water temperature modeling.

The following data and other modeling requirements maybe be required to perform the watershed model simulations:

- **Meteorological Data**: The USLE uses the R factor, or rainfall erosivity index, which describes the kinetic energy generated by the frequency and intensity of the rainfall. It is statistically calculated from the annual summation of rainfall energy in every storm, which correlates to the raindrop size, times its maximum 30-minute intensity. It varies geographically and is given by county. Hourly meteorological data from weather stations within, or near, the sub-watershed will be used in HSPF or LSPC watershed models. Precipitation data for the watershed will be gathered from several sources and the watershed will be subdivided into Thiessen polygons with precipitation stations as centers, to select the station for the watershed. The potential evapotranspiration will be calculated from the maximum and minimum daily temperatures obtained from either NCDC or GAEMN stations. The Hamon PET method will be used to calculate hourly potential evapotranspiration using air temperature, a monthly variable coefficient, the number of hours of sunshine (based on latitude), and absolute humidity (computed from air temperature).

  Land Use/Land Cover: The USLE uses the C factor or cropping factor, which represents the effect plants, soil cover, soil biomass, soil disturbing activities and roads have on erosion and the C factor is based on the land cover and road type. The USLE also uses the P factor or conservation practice factor to represent the effects of conservation practices on erosion. The conservation practices include BMPs such as contour farming, strip cropping and terraces. The watershed models HSPF or LSPC use land cover data as the basis for representing hydrology and nonpoint source loading. GAEPD and/or their contractor shall obtain the most current digital map coverages for land use/land cover for the watersheds to be modeled. In addition, forecasted future land use coverages may be used for future planning. Land cover categories for modeling will include open water, urban, barren or mining, cropland, pasture, forest, grassland, and wetlands. Coverages of imperviousness may also be utilized to develop the typical imperviousness percentages for each land use category. The percent imperviousness of a given land category will be calculated as an area-weighted average of land use classes encompassing the modeling land category.

- **Soils Data**: Soils data for the watershed will be obtained from the State Soil Geographic Database (STATSGO) or Soil Survey Geographic Database (SSURGO) developed by the Natural Resources Conservation Service (NRCS). There are four main hydrologic soil groups. The different soil groups range from soils that have a low runoff potential to soils that have a high runoff potential. The total area that each hydrologic soil group covers within each sub-watershed will be determined. The hydrologic soil group that has the highest percent of coverage within each sub-watershed will be used to represent the sub-watershed. The USLE uses the K factor, or soil erodibility factor, to represent the susceptibility of soil to be eroded. This factor quantifies the cohesive or bonding character of the soil and ability of the soil to resist detachment and transport during a rainfall event. The K factor is a function of the soil type, which is provided by the STATSGO or SSURGO data.

- **Digital Elevation Model**: Digital elevation model (DEM) data will be obtained for the watersheds modeled and shall have a 10-meter grid resolution. These data will be used to determine the channel and watershed slopes for use in the watershed model. The USLE uses the LS factor, or topographic factor, which represents the effect of slope length and slope steepness on erosion. Steeper slopes produce higher overland flow velocities. Longer slopes accumulate more runoff from larger areas and result in higher overflow velocities. The slope length and slope are based on the grid size and ground slope provided by DEM data.

- **Point Source Discharge Data**: The watershed model should be designed to include point source discharge data. The watershed models will include all point sources of nutrients and organic material.

- **Water Withdrawal Data**: The watershed model should be designed to include water withdrawal data.

GA EPD will use the steady state model DOSAG to determine wasteload allocations (WLAs) for oxygen demanding substances. The results of these models will be incorporated into the watershed models.

The watershed model will be calibrated to available daily flows and discrete instream water quality data measured by GA EPD, USGS, local municipalities, counties, George Power, and the Corps of Engineers. The watershed models will simulate the rainfall runoff process for both flow and water quality, and the results of these models will be used as tributary inputs to the river, lake and/or estuary models.

Task 4: River Modeling

For simple river systems that can be modeled under steady state, GAEPD will develop and use GA DOSAG models to determine WLAs for oxygen demanding substances. GA DOSAG is a steady-state, one-dimensional, advection dispersion, mass transport, deterministic model based on the modified Streeter-Phelps equation and can be downloaded from the following website: http://epdsoftware.wileng.com/. The models will be developed for critical conditions in accordance with standard practices. The critical conditions models will be run with the NPDES point sources at their full permit loads.

When dealing with complex hydrodynamic systems, river modeling will be done using GAEPD's EPD RIV-1. Model development and calibration shall be done using the period that has the most complete available data for model input and calibration. The period should span a minimum of two years.

Requirements of the river modeling also include:

- **River Cross Sections**: The EPD RIV-1 hydrodynamic model requires river channel cross sections as input for the open channel hydraulics calculations. The modeler shall obtain available measured cross sections for the modeled river segments and incorporate them into the model geometry. Where cross section data are not available, cross sections may be developed using other means to be approved by the program manager.

- **Watershed Inflows**: River model input data for watershed contributions of flow and water quality will be obtained from the watershed model results.

- **Meteorological Data**: The EPD RIV-1 hydrodynamic model requires hourly meteorological data from one or more monitoring stations in the vicinity of the river to be used as model input.

- **USGS Streamflow Data**: USGS streamflow data will be used where appropriate for boundary flow input. Streamflow data may be used to estimate low-flow statistics, such as 7Q10.

- **Water Quality Data**: Available water quality data collected at the boundary will be used as model input.

- **Facility Monitoring Data**: Daily facility operating data for both wastewater discharges and water withdrawals will be used in the model for the period modeled.

The river model will be calibrated with available USGS streamflow data and water quality data collected at locations within the model reach and during the modeling period.

Task 5: Lake Modeling

Lake models shall consist of linked three-dimensional hydrodynamic and water quality models. The lakes will be modeled in three-dimensions, which will allow GAEPD to calibrate the models to site-specific data and to determine the effect of direct discharges into these systems without assuming laterally averaged segments.

The Environmental Fluid Dynamics Code (EFDC) will be used to simulate the internal flows and water temperature of the lake models. The model can be downloaded from the following website: https://www.epa.gov/ceam/environment-fluid-dynamics-code-efdc-download-page. EFDC or the Water Quality Analysis Simulation Program (WASP) will be used to simulate the fate and transport of water quality constituents within the lake. WASP can be downloaded from the following website: https://www.epa.gov/ceam/water-quality-analysis-simulation-program-wasp. Model development and calibration will be done for a period that has the most complete data set, and should span a minimum of two years.

Lake Hydrodynamic Modeling

EFDC is a general-purpose hydrodynamic model capable of simulating one, two, and three-dimensional flow in surface water systems including rivers and lakes. The EFDC model for each lake will include:

- A three-dimensional model grid having an appropriate resolution based on shoreline and bathymetric data.
- Boundary inflows provided by results from the LSPC watershed model
- Hourly meteorological data including barometric pressure, air temperature, relative humidity, dew point, rainfall, evaporation, wind speed, solar radiation, and cloud cover.
- Water temperature modeling.

Estimated bottom elevations and shoreline boundaries define the EFDC model grid. Bathymetric assumptions will be derived from available cross-sections from lake and estuary bathymetry. In addition, any previously developed models for the lakes and estuaries will be examined to ensure consistency.

EFDC requires boundary conditions to simulate circulation and transportation. These conditions include the water elevations at the downstream boundary, watershed inflows, and meteorological data. The upstream boundaries will be the tributary flows and water quality results from the watershed models. The lake levels recorded at the lake dam will be used to define the water surface elevation at the downstream boundary.

The meteorological data that will be used include barometric pressure, air temperature, relative humidity, dew point, rainfall, evaporation, wind speed, solar radiation, and cloud cover. These data are measured at the NCDC or GAEMN stations.

Water temperature will be simulated in EFDC using solar radiation, atmospheric temperature, heat transfer at the water surface, and the temperature of the hydraulic inputs.

Lake Water Quality Modeling
WASP and EFDC are dynamic models designed to describe aquatic systems. Both EFDC and WASP model time-varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange and both models can be structured in one, two, or three dimensions. WASP contains a series of independent kinetic process routines that can be employed. WASP will be used with its eutrophication module (EUTRO) which models conventional water quality constituents and algal kinetics. The water quality constituents and nutrient and algal kinetics in EUTRO are as follows:

- Organic nitrogen
- Ammonia
- Nitrate-nitrite
- Organic phosphorus
- Orthophosphate
- Chlorophyll *a*
- Dissolved oxygen
- Biochemical oxygen demand (BOD)

WASP is not a hydrodynamic model. The model uses the EFDC model results contained in the hydrodynamic linkage file to provide the transport parameters required by the WASP water quality model. Therefore, the WASP model segmentation must be compatible with the EFDC grid structure.

Both WASP and EFDC models simulate sediment oxygen demand, reaeration, full nutrient dynamics, and algal kinetics. Boundary inflow and constituent concentrations of BOD, total nitrogen, and total phosphorus will be imported from the calibrated HSPF or LSPC models. Since the watershed models only predict total nitrogen and phosphorus loadings, these lumped constituents must be partitioned into their component parts including organic phosphorus, ortho-phosphate, organic nitrogen, ammonia, and nitrate-nitrite for use as input to the lake water quality model. The nitrogen and phosphorus loads will be fractionated based on the results of measured water quality data.

If there are direct discharges to the lakes, daily discharge flows, 5-day BOD, ammonia, total phosphorus, and dissolved oxygen concentrations for the NPDES permitted discharges will be obtained from Operating Monitoring Reports (OMRs) and will be input into the model. If the lake has direct water withdrawals, daily water withdrawal data will also be input into the model.

The model lake water quality model will be calibrated with existing water quality data including chlorophyll *a*, nitrogen components, phosphorus components, dissolved oxygen profiles, and water temperature profiles.

Task 6: Estuary Models
Estuary models will be used to assess pollutant loads to Georgia estuaries. The GA ESTUARY model is a mid-tide, steady state model used to assess the assimilative capacity of Georgia's estuaries for oxygen demanding substances. The models will be developed for critical conditions in accordance with standard

practices and these critical conditions models will be run with the NPDES point sources at their full permit loads. The GA ESTUARY models have been developed for those water bodies that currently have permitted wastewater treatment plants that discharge into them.

For certain estuaries, LSPC watershed models are developed for the River Basin and EFDC, WASP or Finite Volume Coastal Ocean Model (FVCOM) estuary models are used to evaluate the impacts of both point sources and non-point sources, primarily from total oxygen demanding loadings.

Monitoring

The role of the monitoring program is to provide timely water quality data and periodic data analysis reports to customers within the Georgia DNR and elsewhere, and to make these data and reports available to other potential users (other federal, state, and local governmental agencies, educational institutions, consulting firms, and individuals). Data collected through this monitoring program are used for a variety of purposes, but in broad terms, uses may be summarized as the determination of status and trends in water quality Statewide within Georgia.

Specific objectives of the monitoring program are as follows:

1. Determine whether water quality at sampling sites exceeds water quality standards. This objective is intended to address the 303(d) section of the CWA. Results are compared to Georgia's water quality standards.
2. Assess the status of water quality in Georgia. This objective is intended to address the 305(b) section of the CWA.
3. Provide analytical water quality information that describes present conditions and changes (trends). Long-term monitoring at fixed stations followed by periodic statistical analysis of the data and interpretive reports of the results are one of the assessment and reporting functions of the WPMP. These data are extremely valuable because they provide the most efficient and sensitive means for the early detection of emerging water quality problems. The data quality objectives are based primarily on the objective of early detection of deteriorating water quality conditions within Georgia's less impacted waters. These requirements are also adequate for the detection of improving water quality conditions in degraded water bodies as well as for meeting the other objectives stated here.
4. Provide timely and high-quality data for other users. Specific uses of data collected through this program are as varied as the number of entities studying or managing water quality in Georgia. Each user will have its own minimum data quality requirements, but our data quality will be appropriate for most uses. Other uses of data include:

    a. TMDL analyses – data are used to refine and verify TMDL models.
    b. Developments of waste-load allocations – data are used to define maximum discharge limits to waters of the state.
    c. Supporting the wastewater discharge permitting system – data are used by permit writers requiring water quality data to assess facility discharges.
    d. Development of water quality standards – data are often the cornerstone for technical analysis leading to revisions of the state's water quality standards.
    e. Cooperative projects with other governmental entities – data are used to support various conservation/restoration projects.

To address the above objectives, GAEPD measures several conventional water quality constituents. Four constituents can be readily compared to state standards: temperature, pH, dissolved oxygen, and bacteria (fecal coliform, and *Escherichia coli)*. GAEPD measures constituents susceptible to change due to anthropogenic sources: conductivity, hardness, nutrients (total phosphorus, ortho-phosphate, total nitrogen, nitrate-nitrite nitrogen, ammonia nitrogen, and TKN), total suspended solids, biochemical oxygen demand, total organic carbon, and turbidity. In addition, GAEPD monitors lakes that have numeric criteria for nutrients (Total P and Total N) and chlorophyll *a*. and monitors waterbodies for metals to protect aquatic life and priority pollutants to protect human health.

Questions that can be posed by the objectives stated above are:

- Are water quality standards violated at each monitoring station?
- What is the quality of Georgia's waters?
- What are the current conditions and trends in water quality within Georgia?

Figure 1 is a map delineating the 14 major river basins in Georgia.

Coordination with other groups, such as USEPA, USGS, CWW, Regional Development Centers (RDCs), consultants, volunteer monitoring associations, and others is typically done to enhance data collection and minimize duplication of effort. For example, GAEPD may request and receive monitoring and/or analytical assistance from USEPA for types of monitoring or analyses it is typically more suited for, such as ambient toxicity testing, sediment, nutrient and/or periphyton. The GAEPD contracts for water quality monitoring assistance with the USGS and CWW. Also, volunteer groups often target the same sampling location and desired parameters. In these cases, the GAEPD may elect to rely on these efforts based on a thorough review of the group's Sampling Quality Assurance Plan, which is required for all outside organizations intending to submit data for Georgia's 305(b)/303(d) listing assessments. Also, GAEPD will review their history of producing usable data and if they adhere to the QA/QC procedures detailed in this QAPP.

Monitoring resources are prioritized as follows:

1. **Long-Term Trend Station Monitoring**: For water quality trend analyses, established sites are monitored. Water samples for chemical analysis are collected monthly at each of these stations and field measurements and bacteriological samples are collected 16 times during the year.

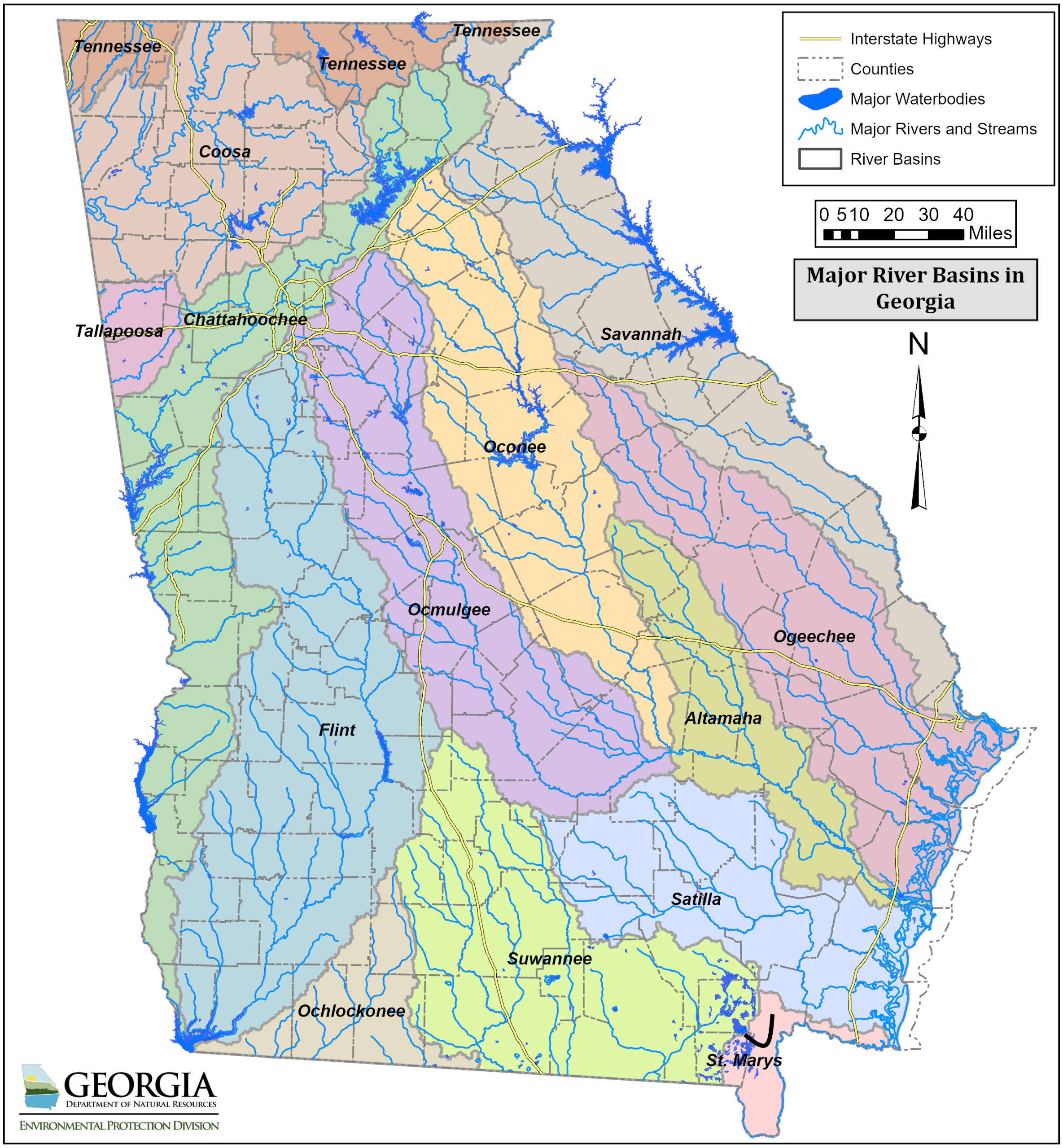
2. **Statewide Targeted Monitoring**: Each year, as many new stations as resources allow are added to the annual station list to increase the percentage of assessed waterbodies. Field measurements including DO, conductivity, pH, salinity, turbidity, and water temperature are conducted at these sites. In addition, chemical samples are collected monthly to determine potential pollutant sources and bacteriological samples are collected 16 times to determine designated use support. Samples for heavy metals are collected quarterly.

3. **NPDES Compliance Monitoring**: GAEPD requires NPDES facilities to conduct monitoring in accordance with their permits. These data are submitted to the State for evaluation and determination of compliance with permit limitations. To ensure that the self-monitoring program is effective, the State conducts facility inspections and splits samples for comparison of laboratory results.

4. **Fish Consumption Advisory:** Fish tissue monitoring for fish advisories is planned by a workgroup consisting of representatives from the WPMP and DNR's Wildlife Resources Division (WRD) and Coastal Resources Division (CRD). The workgroup coordinates a monitoring strategy and selection of fish size and types for the annual monitoring and

assessment. The results are published annually in "*Guidelines for Eating Fish from Georgia Waters*".

Figure 1. Major River Basins in Georgia



5. **Reservoir and Lakes Monitoring**: Major lakes are those lakes within the State of Georgia that are 500 acres or larger. They are divided into 2 categories: Standard lakes for which the State has established specific water quality standards; and Basin lakes, which include all public lakes in a specific basin group. Each year, standard lakes are sampled monthly, April

through October. Each year Basin group lakes are also sampled monthly, April through October, as resources allow. Data collection includes depth profiles of the field measurements and collection of water samples for laboratory analysis. An integrated photic zone water sample is collected for laboratory analysis of selected water quality constituents including nutrients and biochemical oxygen demand, and a sample is filtered on site for chlorophyll *a* analysis. A surface grab sample is collected and analyzed for the presence of *Escherichia coli* bacteria.

6. **Evaluation of Stream Mitigation**: WPMP performs evaluations of stream mitigation projects to document the success of the projects funded under USEPA 319(h) funding Grants.

7. **Eco-region Benthic Monitoring**: Following Georgia's Benthic SOPs, macroinvertebrate sites are sampled during the fall and winter index period (September-February). Periphyton (benthic algae) in streams are sampled during the spring and summer index period (April-October). Chemical samples, field parameters, and flow readings are taken along with the benthic collections.

All stations are geo-referenced, with each station number assigned to a specific latitude and longitude. Though there are several stations located on lakes and reservoirs, the majority of the monitoring stations fall on rivers, streams, and estuarine waters. Most of the stations in the non-coastal regions are located at bridge crossings or other public accesses and are accessible by land. Lakes, estuaries, and other large waterbodies are monitored by boat.

The monitoring programs focus primarily on chemical, physical, and bacterial pathogen characteristics of the water column. The indicators are primarily selected from those parameters that currently have state water-quality criteria and are cost-effective to analyze. Additional indicators may also be included that do not have specific associated standards, but are useful in the interpretation of other measurements, used for modeling, or in identifying long-term trends. A basic core suite of indicators is measured at all stations. Additional indicators may be included depending on site-specific concerns such as use classification, waterbody types, discharge types, and historical or suspected issues. Additional field observations such as weather conditions, water color, water clarity and water level are also recorded at all site visits.

The monitoring program has flexibility built into the sampling schedules to allow for inclement weather, equipment availability, and balancing field staff responsibilities. The individual field staff, with the help of the project team leader, determines their specific daily sampling schedule. However, sampling is completed for each calendar month (i.e., sampling scheduled for January is completed by January 31st).

Each monitoring activity and the associated data are input into the GOMAS database. The data are used in the production of the "Water Quality in Georgia" Report that summarizes all statewide water quality findings and conclusions. Data collected are assessed and used to address the problems or water quality related questions discussed earlier in this section.

A7. Quality Objectives and Criteria for Water Quality Modeling

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify the intended use of the data, define the type of data needed to support decision making, identify the conditions under which the data should be collected, and specify tolerable limits on the probability of making a decision error due to uncertainty in the data (if applicable). Data users develop DQOs to specify the data quality needed to support specific decisions.

Data of known and documented quality are essential to the success of any water quality modeling study, which in turn generates data for use in various evaluations and to make decisions. Model setup, calibration, and validation for the projects under this QAPP will be accomplished using data available from other studies. The QA process for this study consists of using appropriate data, data analysis procedures, modeling methodology and technology, administrative procedures, and auditing. To a large extent, the quality of a water quality modeling study to collect data to be used in the model is determined by the expertise of the modeling and quality assessment teams. Project quality objectives and criteria for measurement data will be addressed in the context of the two tasks discussed above: (1) evaluating the quality of the data used, and (2) assessing the results of the model application.

Project Quality Objectives

The quality of an environmental monitoring program that develops data used in water quality models can be evaluated in three steps: (1) establishing scientific assessment quality objectives, (2) evaluating program design for whether the objectives can be met, and (3) establishing assessment and measurement quality objectives that can be used to evaluate the appropriateness of the methods being used in the program. The quality of a particular data set is a measure of the types and amount of error associated with the data.

Sources of error or uncertainty in statistical inference are commonly grouped into two categories:

- *Sampling error:* The difference between sample values and in situ "true" values form unknown biases due to sampling design. Sampling error includes natural variability (spatial heterogeneity and temporal variability in population abundance and distribution) not specifically accounted for in a design (for design-based inference), as well as variability associated with model parameters or incorrect model specification (for model-based inference).

- *Measurement error:* The difference between sample values and in situ "true" values associated with the measurement process. Measurement error includes bias and imprecision associated with sampling methodology; specification of the sampling unit; sample handling, storage, preservation, and identification; and instrumentation.

Through the establishment and implementation of a TMDL, pollutant loadings from all sources are estimated; links are established between pollutants, sources, and impacts on water quality; maximum pollutant loads are allocated to each source; and appropriate control mechanisms are established or modified so that water quality standards can be achieved (USEPA, 1999).

Sections A7.1 through A7.7 below describe DQOs and criteria for model inputs and outputs, written in accordance with the seven steps described in U.S. EPA's *Guidance for the Data Quality Objectives Process* (EPA QA/G-4) (USEPA, 2000).

A7.1 State the Problem

The protection and restoration of Georgia's waters is the goal of GAEPD activities. To accomplish these goals, computer models are used as tools to determine available assimilative capacity for a variety of pollutants. Modeled pollutants include oxygen demanding substances, sediment, and excessive nutrients. Excessive nutrient levels may add to poor water quality in Georgia's lakes and estuaries. High nutrient levels in most small streams may prohibit normal aquatic life. Elevated levels of these nutrients may be indicators of runoff and effluent waste streams from irrigation and animal production and management operations. Because nitrogen is a limiting nutrient to algal production in estuarine systems, limiting the nitrogen loads to receiving streams may be important to alleviating eutrophication in downstream waters.

A7.2 Identify the Study Question

The objective of modeling projects can be to determine the allowable loads of pollutants concentrations so that water quality standards are attained. Attainment of aquatic life uses is measured by comparing criteria in the WQS for various pollutants to measurements taken from the water column to determine attainment for specific pollutants. Furthermore, if assessments of the stream biota indicate impairment because of WQS exceedances, the stream is considered in "non-attainment" of its designated use.

The models should be suitably flexible to allow adjustment to parameters relative to both quantity and quality of existing resources, as well as the dynamic environmental and anthropogenic influences to flow and water volumes and the overall water quality and character of the state's waters to ensure attainment of current and future designated uses. Furthermore, if, through assessment of these waters, a waterbody is considered impaired, GAEPD will use the water quality monitoring data and models to develop TMDLs to facilitate its recovery and to return the waterbody to attainment.

The load allocations will be used to develop nonpoint source reduction plans based on meeting relevant sediment loads. In general, ambient sediment loads have incorporated a margin of safety such that concentrations at or just less than these loads indicate a potential for unacceptable risks to aquatic life; exceedances are anticipated to produce impairment. If the calculated nonpoint source limit for the sediment load is exceeded, then the pollutant will continue to present a hazard.

Nutrients are a primary cause of impairment. For impairments associated with nutrients, intermediate targets are identified to complement the biocriteria. Load reductions are estimated by comparing instream summer concentrations to desired targets. The assumption underlying the assimilative capacity analysis is that meeting the desired nutrient targets will result in meeting the biocriteria.

A7.3 Identify Information Needs

Flow measurements from gages, water quality monitoring data, watershed assessment data, NPDES monitoring data, water withdrawal data, heat load data, meteorological data, land use and land cover data, soils data, digital elevation model data, and any other recent relevant studies should be incorporated into whatever model is chosen to determine load allocations. Supporting documentation related to GIS is available to GAEPD at the Georgia GIS Clearinghouse website found at https://data.georgiaspatial.org.

A7.4 Specify the Characteristics that Define the Population of Interest

Water quality monitoring and modeling projects must support the goal of quantifying the amount of sediment, nutrients, and oxygen demanding material that Georgia's waters can assimilate while improving biological target scores. In most cases, the statistical criteria for the designations/allocations are detailed with the error discussion in Section A7.6.

Data sources will be compiled from available federal (e.g., EPA, USGS, NOAA) state (GAEPD) sources; from municipal and industrial dischargers; watershed assessment investigations; and those collected by researchers and published in peer-reviewed literature. Where no available data sources can be identified, GAEPD will define methods most practical and applicable to address those needs based on estimates of potential error or imprecision associated with the alternative approach options.

A7.5 Develop the Strategy for Information Synthesis

GAEPD and/or their contractor will use a systematic planning process to develop LSPC, EFDC, WASP, GA DOSAG, EPD RIV-1, GA ESTUARY, WCS, and other models for the assimilative capacity analyses. This process considers the following elements:

- The accuracy and precision needed for the models to predict a given quantity at the application site of interest to satisfy regulatory objectives.
- The appropriate criteria for determining whether the models are accurate and precise enough based on past general experience combined with site-specific knowledge and completeness of the conceptual models.
- How the appropriate criteria would be used to determine whether model outputs achieve the needed quality.

Acceptance criteria that result from systematic planning address the following types of components for modeling projects. Criteria used in selecting the appropriate model will be documented in the modeling reports and typically include the following:

- Technical criteria (concerning the requirements for the model's simulation of the physical system).
- Regulatory criteria (concerning constraints imposed by regulations, such as water quality standards).
- User criteria (concerning operational or economic constraints imposed, such as hardware/software compatibility).

The available models will be compared to enable the Project Manager to select the most appropriate models for a particular study. Typically, a GAEPD-approved model exists that is appropriate for use in the development project. In addition, existing model programming language may be converted into a different programming language to enhance software compatibility. The models which may be used are listed below:

- Loading Simulation Program C++ (LSPC)
- Environmental Fluid Dynamics Code (EFDC)
- Water Quality Analysis and Simulation Program (WASP)
- Finite Volume Coastal Ocean Model (FVCOM)
- GA DOSAG
- EPD RIV-1

- GA ESTUARY
- Watershed Characterization System (WCS)

Models generate predicted contaminant concentrations in water, based on concentrations or loads contributed from one or more sources. The modeling methodology should be able to predict concentrations of target pollutants such as total phosphorus, nitrite and nitrate, dissolved oxygen, and total suspended solids on at least a monthly basis (daily output is preferable to allow for the evaluation of the impacts of individual storms). The approach must also consider the dominant processes regarding pollutant loadings and the instream fate. For example, in some watersheds, primary sources contributing to nutrients and siltation impairments are nonpoint agriculture-related sources which are typically rainfall-driven, and thus relate to surface runoff and subsurface discharge to a stream. With this in mind, the modeling strategy needs to be able to handle agricultural practices that directly affect the transport of sediment-bound pollutants such as total phosphorus and water-soluble pollutants such as nitrate. These agricultural practices include cropping practices, conservation tillage, and artificial (tile) drainage.

A7.6 Specify Performance and Acceptance Criteria

Quantitative measures, sometimes referred to as calibration criteria, include the *relative error* between model predictions and observations as defined below.

$$E_{rel} = \frac{\Sigma |O - P|}{\Sigma O} \, x \, 100$$

where E_{rel}= relative error in percent. The relative error is the ratio of the absolute mean error to the mean of the observations and is expressed as a percent. A relative error of zero is ideal.

Models will be deemed acceptable when they are able to simulate field data within predetermined statistical measures. These statistical criteria will vary depending on the focus of the assimilative capacity. When applying watershed hydrologic models, for example, GAEPD and/or their contractor will use a hydrologic calibration spreadsheet to determine the acceptability of modeling results. The spreadsheet computes the relative error for various aspects of the hydrologic system. Statistical targets that have been developed and implemented in previous studies (Lumb et al. 1994), are defined and met for each aspect of the system prior to accepting the model (Table 3). Similar comparisons are made for other modeling components (e.g., watershed pollutant loads and receiving water quality).

Table 3. Relative Errors and Statistical Targets for Hydrologic Calibration

RELATIVE ERRORS (SIMULATED-OBSERVED)	STATISTICAL TARGET
Error in total volume:	10
Error in 50% lowest flows:	10
Error in 10% highest flows:	15
Seasonal volume error - Summer:	30
Seasonal volume error - Fall:	30
Seasonal volume error - Winter:	30
Seasonal volume error - Spring:	30
Error in storm volumes:	20
Error in summer storm volumes:	50

An overall assessment of the success of the calibration may be expressed using calibration levels.

Level 1: Simulated values fall within the target range (highest degree of calibration).
Level 2: Simulated values fall within two times the associated error of the calibration target.
Level 3: Simulated values fall within three times the associated error of the calibration target.
Level 4: Simulated values fall within *n* times the associated error of the calibration target (lowest degree of calibration).

A7.7 Optimize the Design for Obtaining and Generating Adequate Data or Information

The data requirements encompass aspects of both laboratory analytical results obtained as secondary data and database management to reduce sources of errors and uncertainty in the use of the data. Data commonly required for populating a database to supply data for calibrating a model are listed in Table 4.

Table 4. Typical Secondary Environmental Data to Be Collected

DATA TYPE	EXAMPLE MEASUREMENT ENDPOINT(S) OR UNITS
Geographic or Location Information (Typically in GIS Format)	
Land use	acres
Soils (including soil characteristics)	hydrologic group
Topography (stream networks, watershed boundaries, contours, or digital elevation)	elevation in feet and meters; percent slope
Water quality and biological monitoring station locations	latitude and longitude, decimal degrees
Meteorological station locations	latitude and longitude, decimal degrees
Permitted facility locations	latitude and longitude, decimal degrees
Impaired waterbodies (georeferenced 1998 303(d)-listed AUs)	latitude and longitude, decimal degrees
Dam locations	latitude and longitude, decimal degrees
CSO locations	latitude and longitude, decimal degrees
Mining locations	latitude and longitude, decimal degrees
Flow	
Historical record (daily, hourly, 15-minute interval)	cubic feet per second (cfs)
Dam release flow records	cfs
Peak flows	cfs
Meteorological Data	
Rainfall	inches
Temperature	Deg C
Wind speed	miles per hour
Dew point	Deg C
Humidity	percent or grams per cubic meter
Cloud cover	percent
Solar radiation	Watts per square meter
Water Quality (Surface Water, Groundwater)	
Chemical monitoring data	milligrams per liter (mg/L)
Biological monitoring data	number of taxon

DATA TYPE	EXAMPLE MEASUREMENT ENDPOINT(S) OR UNITS
Discharge Monitoring Report	discharge characteristics including flow and chemical composition
Permit Limits	mg/L
Regulatory or Policy Information	
Applicable state water quality standards	mg/L
U.S. EPA water quality standards	mg/L
On-site Waste Disposal	
Septic systems	number of systems, locations, failure rates
Illicit discharges	straight pipes
Land Management Information	
Agricultural practices (major crops, crop rotation, manure management and application practices, fertilization application practices, pesticide use)	description of crop rotations; pounds manure applied per acre
Best Management Practices	length and width of buffer strips
Additional Anecdotal Information as Appropriate	
Stream networks, watershed boundaries, contours or digital elevation, storm water permits, storm characteristics, reservoir characteristics, fish advisories, facility type, permit status, applicable permits, best management practices, major crops, crop rotation, manure management and application practices, livestock population estimates, fertilization application practices, pesticide use, wildlife population estimates, citizen complaints, relevant reports, existing watershed and receiving water models	specific descriptive codes

Secondary data will be downloaded electronically from various sources to reduce manual data entry whenever possible. Secondary data will be organized into a standard model application database. A screening process will be used to scan through the database and flag data that are outside typical ranges for a given parameter; values outside typical ranges will not be used to develop model calibration data sets or model kinetic parameters. The data used in the model, the time period from which the data were collected, and the quality requirements of the data will be described in the assimilative capacity analyses modeling report. If no quality requirements exist or if the quality of the secondary data cannot be determined, a disclaimer that indicates that the quality of the secondary data is unknown will be added. The wording of this disclaimer will be as follows:

> *The quality of the secondary data used in developing the assimilative capacity analyses could not be determined.*

The goal of the modeling effort is to calculate water or sediment contaminant levels resulting from one or more point and nonpoint sources. The results of the modeling effort could be used to establish National Pollutant Discharge Elimination System (NPDES) permit limits or nonpoint source reduction plans based on meeting relevant ambient water or sediment quality criteria. In general, ambient water and sediment quality criteria have incorporated a margin of safety such that concentrations at or just less than the criterion indicates a potential for unacceptable risks to human health or aquatic life, and exceedances are anticipated to produce impairment. If the calculated point source permit limit for the particular contaminant is exceeded, water or sediment quality will be reduced, presenting a hazard.

Uncertainty in the data due to sampling and measurement errors or errors introduced during data manipulation could result in identifying a hazard when one does not actually exist or in not identifying a hazard when one does exist. The overall assumption being made during this process is that the results of the assessment should be conservative, i.e., errors made by identifying a hazard when one does not actually exist are more acceptable than errors made by not identifying a hazard when one does exist. Reducing data uncertainty is the highest priority. Because these data will be used to develop control measures, including NPDES permits and actions taken by state, territorial, tribal, or local authorities, to implement TMDLs to reduce pollution, it is important to reduce uncertainty by using appropriate QC protocols. Discussions of conventional data quality indicators precision, accuracy, representativeness, completeness, and comparability appear in the Appendix C.

A8. Special Training Requirements/Certification Listed

GAEPD and/or their contractor staff involved in the development of model input data sets and model application have experience in numerical modeling gained through their work on numerous similar projects. Guidance will be provided to modelers by senior modelers who have extensive experience using the applicable model(s). In addition, model users' manuals will be provided to all modelers involved in the project. The Project Manager(s) will ensure strict adherence to the project protocols.

New field personnel receive training in proper sampling and field analysis. Before actual field sampling or field analysis occurs, the new personnel will demonstrate to the Unit Managers, or their designee, their ability to properly calibrate field equipment and perform sampling and analysis procedures.

In addition, annual and as needed refresher training in field and laboratory methods and procedures is provided to the water quality monitoring staff to ensure consistent and appropriate adherence to SOPs. The focus of this training is to review the fundamentals of sample collection, safety, associated documentation, and specific laboratory protocols. Failure to follow and document basic, agreed-upon principles and procedures makes subsequent data use and analysis very difficult. Table 5 lists the current training provided to monitoring field and office modeling staff.

UGA laboratory staff members who initially conduct any part of a laboratory analysis are required to demonstrate their ability to perform the work according to the instructions in the standard operating procedure for that work.

GAEPD Laboratory staff members must successfully complete a training program of classroom instruction or on the job training that instructs them in the requirements of the Waste Management SOP. All sections of the SOP must be included in the training. Initial and annual renewal training is conducted by each Laboratory Manager or the Laboratory Director.

Table 5. Personnel Training

Training	Description	Trainer(s)
WASP	Training in model input, model set up, decay rates and interpretation of model results	EPA Region IV
LSPC	Training in model input, model set up, decay rates and interpretation of model results	Erin Lincoln Tetra Tech
EFDC	Training in model input, model set up, decay rates and interpretation of model results	Erin Lincoln Tetra Tech
WCS - USLE	Training in model input, model set up and	Matthew Revel, Tyler Parsons

Training	Description	Trainer(s)
	interpretation of model results	
EPD RIV-1	Training in model input, model set up, decay rates and interpretation of model results	Larry Guerra, Josh Welte
GA DOSAG	Training in model input, model set up, decay rates and interpretation of model results	Azarina Carmical
GA ESTUARY	Training in model input, model set up, decay rates and interpretation of model results	Elizabeth Booth
CPR	Certification training in Cardio Pulmonary Resuscitation for Adult, Child & Infant	American Red Cross
First Aid	Standard First Aid	American Red Cross
SABs Workshop	Developing Suspended and Bedded Sediment Water Quality criteria	U.S. EPA
Monitoring for Decision Making	Nonpoint Source Monitoring and Management in agriculture and urban landscapes	U.S. EPA/Texas Commission for Environmental Quality & River Systems Institute
Multi-probe Use	Discussion on how to use multi-probes in the field to collect water quality data (single-use and deployment)	Cody Jones, Reid Jackson
Safety	Discussion of safety precautions both in the field and in the lab	Cody Jones, Reid Jackson
Field Surveys	Discussion of survey preparation, procedures, and special considerations	Cody Jones, Reid Jackson
Flow	Discussion and practicum on proper preparation and performance of flow surveys, including use of velocity meters and data processing	Ben Hutton
Rapid Bioassessment Survey (macroinvertebrate)	Review of SOP for collection and analysis of benthic data	Cody Jones
Boating Safety	O & M and trailering for boats safely	GADNR, Cody Jones, Reid Jackson

NOTE: All training records are stored at GAEPD's office in Atlanta, GA

For the collection of samples, each Environmental Specialist of the GAEPD is required to be proficient in the use and calibration of a water quality multi-probe to measure specific conductance, pH, water temperature, and dissolved oxygen. In addition, each Environmental Specialist will be familiar with this QAPP, all applicable SOPs, and study plans.

Additionally, for lake sampling, proficiency may be required in the use of equipment to measure turbidity and chlorophyll *a* values. Lake sampling also involves the proficient use of a secchi disk, Van Dorn sampler, photometer, global positioning system device (GPS), depth gage, zooplankton net, and chlorophyll *a* filtration methods and procedures. Sampling on lake waters involves being familiar with the operation of a number of sizes and types of watercraft, including the proficient transport of such craft.

Before an Environmental Specialist is allowed to perform routine sampling without supervision, a senior Environmental Specialist instructs them in the proper collection and handling techniques for water quality sampling and field measurements. All training records for employees of the GAEPD are maintained within the performance review documentation for each employee and are part of the permanent personnel record of the employee as maintained by the personnel office. Personnel are observed intermittently throughout the year to determine if samples are collected and processed correctly.

Environmental Specialists performing compliance-sampling inspections have had formal training regarding the NPDES permitting program, the Clean Water Act, Georgia's Rules & Regulations for Water Quality Control, inspection procedures, facility entry and wastewater treatment plant operation and safety concerns. They have received on-the-job training from the Unit Coordinator and senior Environmental Specialists in inspection techniques, flow measurement, plant process control and logistic contingencies. Formal training of all FMU associates continues on an ongoing basis through courses offered by the USEPA, GAWP, GRWA and GWWI. The coordinator maintains training records for all unit associates. The coordinator and the USEPA conduct inspection overviews. The Facilities Monitoring Unit has adopted as its definitive guidance documents USEPA's *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* and the *NPDES Compliance Inspection Manual*.

Environmental Specialists performing Rapid Bioassessment Surveys for macroinvertebrates and periphyton as test specimens are familiar with the SOPs and study plans for the survey project. Those staff that have successfully completed taxonomic identification workshops and training classes conduct benthic taxonomic identification of collected specimens.

All field personnel will receive training in CPR and basic first aid through the American Red Cross. Performing or administering CPR and/or First Aid without certified training can lead to legal issues. All GAEPD training activities will be documented using signature sheets.

A9. Quality Objectives and Criteria for Water Quality Monitoring

The USEPA defines Measurement Quality Objectives (MQO's) as "acceptance criteria' for the quality indicators. [They are] quantitative measures of performance…" (Environmental Protection Agency, 2002). In practice, these are often the precision, bias, and accuracy guidelines against which laboratory (and some field) QC results are compared. Precision may be assessed by the analysis of laboratory duplicates or check standard replicates and bias by comparing the mean of the blank and check standard results to known values.

The measurement quality objectives for monitoring data are outlined in Table 6. Although failure to meet these planned MQOs may subject project data to qualification or censoring during post-monitoring quality control review, GAEPD's evaluation of data quality is flexible and these objectives are used as guidance.

In general, GAEPD requires low-level analyses for most of the analytical determinations on GAEPD's samples. Although results for individual analyses vary depending on waterbody pollutant levels, many of the results are often at or near the method detection limits.

Detection limit information in Table 6 is based on the latest determinations by GAEPD's laboratory and the University of Georgia's Agricultural and Environmental Services Laboratory. GAEPD, USGS, and CWW deliver all of their samples to either of these two laboratories for analysis.

Table 6. Measurement Quality Objectives for Water Quality Monitoring

Analyte	**Units**	**Method**	**RL**	**Accuracy (%R)**	**Precision (RPD)**
Multi-probe (Hydrolab®, MS5;YSI Pro DSS)					
Water Temperature	°C	-	-5 ºC	0.10	5 %

Analyte	Units	Method	RL	Accuracy (%R)	Precision (RPD)
pH	SU	-	-	0.2	0.01
Dissolved Oxygen (Clark Cell)	mg/l	-	0.2	0.2	0.01
Dissolved Oxygen (LDO)	mg/L		0.1	0.1-<8mg/L; 0.2->8mg/L	.01
Specific Conductance	µs/cm	-	-	1 %	4 digits
Turbidity	NTU	-	-	5 %	0.1
Water Quality, Flow, Macroinvertebrates, Habitat, Periphyton, Zooplankton					
Flow	cfs	-	-	15 % est.	10 %
Lab Turbidity	NTU	180.1	1.0	90-110	15
Lab Conductivity	µmho/cm	SM 2510B	10	90-110	15
Total Suspended Solids	mg/L	160.2	1.0	90-110	15
Color	PCU	SM 2120B	5	80-120	15
Total Phosphorus	mg/L	365.1	0.02	90-110	15
Ortho Phosphorus	mg/L	365.1	0.04	90-110	15
Ammonia Nitrogen	mg/L	SM 4500-NH_3-G	0.03	90-110	15
Nitrate-Nitrite	mg/L	353.2	0.10	90-110	15
Total Kjeldahl Nitrogen	mg/L	351.2	0.20	80-120	20
Alkalinity	mg/L	SM 2320B	1.0	90-110	15
Hardness	mg/L $CaCO_3$	130.2	1.0	90-110	25
Chloride	mg/L	300.0	10	90-110	15
BOD_5	mg/L	405.1	2.0	85-115	30
COD	mg/L	SM 5220D	10	85-115	25
TOC	mg/L	SM 5310B	1.0	85-115	15
DOC	mg/L	SM 5310B	1.0	85-115	15
Oil & Grease	mg/L	1664	5.0	75-125	15
VOCs	µg/L	524.2	0.50	70-130	20
Hexavalent Chromium	µg/L	SM 3500-CR-D	50	90-110	15
Total Chromium	µg/L	200.8	20	85-115	≤ 15
Total Copper	µg/L	200.8	20	85-115	≤ 15
Total Cadmium	µg/L	200.8	10		
Total Lead	µg/L	200.8	90	85-115	≤ 15
Total Nickel	µg/L	200.8	20	85-115	≤ 15
Total Zinc	µg/L	200.8	20	85-115	≤ 15
Total Selenium	µg/L	200.8	190	85-115	≤ 15
Total Arsenic	µg/L	200.8	80	85-115	≤ 15
Total Mercury	µg/L	245.1	0.2	85-115	≤ 15
Chlorophyll *a* and Pheophytin *a*	µg/L	SM 10200H	1	85-115	20
E. coli (MPN)	MPN/100 mL	SM 9223	20	N/a	N/a

Analyte	Units	Method	RL	Accuracy (%R)	Precision (RPD)
Enterococci	MPN/100 mL	SM 9230D-2013	MPN/100 mL		
Fish Tissue Toxics					
Antimony	mg/kg	200.8	2	85-115	≤ 15
Arsenic	mg/kg	200.8	2	85-115	≤ 15
Beryllium	mg/kg	200.8	1	85-115	≤ 15
Cadmium	mg/kg	200.8	1	85-115	≤ 15
Chromium (Total)	mg/kg	200.8	2	85-115	≤ 15
Copper	mg/kg	200.8	2	85-115	≤ 15
Lead	mg/kg	200.8	1	85-115	≤ 15
Mercury	mg/kg	245.6	0.1	85-115	≤ 15
Nickel	mg/kg	200.8	2	85-115	≤ 15
Selenium	mg/kg	200.8	2	85-115	≤ 15
Silver	mg/kg	200.8	1	85-115	≤ 15
Thallium	mg/kg	200.8	2	85-115	≤ 15
Zinc	mg/kg	200.8	5	85-115	≤ 15
PCB Aroclor 1232	mg/kg	8082	0.1		
PCB Aroclor 1242	mg/kg	8082	0.1		
PCB Aroclor 1248	mg/kg	8082	0.1		
PCB Aroclor 1254	mg/kg	8082	0.1		
PCB Aroclor 1260	mg/kg	8082	0.1	71-119	27
a-Chlordane	mg/kg	8081A	0.01	50-150	40
g-Chlordane	mg/kg	8081A	0.01	50-150	40
Chlordane (total)	mg/kg	8081A	0.01	50-150	40
Chlorpyrifos	mg/kg	8081A	0.01	50-150	40
Dieldrin	mg/kg	8081A	0.01	50-150	40
Toxaphene	mg/kg	8081A	0.35	50-150	40
Aldrin	mg/kg	8081A	0.01	50-150	40
a-BHC	mg/kg	8081A	0.01	50-150	40
b-BHC	mg/kg	8081A	0.01	50-150	40
d-BHC	mg/kg	8081A	0.01	50-150	40
Lindane	mg/kg	8081A	0.01	50-150	40
Hexachlorocyclopentiadiene	mg/kg	8081A	0.01	50-150	40
Hexachlorobenzene	mg/kg	8081A	0.01	50-150	40
Endosulfan I	mg/kg	8081A	0.02	50-150	40
Endosulfan II	mg/kg	8081A	0.03	50-150	40
Endosulfan sulfate	mg/kg	8081A	0.05	50-150	40
Endrin	mg/kg	8081A	0.02	50-150	40
Endrin aldehyde	mg/kg	8081A	0.05	50-150	40
Heptachlor	mg/kg	8081A	0.01	50-150	40
Heptachlor Epoxide	mg/kg	8081A	0.01	50-150	40

Analyte	Units	Method	RL	Accuracy (%R)	Precision (RPD)
Methoxychlor	mg/kg	8081A	0.15	50-150	40
Mirex	mg/kg	8081A	0.01	50-150	40
4,4'-DDD	mg/kg	8081A	0.01	50-150	40
4,4'-DDE	mg/kg	8081A	0.03	50-150	40
4,4'-DDT	mg/kg	8081A	0.01	50-150	40

The USEPA defines Data Quality Objectives (DQO's) as "qualitative and quantitative statements that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors…" (Environmental Protection Agency, 2002). DQOs may be used to evaluate whether the data are adequate to address the project's objectives. Among GAEPD's objectives, the ability to detect changes in water quality (trends) is the cornerstone of our sampling design. A historical perspective, which only long-term records can provide, is necessary to make informed decisions regarding TMDL development, water quality assessments, or the effects of regulatory actions on water quality.
The DQOs for this program can be met by adhering to the procedures defined in this QAPP. Accuracy, precision, completeness, representativeness, and comparability required to meet these objectives are summarized below along with other data quality criteria, such as holding time, sensitivity, and detection limits.

A9.1. Accuracy

Accuracy is determined by how close a reported result is to a true or expected value.

Laboratory accuracy will be determined by following the policy and procedures provided in the Laboratory's Quality Assurance Plan and analyte-specific program SOPs. These generally employ estimates of percent recoveries (% R) for known internal standards, matrix spike and performance evaluation samples, and evaluation of blank contamination.

Depending on the analyte, specific accuracy objectives can be concentration-based (e.g., +/- 0.01% @ <0.05 mg/L and +/- 20% @ >0.05 mg/L), or can be defined in terms of percent recovery percentages (e.g. 80-120 % recovery of matrix spike/PE samples).

Accuracy for multi-probe measurements is tested prior to use using standards that bracket the measurement range, and after use, checking against standards to determine if probes remained in calibration at the end of the measurement period. A NIST-certified thermometer is used to periodically check thermometer accuracy. The post-sampling checks of each unit ensure that the readings taken during the survey(s) were within QC acceptance limits for each multi-probe analyte.

A9.2. Precision

Precision is a measure of the degree of agreement among repeated measurements and is determined through sampling and analyses of replicate samples.

Laboratory precision of lab duplicates will be determined by following the policy and procedures provided in the Laboratory's Quality Assurance Plan (QAP) and the program's individual SOPs. This varies depending on the lab and analyte, but typically involves analysis of same-sample lab duplicates and matrix spike duplicates.

Overall precision objectives using relative percent difference (RPD) of field duplicate samples vary depending on the parameter and typically range from 10-25% RPD. GAEPD recognizes that precision estimates based on small numbers can result in relatively high RPDs (due to small number effect).

Precision of the multi-probe measurements can be determined by taking duplicate (via a second placement of the unit) readings at the same station location. This is sometimes performed for river and lake surveys. Multi-probe precision objectives generally range from 5-10% RPD depending on the parameter.

A9.3. Representativeness

Representativeness refers to the extent to which measurements represent the true environmental condition. Sampling stations are always selected to ensure that the samples taken represent typical field conditions at the time and location of sampling, and not anomalies due to uncommon effects. In many cases, stations are chosen to evaluate site-specific impacts (i.e., “hot spots”) using the same attention to ensuring representativeness.

A9.4. Completeness

Completeness refers to the amount of valid data collected using a measurement system. It is expressed as a percentage of the number of valid measurements that should have been collected. For GAEPD’s monitoring, the completeness criterion is typically 80-100%. This assumes that, at most, one event out of five might be cancelled for some reason that could cause an incomplete data set with up to 20% of the planned-on data not obtained.

A9.5. Comparability

Comparability refers to the extent to which the data from a study is comparable to other studies conducted in the past or from other areas. For GAEPD’s monitoring, the use of standardized sampling, analytical methods, units of reporting, and site selection procedures helps to ensure comparability of data. Review of existing data and methods used to collect historical data have been reviewed and considered in the sampling design. Efforts to enhance data comparability have been made where possible and appropriate.

A9.6. Detection Limits

In general, the detection limits define the smallest amount of analyte that can be detected above signal noise and within certain confidence levels. Typically, Method Detection Limits (MDL) are calculated in the laboratory by analyzing a minimum of seven low-level standard solutions using a specific method. Detection limits in the traditional sense do not apply to some measurements such as pH and temperature that have essentially continuous scales. Multiplication factors are typically applied to MDL values by labs to express Reporting Limits (RL or RDL), which define a level above which there is greater confidence in reported values. Where low-level results are needed, the GAEPD often requests results reported down to the MDL with or without lab qualification (rather than “<RDL”).

A9.7. Holding Times

Most analytes have standard holding times (maximum allowed time from collection to analysis) that have been established to ensure analytical accuracy. For enforcement activities, bacteria sampling and analyses for groundwater and surface waters adhere to the 6-hour delivery and 8-hour maximum holding times, regardless of method. Due to constraints in shipping samples, all other bacterial samples collected for watershed monitoring follow USEPA's allowance of a 24-hour maximum holding time.

A9.8. Sensitivity

This is the ability of the method or instrument to discriminate between measurement responses. The specifications for sensitivity are unique to each analytical instrument and are typically defined in Laboratory QAP and SOPs.

A9.9. Standard Protocols

The use of approved field and lab SOPs by GAEPD and its agents provides some assurance that programmatic data quality objectives shall be met consistently.

A9.10. Performance Auditing

Scheduled and unscheduled field audits are typically performed to evaluate implementation of field methods, consistency with this QAPP and compliance with GAEPD's SOPs for all projects. Field audits attempt to evaluate at least one monitoring crew-member a minimum of one time over the annual monitoring period.

Proficiency testing of laboratory analytical accuracy is performed with single- or double-blind lab QC checks using purchased QC check samples. All audit results are compared to "true" values/results and evaluated against acceptance limit criteria. Results are also provided to lab analysts and survey coordinators.

A10. Documents and Records

Documentation of all modeling activities is necessary for the interpretation of study results. As directed by the Program Manager, GAEPD and/or their contractor will prepare progress reports and other deliverables, which will be distributed to project participants as indicated by the Program Manager. Data and assumptions used to develop the assimilative capacity analyses models will be recorded and documented in the assimilative capacity analyses modeling report.

The format of the raw data to be used for assimilative capacity model parameters, model input, model calibration, and model output will be converted to the appropriate units, as necessary, for use in assimilative capacity analyses development.

The Program Manager and Project Managers will maintain files, as appropriate, as repositories for information and data used in models and for the preparation of any reports and documents during the project. Electronic project files are maintained on network computers and are backed up periodically. The Project Managers will supervise the use of materials in any administrative record. The following information may be included in the hard copy or electronic project files:

- Any reports and documents prepared.
- Contract and project information.
- Electronic copies of model input/output (for model calibration and allocation scenarios).
- Results of technical reviews, model tests, data quality assessments of output data, and audits.

- Documentation of response actions during the project to correct model development or implementation problems.
- Assessment reports for acquired data.
- Statistical goodness-of-fit methods and other rationale used to decide which statistical distributions should be used to characterize the uncertainty or variability of model input parameters.
- Communications (electronic mail, memoranda; internal notes; telephone conversation records; letters; meeting minutes; and all written correspondence among the project team personnel, subcontractors, suppliers, or others).
- Maps, photographs, and drawings.
- Studies, reports, documents, and newspaper articles pertaining to the project.
- Spreadsheet data files: physical measurements, chemistry data, and microbiological data.

The model application will include complete record keeping of each step of the modeling process. As directed by the project managers, documentation may consist of reports and files addressing the following items:

- Assumptions
- Parameter values and sources
- Nature of grid, network design, or subwatershed delineation
- Changes and verification of changes made in code
- Actual input used
- Output of model runs and interpretation
- Calibration and validation of the model(s)

Formal reports are maintained at GAEPD’s Atlanta office.

The Ambient Monitoring Unit (AMU) Manger will be the lead Manager assigned to updating and ensuring project personnel have the most current approved version of the QAPP and any applicable SOPs and project-specific sampling plans. Each QAPP will be assigned a version update number with publication date. Any modifications or updates containing significant changes to methodologies, protocols or data processing and handling will be submitted to the USEPA for review and approval. Distribution of updated plans will follow the distribution list contained within the QAPP.

Documents and records for the monitoring program and specifically for each station, which include lab reports from the laboratories, field observations and field measurements, are kept on file for a minimum of ten years for listing and/or reporting requirements.

A10.1. Field Records

Files for each monitoring location that is sampled during a calendar year will be created for the storage of information about the site. These files will contain all the visual observations and field data. All the files are stored by GAEPD basin and further by a monitoring location number (MON LOC ID). This number correlates with the number given to each major river basin.

Field books and field forms contain all original field notes and are kept on file for each station. The field books and field forms contain information that describes station identification number, station name, date and time of the sample collection, person(s) collecting the samples, type of samples collected, weather conditions at the time of sampling, and field observation and measurements.

Upon completion of the sample collection for the day, the current day's field notes are reviewed for accuracy. If a discrepancy is discovered, immediate corrective action is taken. For the compliance sampling inspections, all field notes are entered into the inspection field book. When results of analyses for the samples are received from the lab, the Environmental Specialist prepares inspection reports for transmittal to the corresponding compliance/enforcement personnel within the WPB responsible for each facility inspected.

A10.2. Laboratory Records

Each sample is sent to the laboratory with a GAEPD laboratory source document. This form acts as a chain-of-custody (COC) form and analytical services request form. The laboratory source document is filled out for each station prior to delivery/shipment. While in the custody of the shipper, all sample shipments are tracked by GAEPD personnel to ensure that the samples are handled properly and arrive within the appropriate holding times.

The reports of the analyses of the samples are optimally produced within 30 days of receipt of the sample. All analytical reports are maintained on file at the EPD lab.

A10.3. Office Records

Formal project folders containing field data, lab data, and ancillary information (including results of calibration and QC checks, model input, and output files, etc.) are kept at the WPB's Sloppy Floyd office in Atlanta, Georgia. These records are maintained, complete, and orderly by the principal investigator. In addition, any other records, or documents applicable to the projects, such as project-specific sampling plans, pre- and post- study meeting notes, audit reports, etc. will be placed as hard copies in the project folder. Report format will include the scope of the project, personnel assignments for specific monitoring and assessment tasks, equipment used with identification numbers, data assessment and any health or safety issues. All records are physically housed in a dedicated file in the WPMP offices. Reports will be maintained in an electronic file as well as in a hard copy paper format and will be available to the public for review during business hours.

A10.4. Sampling Station Registration

Each sampling location (station) has a unique identification number and description. All sampling locations are surveyed according to GAEPD's protocols to determine if the site is suitable for monitoring.

A10.5. Documentation Protocols

GAEPD logbooks, forms, data sheets, lab notebooks, and chain-of-custody forms are formal records. Records should be made in indelible black ink or extra fine point permanent marker. There should be no omissions in the data. Striking a single line through the material to be corrected or deleted and initialed and dated by the person making the change will make any corrections to original documentation or records. The line shall not obscure the original material requiring a change. Groups of related errors on a single page should have one line through the entries and should be initialed and dated with a short comment supplied for the reason of data deletion.

A10.6. Data Handling Records

All records of data verification and validation become part of the permanent record of the station and are included in the files of the GAEPD WPMP. Once the data is transmitted to the GAEPD, all records of the use of the data for the listing and reporting process, computation of TMDLs, and other uses become part of the files of the GAEPD and are stored following, at a minimum, the federal requirements for records retention.

A10.7. Data Archiving and Retrieval

All GAEPD's water quality monitoring data is housed in GOMAS. The GAEPD archives original data into perpetuity. Original field notes, and other paper documents original to the data collection activity remain part of the permanent files of the GAEPD WPB Sloppy Floyd office in Atlanta, Georgia. Copies of electronic water quality data is transferred to the National Archive STOrage and RETrieval System (STORET). The data package is maintained according to the Federal requirement for records retention.

B. DATA GENERATION AND ACQUISITION

B1. Sampling Process Design

B1.1. Purpose/Background

The GAEPD has a comprehensive monitoring program that serves its water quality management needs. This approach addresses all Georgia groundwater and surface waters including rivers, streams, lakes, reservoirs, and coastal estuarine waters.

The monitoring strategy provides a logical progression from intensive data collection and assessments to TMDL development and permit issuance. The key activities involved in sample process design are:

1. **Planning** – Existing data and reports are compiled and used to review historical water quality information and identify data gaps that may be needed to fully assess the water body.

2. **Monitoring** – Field data are collected for targeted and probabilistic waterbodies in the river basin. These data supplement existing data and are used for water quality assessment.

3. **Assessment** – Monitoring data are compared to existing water quality standards to determine if the waterbodies support designated uses.

4. **Wasteload Allocation/TMDL** – Monitoring data are used by the Water Quality Modeling Unit to determine pollutant limits for treated effluent discharges into the watershed by permittees. Limits are set to ensure that state water quality is protected. The TMDL Modeling and Development Unit prepares TMDLs for those waters not meeting their designated uses by the Monitoring & Assessment QA Officer. The Unit calculates the TMDL for the pollutant of concern considering all sources of pollution for the stream segment and includes a margin of safety.

5. **Permits** – Issuance and expiration of all discharge permits are synchronized with watershed assessments. Permits are issued in Georgia under the Federally delegated National Pollutant Discharge Elimination System (NPDES) program.

6. **TMDL Implementation Plans** – Plans are developed for each TMDL developed. The plans include the original basis for listing the waterbody as impaired, a general watershed description, identification of possible cause for the impairment, actions to correct the problem, and additional water monitoring to confirm the water body has been restored to meeting water-quality standards.

This approach considers all sources of water pollution including discharges from municipalities and industries, as well as runoff from urban and agricultural areas. EPD accepts public participation and coordination with other local governmental agencies during water sampling process design.

B1.2. Monitoring Design

Georgia generally uses several methodologies in its waterbody monitoring design.

For many of the sites that are sampled, it is already known whether a water body represented by a particular site is compliant with current water quality standards. The design assumptions for monitoring are as follows:

1. Samples represent average water quality conditions at the time of day, water temperature, and flow conditions that existed during collection.
2. The bias and variability of sampling protocols are not affected by sampling platform (bridge, wading, or boat) or type of sampler used (weighted bottle vs. weighted bucket).
3. The bias and variability of field measurements are not affected by using different personnel using different instruments.
4. The bias and variability of lab analyses are not affected by using two different laboratories or by samples analyzed on different days.
5. Sample contamination is minimal and does not affect constituent concentration in samples.

B1.2.1. River Basins

Georgia's 14 major river basins are sampled each year, resources permitting. Sampling state-wide allows for comparison of different climatic conditions across years.

B1.2.2. Ecoregions

Georgia has 25 Level IV sub-ecoregions in the State. Selection criteria for reference sites included minimal impairment and representativeness. 78 candidate reference sites were evaluated as part of the eco-region project. The reference sites were chosen to represent the best attainable conditions for streams with similar characteristics in each sub-ecoregion. Reference conditions represented a set of expectations for physical habitat, general water quality, and the health of the biological communities in the absence of human disturbance and pollution. This reference database has been used to establish regional guidelines for wadeable streams.

B1.3. Indicator Variables

A variety of core and supplemental indicators are used to assess compliance with water quality standards, to support individual use classifications, and for other information needs and programs. A common set of water quality criteria including pathogen indicators (*E. coli,* enterococci), dissolved oxygen, pH, temperature, and toxic substances apply to all water uses in Georgia including recreation, drinking water, fishing, wild river, scenic river, and coastal fishing. In assessing water quality in lakes, additional indicators include nutrients, and chlorophyll *a*. Core and supplemental indicators are shown in Table 7.

Table 7. Core and Supplemental Indicators

INDICATOR TYPE	AQUATIC LIFE	RECREATION	FISH/SHELLFISH CONSUMPTION
Core	Macroinvertebrate community Fish community Periphyton/Phytoplankton Habitat Flow Dissolved oxygen pH Temperature Turbidity Suspended solids Lake trophic status	Pathogen Indicators Transparency Algal blooms, Chlorophyll *a*	Mercury PCBs Pesticides Shellfish bed closures (non-management)
Supplemental	Toxic pollutants (e.g., metals) Toxicity tests Tissue chemical assays Nutrients Chlorophyll *a* Sediment chemistry Organism condition factor Non-native species Land-use/% impervious cover Fish kills Pollutant loadings	Aesthetics Objectionable deposits (scums, sheens, debris, deposits, etc.) Flow/water level Sediment quality Color/Turbidity pH	Other contaminants of concern Pathogens

B1.4. Long-Term Design Strategy

Consistent with Georgia's Water Quality Monitoring Strategy (January 2017 update), GAEPD's monitoring is an integral component of the Statewide comprehensive monitoring program. Requirements for the monitoring program designed to support watershed assessments and TMDL development are that it be:

- Statewide in scale
- Comprehensive (waters in the State are assessed as resources allow)
- Repeated at regular intervals
- Designed to increase the number of stream miles and lake acres assessed, and
- Designed to reduce the bias toward problem areas

GAEPD is working to meet these goals by incorporating some probabilistic design elements into project sampling designs and add continuous, fixed-site monitoring to provide data pertaining to loads of contaminants carried by major river systems at strategic locations within Georgia. These elements would supplement GAEPD's existing targeted monitoring emphasis. The ultimate long-term GAEPD strategy for Georgia is proposed to utilize a combination of deterministically and probabilistically derived sampling networks, including synoptic surveys for the assessment of designated uses, fixed-station arrays for trend monitoring, intensive, and screening-level targeted monitoring for various purposes, and statistical designs such as random sampling.

The strategy also includes significant efforts by the GAEPD to enable two-way sharing of data. Monitoring data and information are shared with other programs, within the Department, as well as in other agencies, for use in their work. In addition, data from external groups can also be used (based on case-by-case evaluations) to supplement information available to decision makers.

B1.5. Site Selection Criteria

Actual river and stream sampling points are generally a composite of three sub-samples using equal width increments (EWI) for rivers and streams, photic zone composite samples for lakes and estuaries, or determined by field staff as representative of the waterbody. Overall, the data collection efforts for all waterbody types take the following into consideration:

- Site is accessible by wading, from a bridge crossing, or by boat
- Flow is significant enough to ensure a relatively well-mixed, homogenous sample
- Located outside of effluent mixing zones
- Upstream side of bridges whenever possible
- Not directly below large amounts of debris

B1.6. Current Design Approach

Stations are established at publicly accessible, generally fixed locations, with a specific latitude and longitude. Most sites are located at bridge crossings or areas accessible by boat. Targeted stations are strategically located to monitor a specific area of concern:

- Overall water quality in a larger watershed
- Effect of point source discharges
- Effect of non-point sources of pollution (e.g., urban areas, animal operations, agriculture)
- Effect of land use changes
- Waters of significant ecological, recreational, political, or municipal use
- Waters which show an impairment due to unknown causes (e.g., biological data shows possible impairment)
- Significant waterbodies as they leave the state

The assessment program is presently the primary means of meeting the CWA objective relating to assessing the status of designated uses. Prior to each monitoring year, information and data is gathered to identify data gaps and the need for additional information. Input from other internal programs and outside agencies is actively solicited to gain further insight with respect to water quality goals and use-objectives. This process culminates in the development of project-specific sampling plans for obtaining this information.

Water Quality Surveys: consist of monthly sampling for a calendar year for rivers and streams and during the growing season (April – October) for lakes and reservoirs. The selection of indicators is focused on those with Georgia water quality standards that can be cost-effectively analyzed. Additional indicators are also included that may not have specific standards but are useful for interpretation of other measurements.

River and Streams Monitoring: consists of physical and chemical sampling of wadeable and non-wadeable rivers and streams. Sampling includes *in-situ* measurements of water temperature, dissolved oxygen, conductivity, and pH with a multi-parameter probe; field observations to qualify current weather, water level, water color/clarity, and other factors that may affect the outcome of the sample and; chemical sampling of a suite of routine parameters that include: nutrients (TP, TN, NH3-N), BOD_5, alkalinity, hardness, suspended solids, total organic carbon and turbidity. Samples are collected monthly for a minimum of one calendar year obtaining a minimum of 12 data points. As resources allow, a subset of rivers and streams are sampled quarterly for metals of water quality concern (e.g., Hg, Cu, Pb, Se), or sampled 16 times in a calendar year for *E. coli* or enterococci bacteria to calculate 4 bacterial geometric means representing four calendar quarters capturing seasonal variations.

Lakes and Reservoirs Monitoring: consists of physical and chemical sampling of the open water area and tributary embayments of public lakes larger than 500 acres. Sampling includes a depth profile of *in-situ* measurements of dissolved oxygen, pH, conductivity, and water temperature with a multi-parameter probe; field observations to quantify the photic zone, water clarity, qualify current weather conditions, and other factors that may affect the sample and; chemical sampling of a suite of routine parameters that include: *E. coli*, nutrients (TP, TKN, NH_3, and NO_x), BOD_5, chlorophyll-a, alkalinity, hardness, suspended solids, total organic carbon, and turbidity. Annual sampling for lakes is conducted once per month during the growing season of April through October when productivity is high.

Biomonitoring: consists of surveys to collect macroinvertebrates and/or periphyton. Chemical sampling of streams is designed to provide representative information about those waterbodies for a specific moment. Macroinvertebrates and periphyton are used as integrative measures of water quality on long-term and short-term scales.

- Macroinvertebrates: Rapid Bioassessment Protocols (RBPs), based on those developed by the USEPA, are used to monitor the health of benthic macroinvertebrate communities in wadeable streams. Surveys are conducted in wadeable streams using GAEPD's methods and protocols. SOPs are available to the public on the GAEPD's web site at the following web address: https://epd.georgia.gov/watershed-protection-branch/watershed-planning-and-monitoring-program/monitoring

  The structure and function of the macroinvertebrate community are a measure of biological integrity and is also a component of the water quality monitoring program. GAEPD utilizes a standardized method based on the EPA Rapid Bioassessment Protocol to improve data comparability among wadeable sampling sites throughout the State. The macroinvertebrate collection procedures employ a multi-habitat approach that allows for sampling of habitats in relative proportion to their local availability. Macroinvertebrate specimens are identified to species when applicable, counted, and statistically compared to reference conditions with similarities within the sub-ecoregion.

- Periphyton: The analysis of the periphyton (diatoms and soft algae) community in shallow streams employs an indicator species approach whereby inferences on water quality conditions are drawn from an understanding of the environmental preferences and tolerances of the species present. Periphyton communities can exhibit dramatic temporal shifts in species composition throughout the year and as a result information from a single sampling event are generally not indicative of historical conditions. For this reason, the information gained from the algal community assessment is more useful as a supplement to the assessments of other communities that serve to integrate conditions over a longer time period. In some instances, where information pertaining to primary production is required, algal biomass analysis or chlorophyll determinations may be performed. Results of these analyses are used to evaluate the trophic status of lakes and reservoirs. Similar information from riverine and coastal waters is used to identify those waterbodies subjected to excessive nutrient enrichment. Results at public drinking water reservoirs can indicate whether land uses need to be addressed as sources of nutrients and can help water suppliers adjust treatment processes if necessary. Additionally, GAEPD is building a database of periphyton and nutrients to determine biological response to nutrients in streams to assist in the development of nutrient criteria.

Wastewater Discharge Monitoring: serves to document pollutant loading from point sources, assess compliance with NPDES permit limits and supplements river and stream surveys. Discharge measurements provide data for calculation of pollutant mass loadings as well as for assessing impacts on stream biota of low-flow conditions resulting from drought or water withdrawals. Additional site-specific data are collected to assess the facility's discharge quality relative to permit limitations. These data may include pH, DO, TRC, BOD, COD, nutrients, Total Suspended Solids, metals, organics, and *E. coli* bacteria.

Fish Tissue Toxics Monitoring: helps to assess the human health risk associated with the consumption of fish and shellfish from Georgia's waters. Uniform protocols designed to ensure accuracy and prevent cross-contamination of samples are followed for fish collection, processing, and shipping. Lengths and weights are measured, and fish are visually examined for tumors, lesions, or other indications of disease. Data are provided to the DNR, which is the agency responsible for performing the risk assessments and issuing public health advisories. The Department makes a publication available to the public annually on the recommendations for consumption of fish collected from Georgia waters. Sampling is performed once per year for a selected number of sites. Parameters tested from fish tissue samples include PCBs, mercury, and an array of toxic organic chemicals.

Special Project Monitoring: are conducted by GAEPD to address priority issues of concern. These surveys vary in scope and timeframe depending on data requirements, but maintain the same attention to quality in the field and in the lab.

B1.7. Detailed Project-Specific Sampling Plans

Project-specific sampling plans indicate locations, frequencies, analytes, and methods to be used in the project. These plans are supplemental to the programmatic QAPP as they pertain to those projects. If EPD develops a Special Project Monitoring Plans to address a priority issue, the Monitoring Plan will be included as an attachment in the Supplemental Monitoring Grant Annual Reports.

GAEPD evaluates its monitoring program during each planning and assessment cycle and incorporates changes as needed to provide the most comprehensive and effective plan possible with available resources.

B2. Sampling Methods

Samples and measurements are to be taken following the methods listed in Table 8. Any irregularities or problems encountered by field staff should be communicated to the responsible WPMP Unit Coordinator, either verbally or via email, which will assess the situation, consult with other project personnel if needed, and recommend a course of action for resolution.

An overview of the different methods employed is described below.

Table 8. Field Sampling Performance Methods

Performance Requirement	Applicable Method Reference
Sample Collection	SOP#EPD-WPMP-2,4,5 Standard Methods
Multiprobe Use	YSI & Hydrolab manual; SOP# EPD-WPMP-7: Data Sonde Calibration and Maintenance
Multiprobe Deployment	YSI & Hydrolab manual
Benthic macroinvertebrate/habitat	SOP#EPD-Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia
Fish collection/preparation for fish tissue analysis	EPA guidance for fish sampling and analysis for fish advisories (1995); EPD-Fish Tissue Projects SOP: Processing and Handling of Tissue Samples for Fish Consumption Guidelines USGS TWRI Book 5 (1987)
Chlorophyll	SOP#EPD-WPMP-3
Periphyton	Modified RBP (EPA) USGS TWRI Book 5 (1987)
Flow monitoring	SOP#EPD-WPMP-6 USGS TWRI Book 3, Chapters A6-A8 Sontek manual, Aquacalc manual, RiverSurveyor Manual
ISCO sampler	USEPA Environmental Investigations SOPs and Quality Assurance Manual
Digital camera	Camera manuals
Global Positioning System (GPS)	GPS manual

Field measurements:

- Surface – measurements are taken one meter below the water surface (if depth is adequate) or at mid-depth. This method is employed when sampling at bridge crossings or other land accessed stations.
- Profile – measurements are taken just below the water surface and at every meter of depth to the bottom. Method employed primarily at lake and reservoir stations or other sites that exhibit significant stratification.

Samples:

- Grab – samples are taken just below surface (0.1 m). Sample bottles are filled directly by plunging them in to the waterbody, either by submersing by hand, by using a stainless-steel bucket or Labline Poly-Pro water sampler. The grab method is always used for *E. coli*, enterococci, metals, pesticides, chloride, and oil and grease samples.

- Composite – samples are comprised of three sub-samples. Sub-samples are collected using equal width increments (EWI) which consist of 25%, 50%, and 75% of the stream's wetted width. The sub-samples are combined in a churn splitter or carboy container and homogenized. Sample bottles are then filled using the homogenized sample.

- Photic zone composite– The photic zone is determined using a photometer (e.g., Li-Cor), and defined as the depth at which 1/100 of the amount of surface light can penetrate. Samples are collected with a Van Dorn sampler at 0.1 meters followed by one (1) meter intervals to the extent of the photic zone. Samples are combined in a HDPE carboy or churn splitter and homogenized. This method is used for turbidity, BOD, hardness, alkalinity, TOC, chlorophyll *a* and nutrient sampling at designated reservoir stations.

B2.1. Field Safety

The survey coordinators and crew members shall use best professional judgment at all times and at no time allow personal safety to be compromised. In addition, all survey personnel are trained in field safety issues, including what to do in the event of an emergency.

A "standard-issue" **Field Kit** shall be brought on each field survey. These kits include miscellaneous items often needed in the field, such as plastic gloves, safety glasses, sunscreen, insect repellant, poison ivy wash, etc.

A complete **First Aid Kit** containing basic first aid equipment shall be brought (in the vehicle) on each field survey. In situations where sampling stations are far from the vehicle, crews have been instructed to take the first aid kit to the station. All staff will maintain certifications in CPR and First Aid by the American Red Cross.

Each crew member is expected to dress appropriately for the season, weather, and field conditions, especially proper footwear, and raingear. Each crewmember is required wear reflective safety vests at all times during a survey. Flashing lights are also installed on all vehicles to be used when conducting sampling near roadways.

B2.2. Available Field Equipment

Table 9 provides a list of the equipment and disposable items needed by the monitoring staff to perform field sampling and measurements.

Table 9. Field Equipment Inventory and Disposables

Equipment	Model	2023 Inventory	Spare Parts Available
Sample bottles	½ gallon, nutrient, bacteria, metals, VOC, pesticide, oil and grease	300 per office	-
Sample labels	White adhesive labels	1000 per office	-
Sample COC's	Electronic form	Printed as needed	-
pH standards (4.0, 7.0, 10.0 SU)	Fisher Scientific	6 L per office	-
Conductivity Standards (500, 50,000 µmhos/cm)	VWR	6 L per office	-
Distilled or deionized water	Barnstead/Thermolyne 08971	1 per office	Yes
Ice Maker	HOSH IZAKI F-250 BAE	1 per office	No

Equipment	**Model**	**2023 Inventory**	**Spare Parts Available**
Coolers	Igloo/Coleman/Rubber Maid	90	Yes
Cables	Various	31	Yes
DataSondes: OTT & YSI Multi-probe DataSonde	OTT Mini-Sonde 5a, OTT HL4, YSI Pro DSS	36	Yes
Continuous data logger, recorder, and transmitter (telemetry units)	Adcon/Hach	10	Yes
Automated Wastewater Samplers	ISCO Model 3700 ISCO Model 6700 Sequential Sampler	31 total	Yes
Conductivity/Salinity Meters	Fisher-Accumet Model AP-65	5	Yes
Portable Turbidimeter	HACH 2100 P	12	Yes
Portable pH meter	Accumet AP10 Orion Model 250A Orion Model 250 A+	10 total	No
Portable DO meter	YSI Model 58 Hach HQ30d -Luminescent Meter	2 3	Yes
Chlorine Meters	Hach Model DR 820 Hach Model "Pocket Colorimeter II"	4 total	Yes
Van Dorn bottle samplers	Wildco	8	Yes
Sonar depth sounder	Various	7	N/A
Zooplankton Net	Wildco	9	Yes
Flow meters: Scientific Instruments Current Meter Scientific Instruments Current Meter Aquacalc Flow Data Logger Sontek ADV FlowTracker	Mini-Magnetic Head AA – Magnetic Head 5000 Flow Tracker 2D SN P809	4 4 4 6	Yes Yes No (all repair by Mfg.)
Open Channel Flow Meter	ISCO Model 4220	5	Yes
Closed Channel Flow Meter	American Sigma Model 8500	1	Yes
River Surveyor	YSI	4	Yes
LiCor Underwater Photometer	LI-1400, LI210, LI192	8	No (all repair by Mfg.)
Turner Design Field Fluorometer	10-005R	3	Yes
GPS Receiver	Garmin	8	No (all repair by Mfg.
Staff gages	Forestry Supply	30	No
NIST-certified thermometer	Various	10	N/A
Rangefinders	Bushnell	1	N/A
Chlorophyll *a* filtering kits	Millipore Corp.	10	Yes
Dye Testing		available	
Secchi Disk	Wildco	9	Yes
Truck/van	Ford,	12 total	N/A
Boat/trailer	Boston Whaler, Key West, jon boat, Seaborn, Sundance	13 total	Yes

B2.3. Bottle Types, Preservation Techniques and Holding Times

Typical analytes tested with associated bottle type, preservative technique and holding times for water and tissue samples are shown in Table 10.

Table 10. Bottle Type, Preservation Techniques and Holding Times for Samples

Analytes	Bottle Type	Preservative	Holding Times
Lab Specific Conductance	½ gallon plastic	Cool, ≤6 degrees C.	7 days
Lab pH	½ gallon plastic	None	1 day
Lab Turbidity	½ gallon plastic	Cool, ≤6 degrees C.	48 Hours
Lab Alkalinity	½ gallon plastic	Cool, ≤6 degrees C.	14 days
Hardness	250 mL plastic	Cool, ≤6 degrees C.	7 days
Biochemical Oxygen Demand (5-day)	½ gallon plastic	Cool, ≤6 degrees C.	48 Hours
Chemical Oxygen Demand	½ gallon plastic	Cool, ≤6 degrees C.	28 days
Total Organic Carbon	250 mL plastic	H_2SO_4, pH ≤2, cool ≤6 degrees C.	28 days
Dissolved Organic Carbon	250 mL plastic	Filtered, H_2SO_4, pH ≤2, cool ≤6 degrees C.	28 days
Total & Suspended Solids	½ gallon plastic	Cool, ≤6 degrees C.	7 days
Total Ammonia Nitrogen	250 mL plastic	H_2SO_4, pH ≤2, cool ≤6 degrees C.	28 days
Nitrite & Nitrate Nitrogen	250 mL plastic	H_2SO_4, pH ≤2, cool ≤6 degrees C.	28 days
TKN	250 mL plastic	H_2SO_4, pH ≤2, cool ≤6 degrees C.	28 days
Total Phosphorus	250 mL plastic	H_2SO_4, pH ≤2, cool ≤6 degrees C.	28 days
Ortho Phosphorus	250 mL polyethylene	Filtered, Cool, ≤6 degrees C.	48 Hours
E. coli	Sterile, sealed plastic (100 or 250 mL)	Sodium thiosulfate for dechlorination (as needed), Cool, ≤10 degrees C.	24 Hours
enterococcus	Sterile, sealed plastic (100 or 250 mL)	Sodium thiosulfate for dechlorination (as needed), Cool, ≤10 degrees C.	24 Hours
Total Mercury	500 mL plastic NM	HNO_3, pH ≤2	28 days
Total Cadmium	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Chromium	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Copper	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Lead	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Nickel	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Zinc	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Arsenic	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Selenium	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Thallium	500 mL plastic NM	HNO_3, pH ≤2	6 months
Total Antimony	500 mL plastic NM	HNO_3, pH ≤2	6 months
Algae:	Filter	Cool to -20 degrees C.	21 days

Analytes	Bottle Type	Preservative	Holding Times
Chlorophyll *a*, phytoplankton			
Volatile Organics	Glass with Teflon-lined septum caps (40 mL)	1:1 HCL (no headspace)	14 days
Hydrocarbons (Oil and grease, total petroleum hydrocarbons, numerous poly-aromatic hydrocarbons)	Amber glass (1000 mL)	1:1 H_2SO_4, pH ≤2	28 days (O&G)
PCBs and Pesticides	Amber glass (1000 mL)	Cool, ≤6 degrees C.	71 days (extraction) 40 days (analysis)

B2.4. Field Quality Control

Field samples are collected according to standard operating procedures that are updated as necessary and reviewed annually with field personnel. See Section B5 for further detail.

B2.5. Field Documentation
(See Section A9)

B2.6. Decontamination Procedures

Decontamination consists of three phases: (1) pre-sampling, (2) between sites, and (3) post-sampling. All sample bottles arrive from the laboratories pre-cleaned. The following protocols will be used to clean sampling equipment during GAEPD water quality and facility's monitoring.

> **Pre-Sampling:** Before a sampling trip, technicians will make sure that all equipment has been cleaned. If not, they will follow the procedure in the "post-sampling" procedure.
>
> **Between Sites:** All samplers, carboys, and meters, are rinsed thoroughly with deionized water followed by a field rinse from the sample site water.
>
> **Post-Sampling:** After a sampling trip has been completed, all sampling equipment will be thoroughly scrubbed and rinsed with tap water. A phosphate-free laboratory detergent will be used when necessary. A final rinse with deionized water is used after cleaning.

For sampling equipment used in compliance sampling inspections, any devices, equipment, or containers, which come in contact with the fluid being sampled, are required to be washed with phosphate-free laboratory detergent followed by thorough rinsing with deionized water. In the case of objects to be used for metals sampling, they must be rinsed with a 10% solution of nitric acid three times following the phosphate-free detergent wash and rinse. Following the three dilute nitric acid rinses, they must be rinsed at least three times with deionized water (not tap water). The dilute nitric acid rinse is not required for new disposable automatic sampler aliquot inserts (ISCO "ProPak" low density polyethylene bags or equivalent).

When possible, all chemical and bacteriological samples are collected in the appropriate container. If an intermediate sampling device is used to collect a chemical sample, it shall be composed of Teflon® or High-Density Polyethylene. Bacteriological samples are collected directly into sterile sample containers. Subsurface bacteria samples may be collected in a sterile sampling container using a bottle holder connected to a long handle or rope.

All nets used to collect macroinvertebrate or fish samples are thoroughly rinsed to remove debris and clinging organisms after the sample is collected and before leaving the collection site.

B2.7. System Failure and Corrective Action

All sampling sites are identified prior to beginning sampling in the monitoring calendar or fiscal year and every attempt is made to collect all the samples required by the project at each site. If an unexpected problem arises with the site, equipment failure or inability for the designated laboratory to complete analyses for the samples received, the measures outlined in Section B2.7.1 below will be taken.

B2.7.1. Sample Collection/Laboratory Analyses

a. If a sample cannot be collected as scheduled (flooding, dry, equipment failure, temporary inaccessibility, etc.) the project manager or their designee is notified, and the sampling event is rescheduled as soon as possible. If the site has become permanently inaccessible, it is moved upstream or downstream to the nearest accessible location.
b. If equipment becomes inoperable in the field, sampling is rescheduled when properly functioning equipment is available.
c. If samples are lost, or arrive at the laboratory after the holding time has expired, the laboratory notifies the contact at GAEPD responsible for data collection, and the affected sample sites are rescheduled. If samples are lost due to a laboratory accident, the laboratory will notify the GAEPD contact for the project and re-sampling will be scheduled.
d. Any laboratory instrument that fails QC procedures shall not be used until the problem is corrected. Duplicate, laboratory fortified blank, laboratory fortified matrix, and method blanks that fail to meet goals are immediately reviewed for the source of error.
e. If it is not possible to collect a sample, monitoring is rescheduled as soon as possible.

B3. Sample Handling and Custody Requirements

B3.1. Sample Processing

Water samples collected at each site will be processed on site. Sample processing will be accomplished in 4 steps: (1) sample splitting, (2) preserving the sample, (3) storing the sample, and (4) shipment of samples to the laboratory.

1. **Sample Splitting:** Samples will be split when sub-samples are needed for different laboratory analyses. Splitting ensures that all bottles contain an equal amount of all constituents in the bulk water sample.

2. **Sample Preservation:** Nutrient samples are preserved with 5 mL 10% H_2SO_4 for a 250 mL sample. Ortho-Phosphorus and Dissolved Organic Carbon samples are also filtered prior to acid preservation. Bacteria samples are preserved with sodium thiosulfate to absorb any chlorine that may be present during sampling. Trace metal samples are acidified with nitric acid (HNO_3) to a pH <2.

3. **Sample Storage:** All samples are placed immediately on ice and maintained at ≤ 4 °C until they reach the appropriate laboratory.

4. **Sample Shipping:** Samples are either delivered directly or shipped to the laboratory to arrive within 24 hours of the first sampling event. A chain-of-custody form designating the shipper and shipping date and type of sample will accompany the samples.

Samples that are shipped to the laboratory are placed in ice so a temperature of ≤ 4 °C can be maintained. A heavy bag will be placed in the shipping cooler and the samples will be placed inside the bag. Ice will then be poured over the samples and sealed within the bags. Before shipping, the associated chain-of-custody forms are placed in the cooler in a zipper-lock sealable plastic bag and taped to the under-side of the ice chest lid. Shipping containers for chilled samples are high-impact-resistant plastic ice chests. Shipping containers will meet the requirements of the shipping company. All sample bottles will be clearly identified with the sample information. The chain-of-custody form contained on the inside of each sampling container will clearly identify the contents and destination. The outside of the shipping container will be clearly marked with the origin and destination of the shipment. Information on special handling of any sample shipment will be clearly identified on the outside of each container.

Chlorophyll *a* samples for lake work require storage in dark bottles and filtration upon returning from the field. Filters generated must be stored on dry ice until delivered to a laboratory for processing. A laboratory must process the frozen filters within 22 days of delivery.

B3.2. Sample Custody Procedure

The purpose of sample chain-of-custody forms is to document and maintain the integrity of all samples during collection, transportation, analysis, and reporting of analytical results.

Chain of Custody

Waterproof labels are used to identify samples. Each label contains the following information: monitoring location number, monitoring location description, collection date, collection time, and sample collector.

Other information may be entered on the sample label if space permits. However, any other information entered on the label must not interfere with the clarity of the required information. Sample labels will be preprinted and/or filled out in indelible, waterproof ink.

The chain-of-custody contains the same information as the sample label and indicates which analyses to perform on the sample. A sample set is a collection of sample bottles with the same monitoring location number, monitoring location description, collection date, collection time, and sample collector. This form serves as an unbroken link between the sample collectors, sample deliverers/shippers, and the laboratory. See **Appendix E** for example chain-of-custody form.

Transfer of Custody and Shipment

Samples and their containers are kept in a secure storage area until they are delivered to the laboratory or transferred to a commercial courier. Sample containers are sealed prior to delivery to the courier. The shipper will sign a receipt for the transfer of the sample container from their custody and these receipts will be kept in a file located in the field office. Before the shipper is released from custody of the samples, the laboratory will carefully examine the sample container to ensure that it has not been tampered with and that the container was received by the required time.

Laboratory Custody Procedures

All samples received by the laboratories are checked for label identification, chain-of-custody forms, and any discrepancies. Each sample will be assigned a unique laboratory identification number that will be written on the sample bottle and on the Water Quality Laboratory Source Document form. Samples will be stored at the appropriate temperature (4 °C in most instances). Internal chain-of-custody procedures will track the sample from storage through all analytical procedures and its return to storage. Samples will be held in secure storage until disposal or return to sampling organization. The Laboratory Managers at both laboratories are the responsible authorities for the samples once they are received from the shipper. The GAEPD laboratory tracks samples via a Laboratory Information Management System (LIMS). The GAEPD ensures that similar mechanisms are in place for any contract labs it employs.

B4. Analytical Methods

All samples are analyzed using standard protocols and in accordance with USEPA, Standard Methods (latest edition), and 40 CFR Part 136 .

B4.1. Laboratory SOPs

EPD and contract laboratories follow their most current and approved SOPs. See QAPP CD for specific Laboratory SOPs.

B4.2. Analytical Units, Methods, and Holding Times

The methods and associated holding times for common GAEPD parameters are provided in Table 10 and 11 primarily for the GAEPD and UGA laboratories. GAEPD ensures that identical (or similar) established methods are employed by all contract labs to be able to compare data from different labs.

Detection limits using these methods can vary with labs (temporally) and among different labs. For detection limit information, see Table 6 (Element A9 – Quality Objectives).

B4.3. Lab Data Qualifiers

The GAEPD laboratory makes every effort to avoid the use of data qualifiers through sound lab practices such as efficient sample tracking, expedient analysis, and re-testing. In some instances, however, qualification of data is necessary and, in all cases, helpful when needed. The GAEPD LIMs may use the following standard data qualifiers/test results for GAEPD analytes.

GAEPD LIMS Qualifiers:

- “TIE” = Tentatively Identified and Estimated (Mass Spectral Library identification).
- “B” = Analyte detected above RL in the method blank unless “trace” is reported.
- “D” = Analytical results reported are based on a dilution of the sample analyzed on the date indicated in the sample comment.
- “E” = Estimated value due to analysis associated reasons, further explained in the comment along with the associated corrective action.
- “J” = Estimated value due to unacceptable data quality objective or improper laboratory analysis protocol. Reason for usage must be defined in the sample comment.
- “Trace” = Reported value between the method detection limit and the RL.

- "TNTC" = Too many colonies present on the filter membrane to count (microbiological).

For contract labs employed by GAEPD, the use of data qualifiers varies. Whenever possible, GAEPD asks these labs to utilize a set of data qualifiers similar to that used by the GAEPD laboratory.

Table 11. Analytical Reporting Units and Methods

Parameter	Units	Methods(s)
Alkalinity	mg/L	SM 2320B
Ammonia-N	mg/L	SM 4500-NH3-H
Nitrate/Nitrite-N	mg/L	EPA 353.2
Total Kjeldahl-N	mg/L	EPA 351.2
Total Phosphorus	mg/L	EPA 365.1
Ortho Phosphorus	mg/L	EPA 365.1
Chloride	mg/L	EPA 300.0
Chlorophyll *a*	µg/L	EPA 445.0
BOD	mg/L	SM 5210B
COD	mg/L	SM 5220D
TOC	mg/L	SM 5310B/SM 5310C
DOC	mg/L	SM 5310B/SM 5310C
Hardness (Ca & Mg)	mg/L	SM 2340B
Turbidity	NTU	EPA 180.1
Total Suspended Solids	mg/L	SM 2540D
Color	PCU	EPA 110.2
E. coli	MPN/100 mL	SM 9223B
enterococcus	MPN/100ml	SM 9230D
Metals (e.g., Hg, As, CD, Cr, Pb, Se, Zn, Fe, Ni)	µg/L	EPA 200.7, 200.8, 245.1
Volatile Organics	µg/L	EPA 524
Oil and grease, total petroleum hydrocarbons, numerous poly-aromatic hydrocarbons	µg/L	SM 1664 (O&G), EPA 625
PCBs (fish tissue)	µg/L	SM 8082
Organo-Pesticides (fish tissue)	µg/L	SM 8081A

B4.4. Laboratory Turnaround Time Requirements

Generally, chemical (except for metal analyses) and bacteriological analyses results are received from the GAEPD and/or the UGA laboratories within 30–45 days. Metals analyses results are usually received within six weeks. If results are not received in the expected time frame, the Database Officer will contact the Laboratory Section Manager. The Database Officer refers questionable results to the Laboratory Section Manager. If possible, these issues will be resolved within one week. Macroinvertebrate biological analyses turnaround is adjusted according to specific project deadlines. If results are needed sooner than standard turnaround times, the Project Manager is notified, and the suspense date is recorded on the Analysis Form.

B4.5. Laboratory Data Report

Chemical and bacteriological analysis reports and a copy of chain of custody are mailed to the Database Manager in the WPMP for data management.

If biological assessment is performed in-house, all records are available and placed in the project file. If taxonomic identification is contracted to an outside laboratory, the results are mailed to the Project Manager. The biological reporting package will include:

- Macroinvertebrate taxonomic identification report
- List of taxonomic references utilized
- Macroinvertebrate bench sheets
- Chain of custody form

B4.6. Safety and Hazardous Material Disposal Requirements

Macroinvertebrate samples are maintained at least five years after the sample is processed and identified. Since macroinvertebrate samples are preserved in 95% ethanol, they are considered hazardous waste and are disposed in accordance with MSDS. The Laboratory QA Plan describes handling and disposal protocols for chemicals used in sample analyses.

B4.7. Method Validation

Chemical analyses results are validated by periodically comparing data systems results with manually calculated results and reviewing all data. No non-standard or unpublished analyses methods are approved for 106 monitoring.

Biological data is validated by comparing single habitat samples to multi-habitat samples in 25 sub-ecoregions with no significant difference in index results.

B4.8. Corrective Action Process for Analytical System Failure

Any instrument failing QC standard is removed from service until the problem is corrected. Corrective action procedures for Laboratory analyses are described in the Laboratory QA Plan

B5. Quality Control

B5.1. Modeling Quality Control

All modeling and monitoring staff follow the policies and procedures detailed in the GAEPD Standard Operating Procedures (SOPs), Quality Management Plan (QMP), and this Quality Assurance Project Plan (QAPP). In general, training programs, materials, manuals, and reports prepared by GAEPD will be subjected to internal or external technical and editorial reviews before the final versions are submitted.

The data quality of model input and output is addressed, in part, by the training and experience of project staff (Section A9) and documentation of project activities (Section A10). This QAPP and other supporting materials will be distributed to all personnel involved in model development. The Project Managers will ensure that all surface water quality modeling tasks are carried out in accordance with the QAPP. Staff performance will be reviewed to ensure adherence to project protocols.

QC is defined as the process by which QA is implemented. All project modelers will conform to the following guidelines:

- All modeling activities including data interpretation, load calculations, or other related computational activities are subject to audit or peer review. Thus, the modelers are instructed to maintain careful written and electronic records for all aspects of model development.

- A record of where the data used in the analysis was obtained will be kept, and any information on data quality will be documented in the final report.

Surveillance of each modeler’s work will be conducted periodically by the GAEPD Unit QA/QC Officer or the QA/QC Officer’s designee. Modelers will be asked to provide verbal status reports of their work at periodic modeling workgroup meetings. Detailed modeling documentation will be made available to members of the modeling workgroup as necessary.

The ability of computer code to represent model theory accurately will be ensured by following rigorous programming protocols, including documentation within the source code. Specific tests will be required of all model revisions to ensure that fundamental operations are verified to the extent possible. These tests include testing of numerical stability and convergence properties of the model code algorithms, if appropriate. Model results will be generally checked by comparing results to those obtained by other models or by comparison to hand calculations. Visualization of model results will assist in determining whether model simulations are realistic. Model calculations will be compared to field data. If adjustments to model parameters are made to obtain a “fit” to the data, the modelers will provide an explanation and justification that must agree with scientific knowledge and with process rates within reasonable ranges as found in the literature.

Both project-generated and non-project-generated data will be used for model development and calibration. The QA procedures for project-generated data and database development have been discussed elsewhere in this document. All analytical data for the model’s target parameters and most supporting data will have been verified through field QAPP processes before release to the modelers.

The DQOs were discussed in Sections A.7 and A.8 of this document. Rigorous examination of precision, accuracy, completeness, representativeness, detectability, and comparability will be conducted on project-generated data under the direction of the project managers. Project-generated data will be verified and validated using a process that controls measurement uncertainty, evaluates data, and flags or codes data against various criteria. This portion of the QA process is also associated with the final database construction. Modelers will cross-check data for bias, outliers, normality, completeness, precision, accuracy, and other potential problems.

Non-project-generated data may be obtained from either published or unpublished sources and the modelers will examine these data as part of a data quality assessment. Databases that have not been published are also examined considering a data quality assessment. Data provided by other sources will be assumed to meet precision objectives established by those entities. The acceptance criteria for individual data values generally address the issues described in the Appendix C.

B5.2. Field Quality Control

Duplicate field samples for estimating overall precision taken at approximately 10% of the total number of samples. In addition, ambient field blanks are taken at 5% of the total samples to evaluate blank contamination from field activities.

Analytical data from equipment blanks is used to determine the potential for cross contamination between field sampling locations. The water for the equipment blank will be certified inorganic blank water (IBW). Bacteria and BOD field blanks will use sterile buffer water poured into the sample bottles and sent to the laboratory for analysis. See Table 12 for field sampling quality control requirements for water quality analytes and Table 13 for quality control requirements for multiprobe instruments (including continuous deployment).

Training sessions are held in the fall prior to the start of the new sampling year to ensure that field measurements and samples will be taken consistent with accepted and approved SOPs. In addition, field checks or audits are performed by GAEPD's QC Officer to ensure consistent application of field protocols among different field crews.

B5.3. Lab Quality Control

Required lab quality control procedures include detailed recordkeeping, current SOPs, performance evaluations, lab blank, duplicate and matrix spike analyses, and control and calibration charts. For detailed descriptions of calibration and maintenance procedures for GAEPD and the UGA Laboratories, see the applicable Laboratory QAPs and SOPs, adopted herein by reference.

GAEPD requests quality control data from all labs with submitted data packages. These data are used in data validation.

B6. Instrument/ Equipment Testing, Inspection and Maintenance

B6.1. Computer Maintenance

Water quality modeling will involve the acquisition or processing of data and the generation of reports and documents, both of which require the maintenance of computer resources. GAEPD computers are covered by on-site service agreements. When a problem with a microcomputer occurs, state-contracted computer specialists diagnose the trouble and correct it if possible. When outside assistance is necessary, the computer specialists call the appropriate vendor. For other computer equipment requiring outside repair services and not currently covered by a service contract, local computer service companies are used on a time-and-materials basis. Routine maintenance on microcomputers is performed by state contractors. Electric power to each microcomputer flows through a surge suppressor to protect electronic components from potentially damaging voltage spikes. All computer users have been instructed on the importance of routinely archiving project data files from hard drive to external disk storage. The GAEPD office network server is backed up on tape nightly during the week. Screening for viruses on electronic files loaded on microcomputers or the network is standard GAEPD policy. Automated screening systems have been placed on GAEPD's computer systems and are updated regularly to ensure that viruses are identified and destroyed promptly.

Table 12. Field Sampling Quality Control Requirements for Water Quality Analytes (Nutrients, Bacteria, Chlorophyll *a*, etc.)

	Frequency	Corrective Action	Persons Responsible for Corrective Action	Data Quality Indicator
Ambient Field Blanks	Minimum 5% of samples collected	Qualify or censor data as necessary	Survey Coordinator and QA/QC Officer	Accuracy (contamination)
Field Duplicates	Minimum 10% of samples collected	Evaluate and compare lab duplicates and field duplicates (overall precision) Censor or qualify data as necessary	Survey Coordinator and QA/QC Officer	Overall Precision
Performance Evaluation Samples	One time delivery to GAEPD and contract labs for nutrient/metals	Discuss with lab; rerun test samples Censor or qualify data as necessary	Unit QA/QC Officer and lab QC Manager, as appropriate	Accuracy

Table 13. Quality Control Requirements for Multi-Probe Instruments (D.O., pH, Conductivity, Water Temperature, depth)

	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Persons Responsible for Corrective Action	Data Quality Indicator
Pre-Calibration (or pre-deployment)	Each day used	Multi-probe manual(s)	Re-calibrate to within allowable specification	Field survey crew leader	Accuracy/bias Contamination
Field Duplicate reading	10% of sites	RPD < 10%	Re-deploy and start reading sequence again	Field survey crew leader	General precision
Instrument Blank (Turbidimeter)	After Pre & Post Daily Calibration	No target compounds > lowest calibration standard	Retest and/or qualify data	Field survey crew leader	Accuracy/bias Contamination
Post-Survey (or post-deployment) Check and User Report	End of each day or after deployment	Multi-probe manuals	If outside acceptance limits, discard or qualify data	Field survey crew leader	Accuracy/bias Contamination

B6.2. Purpose/ Background/Measurement Traceability

Field staff is responsible for regular cleaning, inspection, and maintenance of their assigned equipment. All equipment should be visually inspected daily for damage or dirt, and repaired or cleaned if needed before use. If meters are stored for long periods (greater than 1 week) without being used, it is recommended that they be calibrated and inspected at least weekly to keep them in good working order. Measurement systems and equipment calibrations are verified accurate to established criteria and are traceable to national standards of measurement or reference materials. All verifications are ensured before a measurement system or support equipment is utilized in the generation of analytical data.

All recordings for instrument calibration are kept in bound calibration logbooks in the calibration laboratory located at the WPB's 7 MLK office in Atlanta, GA, or the associated regional office. Instrumentation calibrated and maintained by field staff are kept in separate calibration logbooks located in their offices. Instruments are identified by model and serial number. Field recordings are maintained for each of the parameters obtained from the Hydrolab Multi-probe DataSonde (water temperature, specific conductance, pH, and dissolved oxygen) in field books with the model and serial number of the instrument used. All spare parts for field meters are kept in a room dedicated for the use at the WPB's 7 MLK office in Atlanta, and at Cartersville, Tifton, and Brunswick District offices, and at the Augusta office at the Phinizy Center for Water Sciences . Analytical data provided by the laboratories are cross-referenced against the field notebooks maintained for the project for each sampling date.

Stock solutions or standard grade chemicals for calibration of measurement systems are obtained from commercial vendors under contract with the GAEPD or directly with the laboratories. All stock solutions are certified traceable to national standards. Standard reference numbers are recorded with the instrument calibration records.

For detailed descriptions of inspection, testing, and maintenance procedures for GAEPD and other contract laboratories, see the applicable Lab QAPs and SOPs, adopted herein by reference.

B6.3. Testing, Inspection, and Maintenance

The thermometer is the only field instrument used to collect a field parameter that is not an aquatic parameter and therefore is not obtained from multi-probe DataSonde. The thermometer measures air temperature at the time of collection. Values will be recorded to the nearest 0.5° C. Each new thermometer will be standardized once. Before each measurement, the thermometer will be checked for liquid separation. After use, the thermometer will be stored in a protective case.

B7. Instrument/ Equipment Calibration

B7.1. Model Calibration

A model calibration is a measure of how well the model results represent field data. Because surface water quality modeling looks at a variety of scenarios that may, in many cases, require enormous capital expenditures, the use of a calibrated model, the scientific veracity of which is well defined, is of paramount importance.

The Project Managers will direct the model calibration efforts. Some model parameters will need to be estimated using site-specific field data for the application of the model. Some example parameters follow:

- Kinetic coefficients and parameters (e.g., partition coefficients, decay coefficients)
- Forcing terms (e.g., sources and sinks for state variables)
- Boundary conditions (specified concentrations, flows)

Models are often calibrated through a subjective trial-and-error adjustment of model input data because many interrelated factors influence model output. However, the experience and judgment of the modeler are a major factor in calibrating a model both accurately and efficiently. The model calibration "goodness of fit" measure may be either qualitative or quantitative. Qualitative measures of calibration progress are commonly based on the following:

- Graphical time-series plots of observed and predicted data.
- Graphical transect plots of observed and predicted data at a given time interval.
- Comparison between contour maps of observed and predicted data, providing information on the spatial distribution of the error.
- Scatter plots of observed versus predicted values in which the deviation of points from a 45-degree straight line gives a sense of fit.
- Tabulation of measured and predicted values and their deviations.

The surface water quality models will be calibrated to the best available data, including literature values, and interpolated or extrapolated existing field data. If multiple data sets are available, an appropriate time period and corresponding data set will be chosen based on factors characterizing the data set, such as corresponding weather conditions, amount of data, and temporal and spatial variability of data. The model will be considered calibrated when it reproduces data within an acceptable level of accuracy. During the initial application of the model, it might be determined that primary data should be collected to better characterize the model inputs; in most cases, however, it is not feasible to collect additional data for use in model setup, calibration, or validation, and the modeling effort depends on the best available data. If primary data must be collected to better characterize the model inputs, a field operations will be performed under the GAEPD Groundwater and Surface Water Monitoring QAPP.

B7.2. Field Instrument Calibration

The field instruments requiring calibration are the specific conductance meter, the pH meter, and the dissolved oxygen meter. The thermometer used in the field sampling is standardized prior to issue and this standardization is checked periodically to ensure the reliability of the measurements. Instrument calibrations are recorded in a bound calibration logbook with entries recorded with identifying instrument model and serial number. Table 14 provides the calibration and maintenance activities for field equipment and instrumentation.

For detailed descriptions of calibration procedures for GAEPD and other contract laboratories, see the applicable Laboratory QA Plan and SOPs, adopted herein by reference.

B8. Inspection of Supplies

The GAEPD Laboratory performs quality assurance of sample bottles, reagents, and chemical preservatives that are provided to field staff. Containers that are purchased as pre-cleaned should be certified by the manufacturer or checked to ensure that the parameters tested are below the published reporting limits. Containers should be stored in a manner that does not leave them susceptible to contamination by dust or other particulates and should remain capped until use. Any containers that show evidence of contamination should be discarded. The Laboratory QC Manager should keep certificates for glass containers certified by the manufacturer on file.

Table 14. GAEPD Field Instrument Calibration and Maintenance

Instrument	Persons(s) Responsible	Frequency of Calibration	Inspection Activity and Frequency	Maintenance Activity and Frequency	Testing Activity and Frequency	Corrective Action (CA)
OTT & YSI Multi-probe	AMU Environmental Specialists	Pre-cal each day of use, and post-use QC checks	Visual and electronic; monthly and/or before each use	Hardware & software repair and maintenance as needed	Pre-survey calibration & post-survey QC checks	Re-calibrate as necessary during pre-calibration; qualifying data if post-survey check indicates excessive drift or inaccuracies (beyond Table 3 criteria) in comparison to pre-calibrated readings and standard solutions
Velocity Meters 1)Price AA 2) Sontek ADV FlowTracker	AMU Environmental Specialists	Before each use	Visual and electronic; before and after each use	Inspect post-use for damage; lubricate parts as needed per SOP. Also, repair and maintenance as needed.	Prior to each use in the lab; field testing in Fall prior to beginning of next year's field season.	Re-calibrate as necessary. If repair and/or re-calibrations ineffective, replace with alternate device.
Lowrance depth finders	AMU Environmental Specialists	Per equipment manual	Per equipment manual	Per equipment manual	Per equipment manual	Per equipment manual
Facility Samplers (ISCO)	FMU Environmental Specialists	NA	Before each use and during site visits	Cleaning as needed; re-deploying with new tubes and bottles, etc.	Before each use	TDB (case-by-case)
Digi-Sense thermometer (NIST-certified)	Cody Jones	Annually, and as needed based on QC checks	Visual & Electronic; before and after each use	As needed	Annual (Fall) QC check and calibration against GAEPD lab NIST-certified thermometer.	Send to manufacturer for re-calibration
Li-Cor	AMU Environmental Specialists	Per equipment manual	Per equipment manual	Per equipment manual	Per equipment manual	Per equipment manual
Turbidity meter	AMU Environmental Specialists	Pre-cal each day of use, and post-use QC checks	Per equipment manual	Per equipment manual	Per equipment manual	Per equipment manual
pH meter	FMU Environmental Specialists	Pre-cal each day of use, and post-use QC checks	Per equipment manual	Per equipment manual	Per equipment manual	Per equipment manual
DO meter	FMU Environmental Specialists	Pre-cal each day of use, and post-use QC checks	Per equipment manual	Per equipment manual	Per equipment manual	Per equipment manual

Additionally, field staff should inspect all bottles before use. Any bottles that are visibly dirty or whose lids have come off during storage should be discarded. It is recommended that field staff periodically check bottles for contamination attributed to storage conditions by filling representative containers with analyte-free water, adding the appropriate preservative(s), and submitting them to the laboratory for metals and wet chemistry analyses. Any container lots showing analyte levels at or above the reporting limits should be discarded.

The majority of chemical preservatives used by the GAEPD are either provided by the GAEPD Laboratory as pre-measured, sealed glass ampules or from a manufacturer with certificates of purity. The certificates are kept on file in the GAEPD 7 MLK office. Any preservatives that show signs of contamination, such as discoloration or the presence of debris or other solids, should not be used and should be discarded.

A summary of inspections to be performed by field staff is presented in Table 15.

Table 15. Consumable Inspections and Acceptance Criteria

Item	Acceptance Criteria
Sample bottles	✓ Bottle blanks less than laboratory reporting limits ✓ No visible dirt, debris, or other contaminants
pH standards (4.0, 7.0, 10.0 SU)	✓ Within ± 0.4 SU of accepted value ✓ No visible discoloration, debris, or other contaminants
Conductivity standards (500, 50,000 µmhos/cm)	✓ Within ± 10% of accepted value ✓ No visible discoloration, debris, or other contaminants
Acid ampules (sulfuric, nitric)	✓ Ampules intact ✓ No visible discoloration, debris, or other contaminants
Distilled or deionized water	✓ No visible discoloration, debris, or other contaminants

B9. Non-Direct Measurements

GAEPD assembles data and information from a wide variety of sources. Reliable scientific data and technical information are essential for making appropriate water use assessments and other decisions affecting waterbody health.

For external or non-direct data sources, GAEPD solicits, accepts, and reviews water quality (and other) data and information from all available sources. Preliminary review of these data involves an evaluation based on three main criteria:

- Monitoring is conducted under an approved Sampling Quality Assurance Plan including acceptable standard operating procedures;
- Use of an acceptable, preferably state certified lab (certified for the applicable analyses) that has a documented, acceptable laboratory QAP; and
- Results are documented in a citable report that includes QA/QC analyses and data management.

These data sources include monitoring data reports from state and federal agencies and nongovernmental organizations, as well as reports on projects resulting from state or local grants or Federally funded through Sections 314, 319, 104, or 604(b) of the CWA. Data collected by volunteer groups (Adopt-A-Stream), or municipalities (watershed assessments) are not used for decision making for water use assessments. These data are used for screening purposes and/or identifying potential problem areas, and are used in the development of annual monitoring plans.

The following generic list provides some of the possible sources of information for GAEPD's watershed/river basin assessment, TMDL and other work.

- State Agencies
- Federal Agencies
- U.S. Geological Survey
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- National Oceanic and Atmospheric Administration National Climatic Data Center
- Municipal Facilities Plans
- Private Consulting Firms
- Colleges, Universities and associated academic institutions
- Watershed and lake associations (citizen monitoring programs)
- Municipal and Industrial NPDES Permit Monitoring Requirements
- Public drinking water systems
- Other Sources

Non-project-generated data may be obtained from published or unpublished sources. The published data will have some form of peer review. These data are generally examined by modelers as part of a data quality assessment. Databases that have not been published are also examined in light of a data quality assessment. Data provided by other sources are assumed to meet precision objectives established by those entities. If historical data are used, a written record of where the data were obtained and any information on their quality will be documented in the final report.

B10. Data Management

Some data are reported electronically and some only as hard copies. Due to the quantity and complexity of information being produced, organized data management is critical to this program.

B10.1. GAEPD Databases

The GAEPD database system (as of 2018) is composed of the following primary databases:

- GOMAS – Georgia envirOnmental Monitoring and Assessment System
    - Water Quality Data
    - Zooplankton Data
    - Diatom Data
    - Benthic Macroinvertebrate Data
    - Fish Contaminant Data
    - 303(d) list/TMDLs
    - 305(b) Water Bodies

- GAPDES - wastewater, stormwater, 401, and safe dams permitting database

The GOMAS database is formatted via MySQL, is dynamically linked to GIS. It is equipped to upload to external databases, such as EPA's WQX/STORET and ATTAINS. Each database has specific uses, and the system is intended to allow fast easy and standardized access to final data for various purposes. STORET will be decommissioned in June 2018. STORET currently has minimal functionality, and most data has already been transferred to EPA's new water quality database (Water Quality Portal).

B10.2. Field and Lab Data Entry

Each survey crew leader has primary responsibility for field-sheet data entry. They are additionally responsible for ensuring the completeness and quality of field data prior to data entry. Internal GAEPD lab managers are also responsible for lab data. A database entry module is provided by GAEPD's Database Manager to facilitate this transfer of information.

All completed GAEPD field sheets, notebook pages, and Chain-of Custody forms are filed with the QA/QC Officer for preliminary review and hard copy filing. A significant amount of the data contained on these forms will be entered into the GAEPD's database. The files are stored at the Sloppy Floyd office and managed by GAEPD's Database Manager. Incomplete and/or erroneous field-recorded data and information will be brought to the attention of the appropriate field crew, coordinator and/or person(s). Field notebook page(s) will be photocopied and added to the final hard copy file.

Laboratory quality-controlled data from GAEPD's Laboratory are sent via the LIMS to the WPB electronically on an approximate monthly basis. These submittals are sent to the Database Manager for preliminary QC checks relating to holding times and blank/duplicate frequencies. In addition, laboratory data are also provided to the Database Manager on standard data forms sent via interoffice or via email for each lab report for the hard copy file folders.

B10.3. Data Availability

After preliminary QC checks, data are available to users as draft data, subject to additional quality control checks and evaluation. Draft data are for internal, departmental use only, and their use is subject to management approval. After data validation has been completed, typically within 3-6 months of receipt of lab data reports, the final data are available in the database and in hard copy files for internal/external use. It may also be available in published reports.

Chemical and biological data will be sent to EPA's Water Quality Portal database via WQX/STORET. WQX/STORET is a repository for water quality, biological, and physical data and is used by state environmental agencies, the USEPA and other federal agencies, universities, private citizens, and many others. The Water Quality Portal acts as the access point for all water quality data that flows through WQX/STORET. The WQX website https://www.epa.gov/waterdata/water-quality-data-wqx includes data retrieval instructions.

C. ASSESSMENT AND OVERSIGHT

C1. Assessments and Response Actions

The QA program under which the water quality modeling and monitoring project will operate includes surveillance, with independent checks of the data obtained from sampling, analysis, and data-gathering activities. This process is illustrated in Figure 2. The essential steps in the QA program are as follows:

- Identify and define the problem
- Assign responsibility for investigating the problem
- Investigate and determine the cause of the problem
- Assign and accept responsibility for implementing appropriate corrective action
- Establish the effectiveness of and implement the corrective action
- Verify that the corrective action has eliminated the problem

Many of the technical problems that might occur can be solved on the spot by the staff members involved, for example, by modifying the Initial Technical Approach or correcting errors or deficiencies in documentation. Immediate corrective actions form part of normal operating procedures and are noted in records for the project. Problems that cannot be solved in this way require more formalized, long-term corrective action.

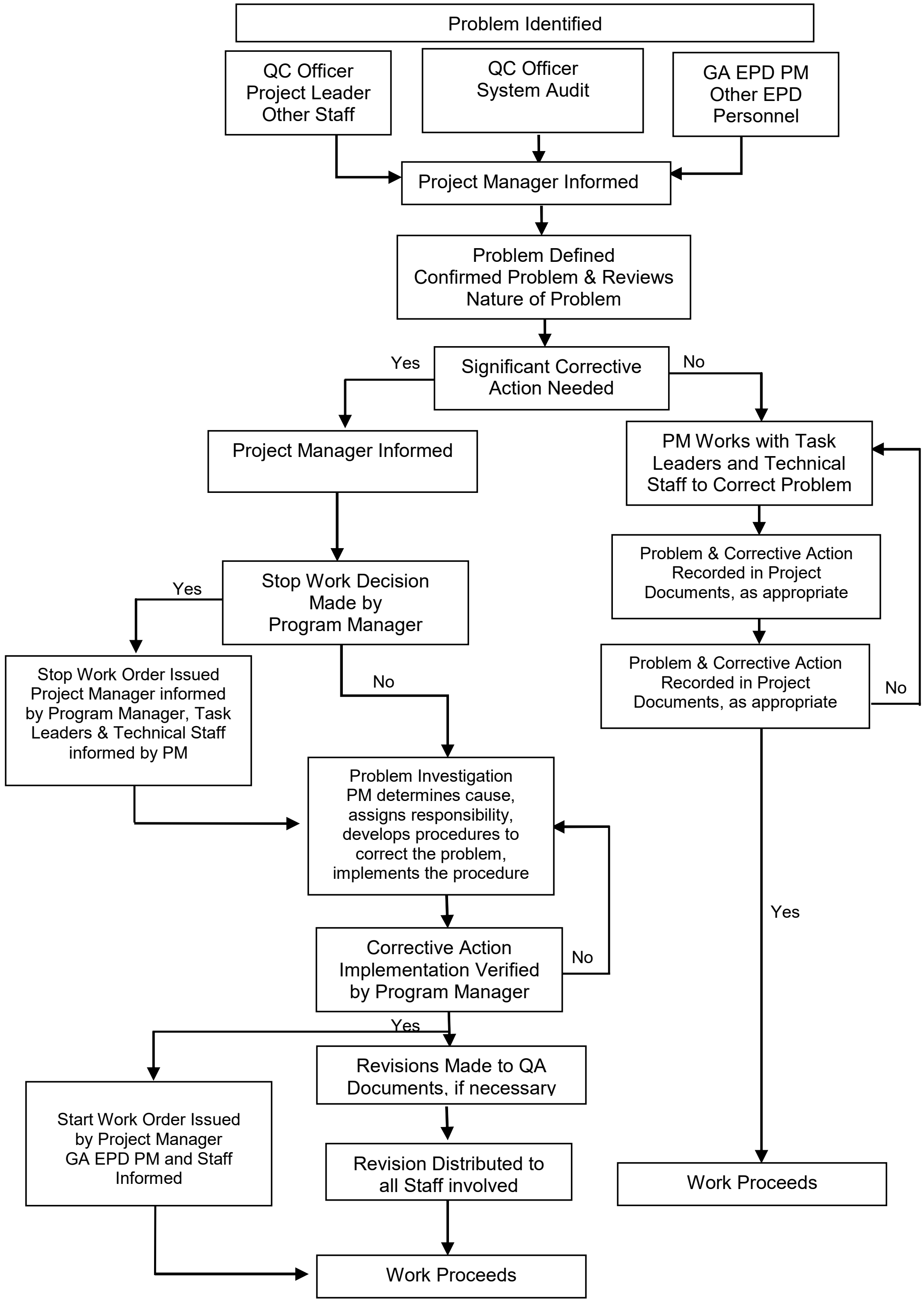
If quality problems that require attention are identified, GAEPD will determine whether attaining acceptable quality requires either short- or long-term actions. If a failure in an analytical system occurs (e.g., performance requirements are not met), the Project Manager will be responsible for corrective action and will immediately inform the Program Manager or the QA/QC Officer, as appropriate. Subsequent steps taken will depend on the nature and significance of the problem, as illustrated in Figure 2. The Project Manager has primary responsibility for monitoring the activities and identifying or confirming any quality problems.

The Program Manager and Project Manager will be notified of major corrective actions and stop work orders. Corrective actions may include the following:

- Reemphasizing to staff the project objectives, the limitations in scope, the need to adhere to the agreed-upon schedule and procedures, and the need to document QC and QA activities.
- Securing additional commitment of staff time to devote to the project.
- Retaining outside consultants to review problems in specialized technical areas.
- Changing procedures. The Project Manager may replace a staff member, if appropriate, if it is in the best interest of the project to do so.

Performance audits are quantitative checks on different segments of project activities; they are most appropriate for sampling, analysis, and data-processing activities. The Project Manager and/or QC Officer is responsible for overseeing work as it is performed and periodically conducting internal assessments during the data entry and analysis phases of the project.

Figure 2. Quality Assurance Process



C1.1 Modeling Response Actions

The Project Manager may perform or oversee the following qualitative and quantitative assessments of model performance periodically to ensure that the model is performing the required task while meeting the quality objectives:

- Data acquisition assessments
- Model calibration studies
- Sensitivity analyses
- Uncertainty analyses
- Data quality assessments
- Model evaluations
- Internal peer reviews

Sensitivity to variations, or uncertainty in input parameters, is an important characteristic of a model. Sensitivity analysis is used to identify the most influential parameters in determining the accuracy and precision of model predictions. This information is important to the user who must establish the required accuracy and precision in model application as a function of data quantity and quality. Sensitivity analysis quantitatively or semi-quantitatively defines the dependence of the model's performance assessment measure on a specific parameter or set of parameters. Sensitivity analysis can also be used to decide how to simplify the model simulation and to improve the efficiency of the calibration process. Model sensitivity can be expressed as the relative rate of change of selected output caused by a unit change in the input. If the change in the input causes a large change in the output, the model is considered to be sensitive to that input parameter. Sensitivity analysis methods are mostly non-statistical or even intuitive by nature. Sensitivity analysis is typically performed by changing one input parameter at a time and evaluating the effects on the distribution of the dependent variable. Nominal, minimum, and maximum values are specified for the selected input parameter.

Initially, sensitivity analysis is performed at the beginning of the calibration process to design a calibration strategy. After the calibration is completed, a more elaborate sensitivity analysis may be performed to quantify the uncertainty in the calibrated model caused by uncertainty in the estimates of the model input parameters.

Informal sensitivity analyses (iterative parameter adjustments) are generally performed during model calibrations to ensure that reasonable values for model parameters will be obtained, resulting in acceptable model results. The degree of allowable adjustment of any parameter is usually directly proportional to the uncertainty of its value and is limited to its expected range of values. Formal sensitivity analyses will be performed based on technical direction from the Program Manager when a certain aspect of the system requires further investigation. For example, formal sensitivity analyses are often performed on the effects of loadings from different sources on instream water quality to allow the development of more feasible and reasonable allocations and load reductions based on the dominant sources.

The Project Manager will perform surveillance activities throughout the duration of the project to ensure that management and technical aspects are being properly implemented according to the schedule and quality requirements specified in this QAPP. These surveillance activities may include assessing how project milestones are achieved and documented, corrective actions are implemented, peer reviews are performed, and data are managed.

System audits are qualitative reviews of project activity to check that the overall quality program is functioning, and that the appropriate QC measures identified in the QAPP are being implemented. If requested by US EPA, GAEPD will conduct an internal system audit and report results to US EPA.

C1.2. Organizational Assessments

Readiness reviews. A readiness review is a technical check to determine if all components of the monitoring project are in place so work can commence at a specific phase. A readiness review will be conducted in conjunction with the annual 106 work plan development to ensure sufficient equipment, staffing and funding are available. At a minimum, the following issues will be addressed:

1. Development of project specific Sampling Work Plans and availability and accessibility of an up-to-date copy of the QAPP and all associated quality system SOPs to the project.

2. Availability of current reference documents including the following:
    a. Most recent Monitoring and Assessment Program Plan.
    b. Most recent SOPs for Macroinvertebrate Stream Surveys.
    c. Most recent SOPs for Chemical and Bacteriological Sampling of Groundwater and Surface Waters.
    d. Most recent version of the 303(d) List.
    e. Rules & Regulations for Water Quality Control, Chapter 391-3-6-.03 General Water Quality Criteria.

3. Availability of electronic data sources including:
    a. WQX/STORET – Water Quality Portal
    b. ATTAINS
    c. GOMAS
    d. GAPDES

4. Availability of equipment, operating, and calibration instructions for the equipment, record sheets and other necessary supplies.

5. Availability of appropriate sampling supplies and equipment.

6. Proper alignment of appropriate laboratory to receive the samples and accessibility of lab sheets, tags, and other necessary supplies.

7. Availability of staff.

8. Appropriate training of staff and opportunity for staff to resolve questions, concerns, and issues prior to the onset of the monitoring project.

C1.3. Assessment of Project Activities

1. Readiness Review. Monitoring, analyses, and assessment staff is contacted to ensure appropriate equipment, staffing, and funding are available.

2. Surveillance. Surveillance is the continual or frequent monitoring of the status of the project and the analyses of records to ensure specified requirements are being fulfilled.

3. Performance Evaluation (PE). A PE is an audit in which the quantitative data generated by the measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory. "Blind" PE samples are those whose identity is unknown to those operating the measurement system. The GAEPD performs blind PE studies each year on specific parameters according to protocols described in the Laboratory QAP.

4. Audit of Data Quality. An audit of data quality reveals how the data were handled, what judgments were made, and whether uncorrected mistakes were made. The Survey Team Leader and the Database Officer review data prior to use and production of a project's final report review data. Audits of data quality identify the means to correct systematic data reduction errors.

5. Data Quality Assessment (DQA). DQA involves the application of statistical tools to determine whether the data meet the assumptions that the DQO's and data collection design were developed under and whether the total errors in the data are tolerable. Guidance for Data Quality Assessment (USEPA QA/G-9, 2000) provides non-mandatory guidance for planning, implementing, and evaluating retrospective assessments of the quality of the results from environmental data operations. This document is used as guidance by the GAEPD when reviewing data for projects.

C1.4. Assessment Personnel

The QAPP Project Manager will perform internal audits. Key assessment personnel are identified in Table 16 below. In the event deviations from the QAPP are needed to efficiently conduct this program component, the issue will be discussed with the QAPP Manager and documented in the assessment report provided as part of the project plan.

Table 16. Assessment Activities Personnel

Assessment Activities	Responsible Personnel
Readiness Review	Unit Coordinators and Program Manager II
Surveillance	Unit Coordinators
Performance Evaluation	Individual Laboratory QA/QC Officers
Audits of Data Quality	Survey Team Leader and Database Officer
Data Quality Assessment	QA/QC Officer, QAPP Manager and Data Assessment Specialist

C2. Reports to Management

Effective communication between all personnel is an integral part of a quality system. Planned reports provide a structure for apprising management of the project schedule. Deviations from approved QA and work plans, impact of these deviations on data quality, and potential uncertainties in decisions based on the data shall be included in reports to management.

C2.1. Frequency, Content and Distribution of Reports

This QAPP indicates frequency, content, and distribution of reports so management may anticipate events and move to improve potentially adverse results. An important benefit of the status reports is the opportunity to alert management of data quality problems, propose viable solutions, and procure additional resources (Table 17).

Table 17. Project Status Reports

Project Status Reports	Frequency	Distribution
Quarterly Activity Reports	Quarterly	Unit Coordinators Program Manager
Final GAEPD Monitoring and Assessment Program Plan	Annually	USEPA
Annual Performance Report	Annually	USEPA
106 Electronic Workplan	Annually	USEPA
Data Audits	Continuously	GAEPD Laboratory QAPP Manager
Data Quality	Continuously	QAPP Manager

If program assessment is not conducted on a continual basis, data integrity generated in the program may not meet quality requirements. It is recognized that changes made in one area or procedure may affect another part of the project. Documentation of all changes shall be maintained and included in the reports to management. QAPP reports will be stored in the central office at the Sloppy Floyd office for at least 10 years.

D. DATA VALIDATION AND USABILITY

D1. Data Review, Verification, and Validation

Data review and validation services provide a method for determining the usability and limitations of data and provide a standardized data quality assessment. Verification of new model components or parameters (when applicable) improves the predictive capabilities of new models or modified existing models. Experienced professionals will be used in the data review, compilation, and evaluation phases of the study. GAEPD will be responsible for reviewing data entries, transmittals, and analyses for completeness and adherence to QA requirements. The data will be organized in a standard database on a computer. A screening process that scans through the database and flags data outside typical ranges for a given parameter will be used. Typical ranges are generally determined by reviewing a minimum of one year of historical data for a particular system. These ranges can vary greatly due to season and location. Values outside typical ranges will not be used to develop model calibration data sets or model kinetic parameters.

Field staff, laboratory bench chemists, and data entry staff are each responsible for verifying that all records and results they produce, or handle are completely and correctly recorded, transcribed, and transmitted. Each staff member and analytical Unit Supervisor is also responsible for ensuring that all activities performed (sampling, measurements, and analyses) comply with all requirements outlined in the QAPP, Laboratory QAP, and individual sampling SOPs.

The Unit Coordinators are responsible for final verification and validation of all results.

D1.1. Guidance Documents

Documents used to review, verify, and validate data are as follows:

- Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03 Water Use Classifications and Water Quality Standards
- Most current version of Georgia's 305(b)/303(d) List of Waters
- SOP for Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia (May 2007)
- SOP for Periphyton
- Program SOP#EPD-WPMP-1 Planning & Document Protocols for Water Quality Assessments (April 2020)
- Program SOP#EPD-WPMP-2 Surface Water Sampling (Rivers and Streams) (May 2020)
- Program SOP#EPD-WPMP-3 Chlorophyll-*a* Sample Collection and Processing (May 2020)
- Program SOP#EPD-WPMP-4 Lake Profiling and Composite Sample Collection (September 2020)
- Program SOP#EPD-WPMP-5 Wastewater Sampling (August 2020)
- Program SOP#EPD-WPMP-6 Streamflow Measurements (May 2020)
- SOP# EPD-WQMP-7: Data Sonde Calibration and Maintenance (April 2011)
- EPD-Fish Tissue Projects SOP: Processing and Handling of Tissue Samples for Fish Consumption Guidelines

These documents can also be found at https://epd.georgia.gov/watershed-protection-branch/monitoring#toc-sops-and-qapp- .

https://epd.georgia.gov/watershed-protection-branch/monitoring#toc-sops-and-qapp-

D1.2. Sample Collection Procedures

For acceptable biological data, samples are collected according to protocols described in the SOP for *Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia* (March 2007). Chemical and bacteriological samples are collected according to protocols for specific water types as described in the Program SOPs referenced above.

D1.3. Sample Handling

For acceptable biological data, samples are handled and processed according to protocols described in the SOP for *Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia* (March 2007). Chemical and bacteriological samples are handled according to protocols for specific water types as described in the Program SOPs referenced above.

D1.4. Analytical Procedures

For acceptable biological data, samples are analyzed according to protocols described in the SOP for *Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia* (March 2007). All bacteriological and chemical samples are analyzed according to methods described in the GAEPD's Laboratory QA Plan (GAEPD, 2007) and in accordance with Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA, 1998).

D1.5. Quality Control

Quality control procedures described in the SOP for *Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia* (March 2007), Program SOPs listed above, Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA 1998), and GAEPD Laboratory QA Plan (GAEPD 2007) shall be followed for resulting data to be acceptable for use in water quality assessments and TMDL development.

D2. Validation and Verification Methods

The Project Manager will review or oversee review of all data related to the project for completeness and correctness. The Project Manager will resolve these issues with the modeling and monitoring team.

D2.1. Model Data Verification

Raw data received in hard copy format will be entered into a standard database. All entries will be compared to the original hard copy data sheets by the team personnel. Screening methods will be used to scan through the database and flag data that are outside typical ranges for a given parameter. Data will also be manipulated using specialized programs and Microsoft Excel. A percentage of the calculations will be recalculated by hand to ensure that correct formula commands were entered into the program. If 5 percent of the data calculations checked are incorrect, all calculations will be rechecked after the correction is made to the database. Data quality will be assessed by comparing entered data to original data; performing the data and model evaluations described in Sections A.7, B.5, and C.1; and comparing results with the measurement performance or acceptance criteria summarized in the data review and technical approach documentation to determine whether to accept, reject, or qualify the data. Results of the review and validation processes will be reported to the Project Manager.

General guidelines and procedures for model data validation and calibration are listed in Section B7.1. Verification will be performed by comparing new model parameters or components to theory. Model validation evaluates the model's ability to appropriately simulate conditions under a data set or time period that is independent from those used in the calibration. The calibration and validation process will be documented, as necessary, in the surface water modeling report.

Because the goal is to be able to assess water body conditions and predict when point and nonpoint source loads produce water or sediment-quality impairment based on the ambient water and sediment-quality criteria, model calibration and validation should strive to reduce errors (deviations between model predictions and observed measurement data) to zero.

A set of parameters used in the calibrated model might not accurately represent field values, and the calibrated parameters might not represent the system under a different set of boundary conditions or hydrologic stresses. Therefore, a second model validation period helps establish greater confidence in the calibration and the predictive capabilities of the model. A site-specific model is considered "validated" if its accuracy and predictive capability have been proven to be within acceptable limits of error independently of the calibration data. In general, model validation is performed using a data set that differs from the calibration data set (i.e., low-flow data set for calibration versus higher-flow data set for verification). If only a single time series is available, the series may be split into two sub-series, one for calibration and another for validation. If the model parameters are changed during the validation, this exercise becomes a second calibration, and the first calibration needs to be repeated to account for any changes.

Model validation will be accomplished by calibration. A model calibration is the process of adjusting model inputs within acceptable limits until the resulting predictions give good correlation with observed data. Commonly, the calibration begins with the best estimates for model input based on measurements and subsequent data analyses. Results from initial simulations are then used to improve the concepts of the system or to modify the values of the model input parameters. The success of a model calibration is largely dependent on the validity of the underlying model formulation.

D2.2. Chemical Data Verification

Chemical data are verified according to the GAEPD Laboratory QA Plan (GAEPD, 2007). GAEPD laboratory personnel are responsible for verifying chain-of-custody, receipt log, calibration logs, and all applicable quality assurance protocols are properly followed for chemical and bacteriological analyses.

The GAEPD laboratory analytical supervisor is responsible for chemical and bacteriological final data verification and ensuring the results are mailed to the data users. The GAEPD Laboratory flags any questionable data. Flags are defined in Section B4.3.

D2.3. Process for Validating and Verifying Data

The GAEPD Laboratory validates results by periodically comparing computer calculation with hand-calculated results. A second analyst and a supervisor review all results before results are reported. The GAEPD's QA Plan (GAEPD, 2007) provides additional information.

When analyses results from GAEPD's Laboratory are received by project personnel, the data are reviewed. The appropriate GAEPD Laboratory analytical supervisor is contacted to confirm unusual or unlikely results. Project field staff are contacted about questionable field data. No specific software is used for data validation. Examples of data receipt and verification audit forms are contained in Appendix E.

D2.4. Biological Data Verification

All biological data are verified through quality control checks described in Chapter 4 of the SOP for *Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia* (March 2007). Biological data are verified, and scoring checked by WPMP staff before entry into GOMAS according to protocols described in the SOP for *Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia* (March 2007).

D2.5. Process for Resolving Issues

Table 18 details the data quality check-points, person responsible for verification and how issue is resolved.

Table 18. Data Verification Process

Data Quality Check Points	Person Responsible for Verification	Issue Resolution
Biological Check Points		
Biological Logs	In-house QC Officer*	Contact sampler
Biological QC Logs	In-house QC Officer*	Contact sampler and/or taxonomist
Taxa List entry in GOMAS	Cody Jones	Contact taxonomist
Biological Scoring Verification	Cody Jones	Contact taxonomist
GOMAS Data Entry	Cody Jones	Contact data entry personnel
Meter Check Points		
Calibration Logs	In-house QC Officer*	Contact sampler
QC Readings	In-house QC Officer*	Contact sampler
Chemical and Bacteriological Check Points		
QC sample collections	In-house QC Officer*	Contact sampler
Analyses QC	Laboratory Analytical Supervisor	Contact analyst
Data Review	Project Team Leaders	Contact analyst
LIMS and GOMAS data entry	Laboratory Supervisor and WPMP Database Officer	Contact data entry personnel

* In-house QC officer refers to the GAEPD staff member designated by the Project Manager to ensure quality control measures are done in accordance with SOPs.

D2.6. Laboratory Issues Documentation

Issues with the GAEPD or other contracted laboratories analyses results are documented in the Verification database. A copy of the Chemical and Bacteriological Results Verification Audit Form is included in Appendix E. After data issues have been resolved by the GAEPD or other laboratory, data in the LIMS and/or GOMAS are to be appropriately flagged or discarded.

D3. Reconciliation with Data Quality Objectives

All data quality indicators will be calculated at the completion of the data analysis phase. Measurement quality requirements will be met and compared with the DQOs to confirm that the correct type, quality, and quantity of data are being used for the project. The interpretation and presentation stage includes inspection of the form of the results, and the meaning and reasonableness of the computation results and post-simulation analysis.

D3.1. Reconciliation of Project Results with Data Quality Objectives

These data and data collection by other organizations (e.g., USGS, EPA, GAEPD contractors, etc.) will be subsequently analyzed and used by the GAEPD for water quality assessments, TMDL development, stream and lake standards modifications, and permit decisions. Data quality will be reconciled with objectives of the project following the procedures outlined in Section B.10 and with the following.

D3.1.1. Chemical and Bacteriological Data Reconciliation

When chemical and bacteriological data are received from the GAEPD or other laboratories, the Survey Crew Leader and Database Manager review the data for unusual or unlikely results (outliers). The appropriate laboratory manager is contacted by email regarding any questionable results. The Laboratory Manager reviews the analyses, blank logs analyses, and data recording errors and responds by email. Survey Crew Leader and Database Officer make corrections on associated paperwork and data entry.

D3.1.2. Biological Data Reconciliation

When biological data are received by AMU staff, taxa lists, and biological index scoring is reviewed. If discrepancies in scoring are found, AMU contacts the taxonomist that identified the sample to discuss differences. After mutual agreement is reached, all paperwork is corrected, and data are entered into GOMAS.

D3.1.3. Field Data Reconciliation

When field data are received, measurements will be reviewed by the Project technical staff. Field staff will be contacted concerning any questionable information. Field staff will review equipment calibration logs and field notes to determine data quality. Project staff will make corrections and/or flag data on associated paperwork and data entry.

D3.2. How Data Limitation Will Be Reported

Electronic chemical, bacteriological, biological, and habitat assessment data are obtained by data users from the GAEPD. Chemical and bacteriological data limitations are marked in GOMAS by the appropriate flag (Section B4.3). Biological and habitat assessment limitations are noted in the GOMAS comments section. Limitations are also recorded in the field notes stored in the watershed files.

D3.3. Data Rejection

In the event data cannot be reconciled with DQO, it is removed from the data set. If possible, additional monitoring is conducted. Project staff will be responsible for ensuring data reconciliation or data removal if reconciliation is not possible. The guidance document used to reconcile data is the *Guidance for Data Quality Assessment – Practical Methods for Data Analyses EPA QA/G-9* (USEPA, 2000).

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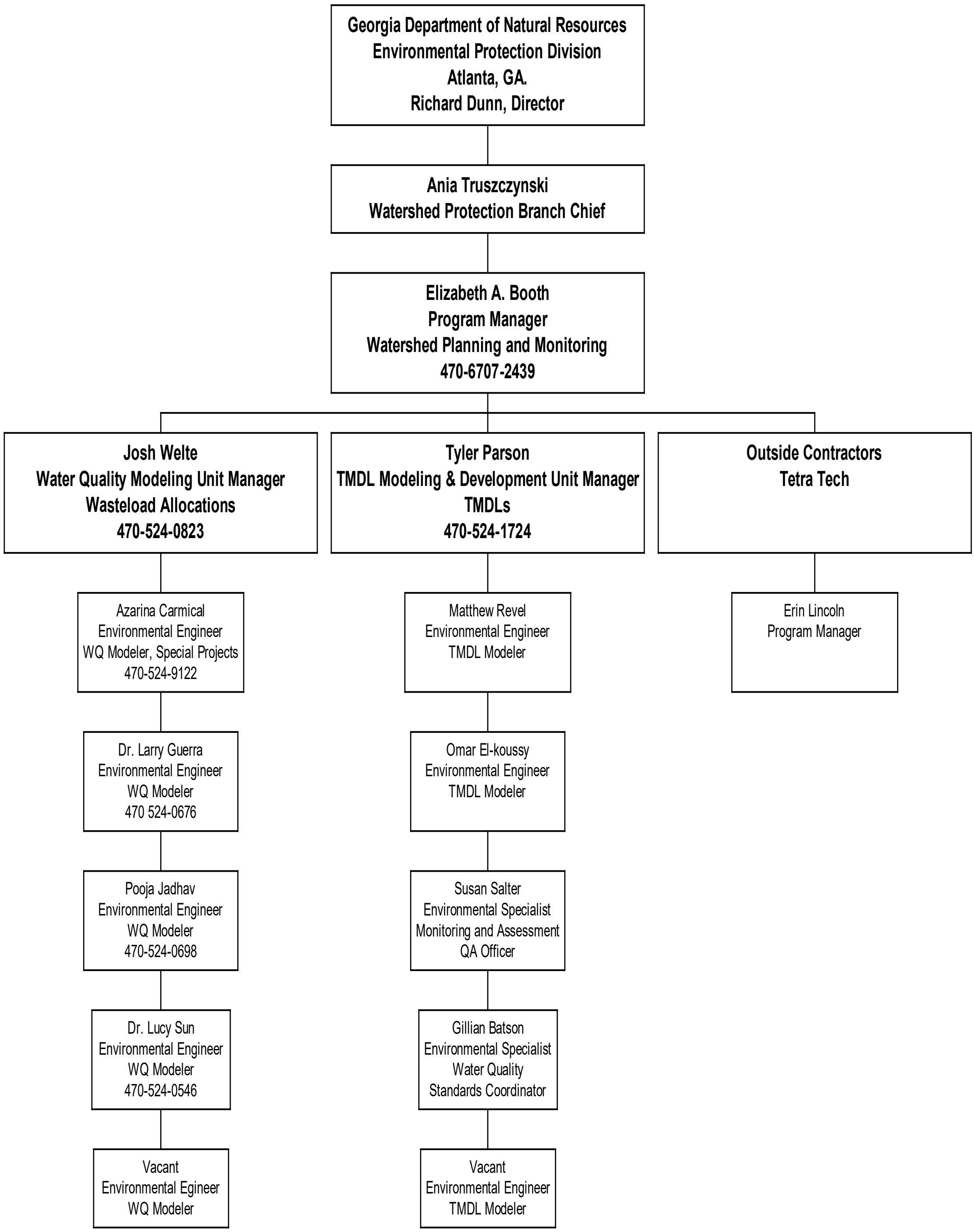
APPENDIX A

Organization Chart for Water Quality Modeling

Organizational Chart for Water Quality Modeling



Jennifer Shadle of EPA Region IV will serve as the EPA project officer (PO) for any water quality modeling projects funded by federal 106 or 604(b) funds. While the water quality modeling work is technically being administered by GAEPD, since it may be funded using federal funds, EPA retains signatory and approval authority for its performance. The EPA PO, with the assistance of EPA's Region IV QA officer (QAO), Stephanie McCarthy, will review and approve the QAPP. Additional EPA QA Officers responsibilities may include conducting external performance and system audits and participating in EPA QA reviews of the study.

Elizabeth Booth, of GAEPD Watershed Protection Branch, is the GAEPD Program Manager (PM) providing oversight for the water quality modeling contract. She will review and approve the QAPP and ensure that all contractual issues are addressed as work is performed on projects. In addition, she will provide overall project/program oversight for studies. She will work with the GAEPD Project Managers to ensure that the project objectives are attained. She will also have the following responsibilities:

- Providing oversight for analytical model design, model selection, data selection, model calibration, model validation, and adherence to project objectives.
- Reviewing and approving the project work plan, QAPP, and other materials developed by a contractor to support the project.
- Coordinating with contractors, reviewers, and others to ensure technical quality and contract adherence.

The GAEPD Project Managers responsible for day-to-day activities are Josh Welte for Water Quality Modeling and Tyler Parsons, for TMDL Modeling. EPD may also employ contractor assistance for additional modeling. Contract documents will require adherence to a QAPP. Josh Welte and Tyler Parsons supervise the overall project, including study design and model applications. Specific responsibilities include the following:

- Coordinating project assignments, establishing priorities, and scheduling.
- Ensuring completion of high-quality projects within established budgets and time schedules.
- Acting as primary point of contact for the Program Manager.
- Providing guidance, technical advice, and performance evaluations to those assigned to the project.
- Implementing corrective actions and providing professional advice to staff.
- Preparing or reviewing preparation of project deliverables, including the QAPP and other materials developed to support the project.
- Providing guidance on development of new site-specific models and peer review of GAEPD-developed models.
- Providing QC evaluations to ensure that QC is maintained throughout the data collection and analysis process, including reviewing site-specific model equations and codes (when necessary) and double-checking work as it is completed.
- Providing support to GAEPD in interacting with the project team, technical reviewers, and others to ensure that technical quality requirements of the study design objectives are met.

The GAEPD QA Officer is Susan Salter, whose primary responsibilities include the following:

- Providing support to the Managers in preparation and distribution of the QAPP.
- Reviewing and approving the QAPP.
- Monitoring QC activities, as necessary, to determine conformance.
- Reviewing and approving SQAPs from outside groups that want to submit data for 305(b)/303(d) assessment purposes

If contractors are used, the contractor Project Lead (PL) will supervise the overall project, including study design and model applications. Specific responsibilities of the PL include the following:

- Coordinating project assignments, establishing priorities, and scheduling.
- Ensuring completion of high-quality projects within established budgets and time schedules.
- Acting as primary point of contact for the Project Manager.
- Providing guidance, technical advice, and performance evaluations to those assigned to the project.
- Implementing corrective actions and providing professional advice to staff.
- Preparing or reviewing preparation of project deliverables, including the QAPP and other materials developed to support the project.
- Providing guidance on development of new site-specific models and peer review of GAEPD-developed models.
- Providing support to GAEPD in interacting with the project team, technical reviewers, and others to ensure that technical quality requirements of the study design objectives are met.

If contractors are used, the contractor QA Officer primary responsibilities include the following:

- Providing support to the PL in preparation and distribution of the QAPP.
- Reviewing and approving the QAPP.
- Monitoring QC activities to determine conformance.

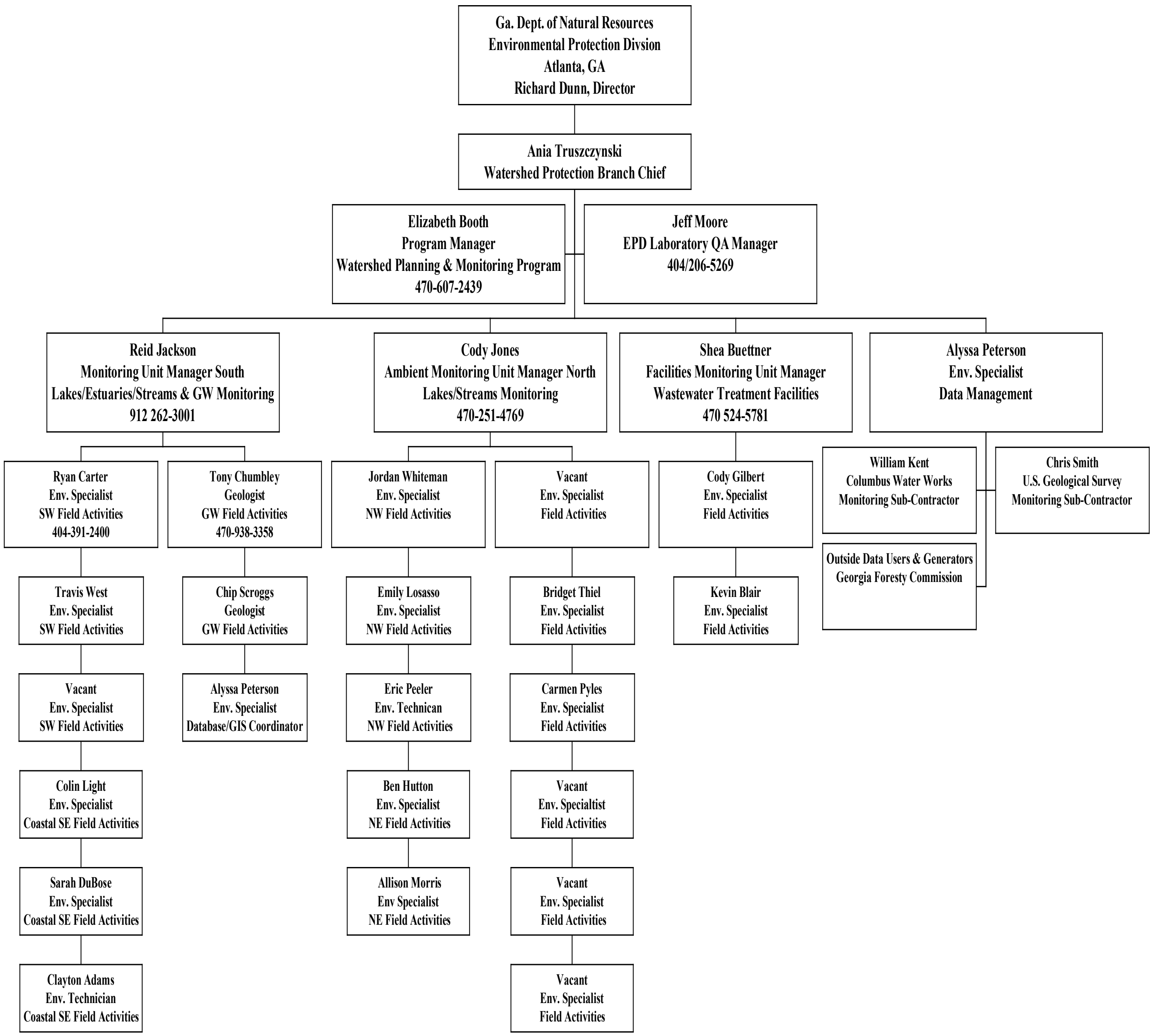
Contractor (if used) and EPD modeling staff will be responsible for the development of model input data sets, calibration and validation of the model, application of the model results, and writing of a final report. They will implement the QA/QC program, complete assigned work on schedule and with strict adherence to the established procedures, and complete required documentation. Other technical staff will perform literature searches; assist in secondary data collection, compilation, and QA review; and aid in completing draft and final modeling reports, which will support draft and final TMDL reports developed by GAEPD.

Other QA/QC staff, including technical reviewers and technical editors selected, as needed, will provide peer review oversight of the content of the work products, and ensure that the work products comply with GAEPD's specifications.

APPENDIX B

Organization Chart for Water Quality Data Collection and Assessment

Organizational Chart for Water Quality Data Collection and Assessment



Elizabeth Belk will serve as the EPA liaison for all water quality monitoring efforts performed by GAEPD's WPMP. She also serves as the initial point of contact for all Supplemental Monitoring Grants awarded to GAEPD.

Elizabeth Booth, of GAEPD Watershed Protection Branch, is the GAEPD Program Manager (PM) providing oversight for the water quality monitoring data collection and assessment. She will review and approve the QAPP and ensure that all data collection and assessment issues are addressed. In addition, she will provide overall project/program oversight. She will work with the GAEPD Project Managers to ensure that the project objectives are attained.

Jeff Moore will serve as the Laboratory Quality Assurance Manager, overseeing all lab SOP's and analytical methods.

The GAEPD Project Managers that are responsible for day-to-day activities are Reid Jackson for South Georgia surface water planning and monitoring as well as state-wide trend groundwater planning and monitoring, Cody Jones for North Georgia surface water planning and monitoring, Shea Buettner for facilities monitoring, and Alyssa Peterson for all water quality database management.

APPENDIX C

Data Quality Indicator Definitions

DATA QUALITY INDICATOR DEFINITIONS

Measurement acceptance or performance criteria are quantitative statistics used to interpret the degree of acceptability or utility of the data to the user. The quality of existing environmental monitoring data and generated data is some measure of the types and amount of error associated with the data. These criteria, also known as data quality indicators, include the following:

- Precision
- Accuracy
- Representativeness
- Comparability
- Completeness

Data used in water quality modeling are generally data contained in federal and state government water quality databases. It is assumed that data obtained from government agency databases have been screened and have met specified measurement performance criteria. These criteria may not be reported for the parameters of interest in the databases. Measurement performance or acceptance criteria for various parameters will be documented in the final report. Parameters for which measurement performance or acceptance criteria may be set include the following:

- Software run time
- Software processing capabilities
- Model prediction results relative to decision error
- Data used in model(s)

Precision is a measure of internal method consistency. It is demonstrated by the degree of mutual agreement between individual measurements or enumerated values of the same property of a sample, usually under demonstrated similar conditions. Precision of field sampling methods is estimated by taking duplicate samples for analysis. This QC calculation also addresses uncertainty due to natural variation and sampling error. Precision of available data used will be noted if available. Precision of generated data produced by the model may be examined by performing replicate runs.

Accuracy is defined as the degree of agreement between an observed value and an accepted reference or true value. Accuracy is a combination of random error (precision) and systematic error (bias), which are due to sampling and analytical operations. Bias is the systematic distortion of a measurement process that causes errors in one direction so that the expected sample measurement is always greater or lesser to the same degree than the sample's true value. Because accuracy is the measurement of a parameter and comparison with a "truth," and the true values of environmental physicochemical characteristics cannot be known, use of a surrogate is required.

Accuracy of non-direct data obtained from government agency databases and entered into the project database can be expressed as the percentage of values, by field, not included as valid values in their associated system reference tables. For example, a code entered incorrectly or in the wrong field would constitute inaccurate data. The accuracy of non-direct data will be controlled by double-checking all automatically mapped data. Accuracy of the model will be determined by comparing the contaminant concentrations calculated for a given area with actually measured contaminant concentrations reported in the database under conditions used in the model simulation. Accuracy of data entry into the project database will be controlled by double-checking all manual data entries.

Data representativeness is defined as the degree to which data accurately and precisely represents a characteristic of a population, a parameter, and variations at a sampling point, a process condition, or an environmental condition. It therefore addresses the natural variability or the spatial and temporal heterogeneity of a population. Comparisons of the loadings data and measured environmental concentrations will be made to examine sources and sinks of materials. Preliminary knowledge of the area will be used to select appropriate sites and stations in the vicinity of point source discharges for the initial and later modeling phases.

Two data sets are considered to be comparable when there is confidence that the two sets can be considered equivalent with respect to the measurement of a specific variable or group of variables. Measurement data used in the model will follow protocols established by the appropriate government agency to permit comparisons of water quality data at different sites on the study site. Data sets will be examined with respect to variables of interest, commonality of units of measurement, and similarity in analytical and QA procedures. Additional comparability of data may be ensured by similarity in geographic, seasonal, and sampling method characteristics.

Completeness is defined as the percentage of measurements made that are judged to be valid according to specific criteria and entered into the data management system. To achieve this objective, every effort is made to avoid accidental or inadvertent sample or data loss. Lack of data entered into the databases will reduce the ability of the project to calibrate and verify the model. Although some fields in the project database should never contain blanks (e.g., facility name), other fields could be impossible to fill or might not be filled until later (e.g., completion date of an activity). Completeness is thus also defined as the percentage of data available to cover all aspects of model development. In any complex model study, it is inevitable that there will be some data gaps. These data gaps and the assumptions used in filling the gaps will be documented. Percent completeness (%C) for measurement parameters can be defined as follows:

$$\%C = \frac{v}{T} x\ 100$$

Where v = the number of measurements judged valid
T = the total number of measurements

The model application will be considered complete when no less than 85 percent of the measurement data, parameter variables, and output values are judged valid; however, other considerations must be considered as well, depending on the use of the data.

Acceptance criteria will be obtained from any existing QAPPs, sampling and analysis plans, standard operating procedures, laboratory reports, and other correspondence for a given source of non-direct measurement data, if available. The data assessment and quality guidelines associated with a given type of measurement will be developed from these sources and documented. The secondary data will be reviewed and compared with the guidelines in this plan. Data not meeting the acceptance criteria requirements will be rejected or their status documented, as deemed appropriate by the Project Manager.

Model Sensitivity Analysis

The sensitivity to variations or uncertainty in input parameters is an important characteristic of a model. Sensitivity analysis is used to identify the most influential parameters in determining the accuracy and precision of model predictions. This information is of importance to the user who must establish required accuracy and precision in model application as a function of data quantity and quality. Sensitivity analysis quantitatively or semi-quantitatively defines the dependence of the model's performance assessment measure on a specific parameter or set of parameters. Sensitivity analysis can also be used to decide how to simplify the model simulation and to improve the efficiency of the calibration process.

Model sensitivity may be expressed as the relative rate of change of selected output caused by a unit change in the input. If the change in the input causes a large change in the output, the model is then considered to be sensitive to that input parameter. Sensitivity analysis methods are mostly non-statistical, or even intuitive by nature. Sensitivity analysis is typically performed by changing one input parameter at a time and evaluating the effects on the distribution of the dependent variable. Nominal, minimum, and maximum values are specified for the selected input parameter.

Initially, sensitivity analysis is performed at the beginning of the calibration process to design a calibration strategy. After a calibration is completed, a more elaborate sensitivity analysis is performed to quantify the uncertainty in the calibrated model caused by uncertainty in the estimates of the model input parameters.

Informal sensitivity analyses (iterative parameter adjustments) are generally performed during model calibrations, to ensure that reasonable values for model parameters will be obtained, resulting in acceptable model results. The degree of allowable adjustment of any parameter is usually directly proportional to the uncertainty of its value and is limited to its expected range of values. Formal sensitivity analyses will be performed based on technical direction from the Program Manager when there is a certain aspect of the system that requires further investigation. For example, formal sensitivity analyses are often performed on the effects of loadings from different sources on instream water quality to allow the development of more feasible and reasonable allocations and load reductions based on the dominant sources.

APPENDIX D

Monitoring Stations and Facilities

1. **2023 Surface Water Monitoring Stations**
2. **Coastal Shellfish Monitoring Stations**
3. **Coastal Beach Monitoring Stations**
4. **DNR State Parks Lake Beach Monitoring Stations**
5. **Ground Water Monitoring Wells**
6. **Parameters for Fish Tissue Testing Program**
7. **Major NPDES Facilities and Industrial Pretreatment Facilities**

1. 2023 SURFACE WATER MONITORING STATIONS
Rivers/Streams, Lakes/Reservoirs, Estuaries/Sounds

Rivers and streams stations are sampled monthly for field and chemical parameters for one calendar year every five years. Four bacteria samples are collected each calendar quarter during the focused monitoring year.

Lakes, reservoirs, and estuaries are sampled once a month during the growing season (April-October).

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
LK_01_7	Lake Burton – 1/4-mile South of Burton Island (aka Tallulah River)	Savannah	Cartersville AMU	Lake Trend Monitoring	34.83523	-83.5538	X		X						X
LK_01_8	Lake Burton - Dampool (aka Tallulah River u/s Lake Burton Dam)	Savannah	Cartersville AMU	Lake Trend Monitoring	34.79532	-83.5401	X		X						X
LK_01_9	Lake Rabun - ~4.5 mi u/s Dam (Mid Lake)	Savannah	Cartersville AMU	Lake Trend Monitoring	34.76353	-83.4558	X		X						X
LK_01_10	Lake Rabun - Dampool (aka Tallulah River - Upstream From Mathis Dam)	Savannah	Cartersville AMU	Lake Trend Monitoring	34.76472	-83.4178	X		X						X
LK_01_11	Lake Hartwell at Interstate 85	Savannah	Augusta AMU	Lake Trend Monitoring	34.48417	-83.0298	X		X						X
LK_01_22	Lake Hartwell - Dam Forebay	Savannah	Augusta AMU	Lake Trend Monitoring	34.35873	-82.8244	X		X						X
LK_01_27	Lake Russell Between Markers 42 and 44 (Mid Lake)	Savannah	Augusta AMU	Lake Trend Monitoring	34.12778	-82.6736	X		X						X
LK_01_29	Lake Richard B. Russell - Dam Forebay	Savannah	Augusta AMU	Lake Trend Monitoring	34.02633	-82.5942	X		X						X
LK_01_38	Clarks Hill Lake- Savannah River At U.S. Highway 378	Savannah	Augusta AMU	Lake Trend Monitoring	33.85786	-82.3996	X		X						X
LK_01_39	Clarks Hill Lake- Savannah River At Dordon Creek	Savannah	Augusta AMU	Lake Trend Monitoring	33.76586	-82.2718	X		X						X
LK_01_40	Clarks Hill Lake - Dam Forebay	Savannah	Augusta AMU	Lake Trend Monitoring	33.66269	-82.1985	X		X						X
LK_01_67	Lake Tugalo - u/s Tugalo Lake Rd (aka Bull Sluice Rd.)	Savannah	Atlanta AMU	Lake Trend Monitoring	34.73781	-83.3406	X		X						X
LK_01_68	Lake Tugalo - Upstream From Tugaloo Dam	Savannah	Atlanta AMU	Lake Trend Monitoring	34.715	-83.3517	X		X						X

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
LK_01_71	Clarks Hill Lake - Little River At Highway 47	Savannah	Augusta AMU	Lake Trend Monitoring	33.69272	-82.3388	X		X						X
LK_03_520	Lake Oconee At Highway 44, Oconee River Arm	Oconee	Augusta AMU	Lake Trend Monitoring	33.43139	-83.2657	X		X						X
LK_03_525	Lake Sinclair - Little River & Murder Creek Arm, U/S U.S. Hwy 441	Oconee	Augusta AMU	Lake Trend Monitoring	33.189	-83.2953	X		X						X
LK_03_526	Lake Sinclair - 300 Meters U/S Dam (Dam Forebay)	Oconee	Augusta AMU	Lake Trend Monitoring	33.14282	-83.2026	X		X						X
LK_03_530	Lake Sinclair - Midlake, Oconee River Arm	Oconee	Augusta AMU	Lake Trend Monitoring	33.1968	-83.2742	X		X						X
LK_03_538	Lake Oconee 300 Meters U/S Wallace Dam (Dam Forebay)	Oconee	Augusta AMU	Lake Trend Monitoring	33.35167	-83.1608	X		X						X
LK_03_545	Lake Oconee - Richland Creek Arm	Oconee	Augusta AMU	Lake Trend Monitoring	33.3947	-83.1767	X		X						X
LK_03_600	Lake Sinclair- Little River/Oconee River Confluence	Oconee	Augusta AMU	Lake Trend Monitoring	33.1875	-83.275	X		X						X
LK_03_17700	Lake Oconee - Lick Creek Cove near Old Phoenix Rd.	Oconee	Augusta AMU	Lake Trend Monitoring	33.40382	-83.2724	X		X						X
LK_04_893	Lake Jackson at confluence of Alcovy River and Yellow/South River Branch	Ocmulgee	Atlanta AMU	Lake Trend Monitoring	33.36314	-83.8613	X		X						X
LK_04_897	Lake Jackson - Dam Forebay	Ocmulgee	Atlanta AMU	Lake Trend Monitoring	33.322	-83.8409	X		X						X
LK_05_2076	High Falls Lake - Midlake	Ocmulgee	Atlanta AMU	Lake Trend Monitoring	33.1973	-84.031	X		X						X
LK_05_2078	High Falls Lake - Dam Forebay	Ocmulgee	Atlanta AMU	Lake Trend Monitoring	33.1799	-84.0209	X		X						X
LK_05_2131	Lake Juliette - Midlake	Ocmulgee	Atlanta AMU	Lake Trend Monitoring	33.0464	-83.8106	X		X						X
LK_05_2132	Lake Juliette - Dam Forebay	Ocmulgee	Atlanta AMU	Lake Trend Monitoring	33.0338	-83.7572	X		X						X
LK_05_2144	Lake Tobesofkee - Midlake	Ocmulgee	Atlanta AMU	Lake Trend Monitoring	32.8346	-83.8161	X		X						X

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
LK_05_2146	Lake Tobesofkee - Dam Forebay	Ocmulgee	Atlanta AMU	Lake Trend Monitoring	32.8215	-83.7706	X		X						X
LK_09_3199	Banks Lake - Near Lakeland, GA	Suwannee	Tifton AMU	Lake Trend Monitoring	31.02667	-83.1056	X		X						X
LK_11_3467	Lake Blackshear - Midlake	Flint	Tifton AMU	Lake Trend Monitoring	31.9665	-83.9342	X		X						X
LK_11_3520	Lake Blackshear - Dam Forebay	Flint	Tifton AMU	Lake Trend Monitoring	31.8479	-83.9394	X		X						X
LK_11_3534	Flint River Reservoir - Midlake, Flint River Arm	Flint	Tifton AMU	Lake Trend Monitoring	31.6085	-84.119	X		X						X
LK_11_3535	Flint River Reservoir (Lake Worth) - Dam Forebay	Flint	Tifton AMU	Lake Trend Monitoring	31.6033	-84.1365	X		X						X
LK_11_3551	Lake Worth (original) - Above Hwy 91 Bridge / Diversion Dam (aka Lake Chehaw)	Flint	Tifton AMU	Lake Trend Monitoring	31.6109	-84.15	X		X						X
LK_11_3569	Lake Seminole - Flint River Arm at Spring Creek	Flint	Tifton AMU	Lake Trend Monitoring	30.7627	-84.8171	X		X						X
LK_12_3913	Lake Sidney Lanier - Little River Embayment, Between M1WC & 3LR	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	34.355	-83.8427	X		X						X
LK_12_3995	Lake Sidney Lanier at Boling Bridge (State Road 53) on Chestatee River	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	34.31235	-83.9501	X		X						X
LK_12_3998	Lake Sidney Lanier at Lanier Bridge (State Road 53) on Chattahoochee River	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	34.32195	-83.880171	X		X						X
LK_12_4001	Lake Sidney Lanier at Browns Bridge Road (State Road 369)	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	34.261666	-83.9507	X		X						X
LK_12_4005	Lake Sidney Lanier - Flat Creek Embayment, 100' U/S M7FC	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	34.2587	-83.9198	X		X						X
LK_12_4007	Lake Sidney Lanier - Balus Creek Embayment, 0.34m SE M6FC	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	34.2504	-83.9244	X		X						X
LK_12_4010	Lake Sidney Lanier - Mud Creek Embayment, Betw Marina & Ramp	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	34.2333	-83.9373	X		X						X
LK_12_4012	Lake Lanier upstream from Flowery Branch Confluence (Midlake)	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	34.20028	-83.9829	X		X						X

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
LK_12_4019	Lake Sidney Lanier - Six Mile Creek Embayment, 300' E M9SM	Chattahoochee	Atlanta AMU	Targeted Lake Monitoring	34.2335	-84.0287	X		X						X
LK_12_4028	Lake Sidney Lanier upstream of Buford Dam Forebay	Chattahoochee	Atlanta AMU	Targeted Lake Monitoring	34.16278	-84.0671	X		X						X
LK_12_4048	West Point Lake at LaGrange Water Intake near LaGrange, Ga. (aka Chattahoochee River at Lagrange Intake)	Chattahoochee	Atlanta AMU/USGS	Lake Trend Monitoring	33.0783	-85.1108	X		X						X
LK_12_4060	West Point Lake - Dam Forebay	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	32.9208	-85.1834	X		X						X
LK_12_4072	Lake Harding - Midlake, Main Body	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	32.7379	-85.1125	X		X						X
LK_12_4074	Lake Harding - Dam Forebay (aka Chattahoochee River US Bartletts Ferry Dam)	Chattahoochee	Atlanta AMU/CWW	Lake Trend Monitoring	32.6633	-85.0903	X		X						X
LK_12_4078	Goat Rock Lake - Dam Forebay	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	32.6112	-85.0794	X		X						X
LK_12_4079	Lake Oliver - Chattahoochee River at Columbus Water Intake near Columbus, GA	Chattahoochee	CWW	Lake Trend Monitoring	32.5214	-84.9983	X		X						
LK_12_4080	Lake Oliver - Dam Forebay	Chattahoochee	Atlanta AMU	Lake Trend Monitoring	32.516	-85.0009	X		X						X
LK_12_4097	Lake Walter F. George at U.S. Highway 82 (aka Chattahoochee River at Hwy 82)	Chattahoochee	Tifton AMU	Lake Trend Monitoring	31.89194	-85.1208	X		X						X
LK_12_4103	Lake Walter F. George at Dam Forebay	Chattahoochee	Tifton AMU	Lake Trend Monitoring	31.62917	-85.0725	X		X						X
LK_12_4107	Lake Andrews - Dam Forebay	Chattahoochee	Tifton AMU	Lake Trend Monitoring	31.2632	-85.113	X		X						X
LK_12_4113	Lake Seminole - Chattahoochee Arm, Lower	Chattahoochee	Tifton AMU	Lake Trend Monitoring	30.7662	-84.9201	X		X						X
LK_12_4115	Lake Seminole - Dam Forebay	Chattahoochee	Tifton AMU	Lake Trend Monitoring	30.7115	-84.8647	X		X						X
LK_14_4494	Lake Allatoona Upstream from Dam	Coosa	Cartersville AMU	Lake Trend Monitoring	34.16083	-84.7258	X		X						X
LK_14_4497	Lake Allatoona at Allatoona Creek Upstream from Interstate 75	Coosa	Cartersville AMU	Lake Trend Monitoring	34.08583	-84.7114	X		X						X

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
LK_14_4502	Lake Allatoona at Etowah River upstream from Sweetwater Creek	Coosa	Cartersville AMU	Lake Trend Monitoring	34.19	84.57778	X		X						X
LK_14_4523	Carters Lake (CR1) - Upper Lake, Coosawattee Arm	Coosa	Cartersville AMU	Lake Trend Monitoring	34.62087	-84.6212	X		X						X
LK_14_4524	Carters Lake - Midlake (upstream from Woodring Branch)	Coosa	Cartersville AMU	Lake Trend Monitoring	34.6076	-84.638	X		X						X
LK_14_4553	Lake Allatoona at Little River upstream from Highway 205	Coosa	Cartersville AMU	Lake Trend Monitoring	34.15861	-84.5772	X		X						X
LK_14_4556	Lake Allatoona downstream from Kellogg Creek	Coosa	Cartersville AMU	Lake Trend Monitoring	34.13861	-84.6392	X		X						X
LK_15_4895	Lake Chatuge LMP 12 at State Line (aka Hiawassee River)	Tennessee	Cartersville AMU	Lake Trend Monitoring	34.98333	-83.7886	X		X						X
LK_15_4899	Lake Nottely (LMP15A) at Reece Creek	Tennessee	Cartersville AMU	Lake Trend Monitoring	34.91152	-84.0506	X		X						X
LK_15_4900	Lake Nottely - Dam Forebay (aka Nottely River - Upstream From Nottley Dam)	Tennessee	Cartersville AMU	Lake Trend Monitoring	34.95778	-84.0922	X		X						X
LK_15_4907	Lake Blue Ridge (LMP18) - 300 Meter Upstream Of Dam	Tennessee	Cartersville AMU	Lake Trend Monitoring	34.88167	-84.28	X		X						X
LK_15_4908	Lake Blue Ridge (LMP18A) - 4 miles upstream Dam	Tennessee	Cartersville AMU	Lake Trend Monitoring	34.84017	-84.2731	X		X						X
SH_02_56	Mouth of Wilmington River - Marker #19 Wassaw Sound	Ogeechee	Brunswick AMU	Estuary Trend Monitoring	31.93242	-80.9771	X	X							X
SH_02_317	Little Ogeechee River at Green Island	Ogeechee	Brunswick AMU	Estuary Trend Monitoring	31.88823	-81.088	X	X							X
SH_02_364	St Catherines Sound at Medway River near Midway, GA	Ogeechee	Brunswick AMU	Estuary Trend Monitoring	31.71547	-81.1568	X	X							X
SH_02_372	Sapelo Sound at South Newport River near Barbour Island	Ogeechee	Brunswick AMU	Targeted Estuary Monitoring (Designated use: Fishing)	31.55411	-81.2004	X	X							X
SH_02_374	Sapelo River - Mouth of Broro River - 1.4 miles South of Shellman's Bluff	Ogeechee	Brunswick AMU	Targeted Estuary Monitoring (Designated use: Fishing)	31.54486	-81.316	X	X							X

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
SH_06_2857	Altamaha River - channel marker #201 off Wolf Island	Altamaha	Brunswick AMU	Estuary Trend Monitoring	31.31917	-81.325	X	X							X
SH_06_15212	Doboy Sound	Altamaha	Brunswick AMU	Targeted Monitoring (Designated use: Fishing)	31.39494	-81.2944	X	X							X
SH_07_3008	St. Andrews Sound at Satilla River near	Satilla	Brunswick AMU	Estuary Trend Monitoring	30.98316	-81.4532	X	X							X
SH_07_3029	Turtle River off Hermitage Island	Satilla	Brunswick AMU	Estuary Trend Monitoring	31.22028	-81.5642	X								
SH_07_3032	Turtle River - Georgia Highway 303	Satilla	Brunswick AMU	Estuary Trend Monitoring	31.18694	-81.5314	X								
SH_07_3035	Brunswick Harbor (off East River) - 0.83 miles SW of Brunswick	Satilla	Brunswick AMU	Estuary Trend Monitoring	31.14361	-81.4975	X								
SH_07_3036	Brunswick River - U.S. Highway 17	Satilla	Brunswick AMU	Estuary Trend Monitoring	31.1164	-81.4858	X								
SH_07_3049	Cumberland Sound at St. Marys River nr St Marys, GA	Satilla	Brunswick AMU	Estuary Trend Monitoring	30.72807	-81.4898	X	X							X
SH_07_15209	St. Simons Sound	Satilla	Brunswick AMU	Targeted Monitoring (Designated use: Fishing)	31.12568	-81.412	X	X							X
RV_01_33	Coldwater Creek at County Road 193 near Ruckersville	Savannah	Augusta AMU	Targeted Monitoring (Impaired FC)	34.22324	-82.8308	X		X						
RV_01_34	Beaverdam Creek at Ruckersville Rd near Elberton	Savannah	Augusta AMU	Targeted Monitoring (Impaired FC)	34.14211	-82.8394	X		X						
RV_01_66	Chattooga River near Clayton, GA	Savannah	USGS	Trend Monitoring	34.81398	-83.3064	X		X	X				X	
RV_01_87	Savannah River below Spirit Creek near Augusta, GA	Savannah	USGS	Trend Monitoring	33.3306	-81.9153	X		X	X				X	
RV_01_88	Butler Creek at State Rd 4 near Augusta	Savannah	Augusta AMU	Targeted Monitoring (pH)	33.41415	-82.0879	X								
RV_01_109	Savannah River near Clyo, GA.	Savannah	USGS	Trend Monitoring	32.525	-81.264	X		X	X				X	
RV_01_120	Savannah River at GA 25, at Port Wentworth, GA	Savannah	USGS	Trend Monitoring	32.16583	-81.1539	X		X	X				X	

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
RV_01_144	Kettle Creek at Stone Ridge Rd	Savannah	Augusta AMU	Targeted/Trend Monitoring	33.68301	-82.8575	X		X	X	X	X		X	X
RV_01_244	Charlies Creek at Charlies Creek Rd East of Hiawassee, GA	Savannah	Atlanta AMU	Trend Biological Monitoring (SEMN)	34.95895	-83.5716	X			X	X	X	X	X	
RV_01_248	Coleman River at Coleman River Rd near Clayton, GA	Savannah	Atlanta AMU	Trend Biological Monitoring (SEMN)	34.95203	-83.5166	X			X	X	X	X	X	
RV_01_269	Sweetwater Creek at Wire Rd near Dearing	Savannah	Augusta AMU	Targeted Monitoring (DW Assessment)	33.415	-82.4533	X		X		X				
RV_01_17293	Wahachee Creek at Dr. George Ward Rd near Elberton	Savannah	Augusta AMU	Targeted Monitoring (Impaired FC)	34.02278	-82.7596	X		X						
RV_01_17294	Tributary to Van Creek at John Rucker Rd near Elberton	Savannah	Augusta AMU	Targeted Monitoring (pH)	34.14688	-82.7802	X								
RV_01_17902	Raiden Creek at McWhorter Rd near Maxey’s	Savannah	Augusta AMU	Targeted Monitoring (DW Assessment)	33.76933	-83.1305	X		X		X				
RV_01_17904	Gum Branch at Ridgewood Drive near Hartwell	Savannah	Augusta AMU	Targeted Monitoring (pH)	34.37738	-82.902	X								
RV_01_18000	Sherrills Creek at Brown Chappel Rd near Union Point	Savannah	Augusta AMU	Targeted Monitoring (DW Assessment)	33.61274	-83.0097	X		X		X				
RV_01_18001	Dry Branch at Carver St NE near Thomson	Savannah	Augusta AMU	Probabilistic Monitoring	33.46959	-82.4255	X		X	X	X				
RV_01_18003	Newberry Creek at Claxton-Lively Rd near Shell Bluff	Savannah	Augusta AMU	Probabilistic Monitoring	33.14331	-81.854	X		X	X	X				X
RV_01_18009	Little Beaverdam Creek at Saddler Rd near Dewy Rose	Savannah	Augusta AMU	Probabilistic Monitoring	34.19377	-82.9379	X		X	X	X				
RV_02_280	Little Ogeechee River at Shoals Rd near Culverton	Ogeechee	Augusta AMU	Targeted Monitoring (pH and Pb)	33.25719	-82.8579	X				X				
RV_02_298	Ogeechee River at GA24, near Oliver, GA	Ogeechee	USGS	Trend Monitoring	32.49475	-81.5558	X		X	X				X	
RV_02_313	Ogeechee River at Fort McAllister State Park	Ogeechee	Brunswick AMU	Targeted Monitoring (enterococci)	31.89061	-81.2008	X	X							
RV_02_340	Fifteenmile Creek at Dutch Ford Rd near Metter	Ogeechee	Augusta AMU	Targeted Monitoring (Impaired FC)	32.34791	-82.0428	X		X						

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
RV_02_343	Tenmile Creek at Excelsior Church Rd near Excelsior	Ogeechee	Augusta AMU	Probabilistic Monitoring	32.2801	-81.9615	X		X	X	X				
RV_02_343	Ten Mile Creek at Road S2242 near Excelsior, GA	Ogeechee	Brunswick AMU	Probabilistic Monitoring	32.27965	-81.9616	X		X	X	X				
RV_02_350	Lotts Creek at State Road 250 (Nevils-Daisy Rd)near Nevils, GA	Ogeechee	Brunswick AMU	Targeted Monitoring (Impaired FC)	32.26442	-81.8084	X		X					X	
RV_02_351	Thick Creek at CR197 (Daisy Nevils Hwy.) near Daisy, Ga	Ogeechee	Brunswick AMU	Targeted Monitoring (Impaired FC)	32.2167	-81.8252	X		X					X	
RV_02_358	Salt Creek at US Hwy 17 near Savannah, GA	Ogeechee	Brunswick AMU	Probabilistic Monitoring	32.0399	-81.2037	X		X		X				
RV_02_359	Little Ogeechee River at U.S. Highway 17 near Burroughs, GA	Ogeechee	Brunswick AMU	Targeted Monitoring (Impaired FC)	32.00732	-81.2368	X		X					X	
RV_02_462	Mill Creek at Bulloch County Road 386 Old River Road near Brooklet, GA	Ogeechee	Brunswick AMU	Trend Monitoring (Bio Site ID: Trend08)	32.44001	-81.5791	X		X	X	X	X	X	X	
RV_02_15769	Ogeechee River at RM 2.5	Ogeechee	Brunswick AMU	Targeted Monitoring (enterococci)	31.84269	-81.0716	X	X							
RV_02_15770	Ogeechee River at RM 5 at Middle Marsh Islands near Richmond Hill, GA	Ogeechee	Brunswick AMU	Estuary Site (Designated use: Recreation)	31.85699	-81.1105	X	X							X
RV_02_16832	Goldens Creek off N. Norwood St nr North Pond	Ogeechee	Augusta AMU	Targeted Monitoring (NH3)	33.41416	-82.6698	X			X					
RV_02_16833	Goldens Creek at SR 16/Macon Hwy	Ogeechee	Augusta AMU	Targeted Monitoring (NH3)	33.39976	-82.673	X			X					
RV_02_17701	North Fork Ogeechee at Brooks Rd near Union Point	Ogeechee	Augusta AMU	Targeted/Trend Monitoring	33.58844	-83.0094	X		X	X	X	X		X	X
RV_02_17986	Little Ogeechee River near Pine Island, GA	Ogeechee	Brunswick AMU	Probabilistic Monitoring	31.86713	-81.0199	X	X			X				
RV_02_17987	Tidal Creek off Hoover Creek near Savannah, GA	Ogeechee	Brunswick AMU	Probabilistic Monitoring	31.94807	-81.1607	X	X			X				
RV_02_18002	Fifteenmile Creek at Patty Ford Bridge Rd near Twin City	Ogeechee	Augusta AMU	Probabilistic Monitoring	32.53046	-82.0763	X		X	X	X				
RV_03_491	North Oconee River at Newton Bridge Road near Athens ,GA	Oconee	Atlanta AMU	Targeted Monitoring (DW Assessment)	34.01094	-83.4071	X		X		X				

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
RV_03_502	Oconee River at Barnett Shoals Road, near Watkinsville, GA	Oconee	USGS	Trend Monitoring	33.8562	-83.3265	X		X	X				X	
RV_03_514	Jacks Creek at Snows Mill Road (County Road 45) near Monroe, GA	Oconee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.80667	-83.6636	X		X		X				
RV_03_640	Oconee River at I-16, near Dublin, GA	Oconee	USGS	Trend Monitoring	32.48037	-82.8582	X			X				X	
RV_03_690	Bear Creek at Arnold Rd near Statham, GA	Oconee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.9823	-83.5657	X		X		X				
RV_03_18004	Commissioner Creek at Wriley Rd near McIntyre	Oconee	Augusta AMU	Probabilistic Monitoring	32.85239	-83.1545	X		X	X	X				
RV_03_18005	Town Creek at US Hwy 441 near Irwinton	Oconee	Augusta AMU	Targeted Monitoring (NH3)	32.81227	-83.1845	X			X					
RV_03_18006	Town Creek D/S WPCP off Lavender Rd near Irwinton	Oconee	Augusta AMU	Targeted Monitoring (NH3)	32.81075	-83.1881	X			X					
RV_03_18007	Unnamed trib to Helton Branch D/S WPCP near Irwinton	Oconee	Augusta AMU	Targeted Monitoring (NH3)	32.82432	-83.2087	X			X					
RV_03_18008	Unnamed trib to Helton Branch U/S WPCP near Irwinton	Oconee	Augusta AMU	Targeted Monitoring (NH3)	32.82409	-83.209	X			X					
RV_03_18010	North Oconee River at New Kings Bridge Rd near Athens, GA	Oconee	Atlanta AMU	Targeted Monitoring (DW Assessment)	34.06731	-83.4629	X		X		X				
RV_03_18011	Trib to Sugar Creek at Saffold Road near Buckhead, GA	Oconee	Atlanta AMU	Probabilistic Monitoring	33.55158	-83.3416	X		X	X	X				
RV_04_848	South River at GA Hwy 81 near Snapping Shoals, GA	Ocmulgee	USGS	Trend Monitoring (Lake Trib)	33.45265	-83.9271	X			X				X	
RV_04_876	Yellow River at Georgia Hwy. 212 near Stewart, GA	Ocmulgee	USGS	Trend Monitoring (Lake Trib)	33.45427	-83.8813	X		X	X				X	
RV_04_887	Alcovy River at Alcovy Tressle Road near Social Circle ,GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.63954	-83.779	X		X		X				
RV_04_888	Alcovy River at Newton Factory Bridge Road near Stewart, GA	Ocmulgee	USGS	Trend Monitoring (Lake Trib)	33.4494	-83.8283	X		X	X				X	
RV_04_892	Tussahaw Creek at Fincherville Road near Jackson, GA	Ocmulgee	USGS	Trend Monitoring (Lake Trib)	33.37887	-83.9634	X			X				X	

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
RV_04_964	Brown Branch at South Ola Rd near Locust Grove, GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.35782	-84.0585	X		X		X				
RV_04_18017	Tributary to Doolitte Creek at Fontaine Circle in Atlanta, GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (Tetrachloroethylene)	33.72412	-84.2857	X								
RV_04_18019	Tussahaw Creek at Leguin Mill Road near Locust Grove, GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (new site)	33.38501	-84.0347	X								
RV_05_2090	Tobesofkee Creek at SR 74 near Macon, GA	Ocmulgee	Atlanta AMU	Targeted Mentoring (E coli recreation)	32.866	-83.839	X		X						
RV_05_2165	Ocmulgee River at New Macon Water Intake	Ocmulgee	USGS	Trend Monitoring	32.89925	-83.6641	X		X	X				X	
RV_05_2203	Ocmulgee River at Hawkinsville, GA	Ocmulgee	USGS	Trend Monitoring	32.28176	-83.4628	X		X	X				X	
RV_05_2223	Ocmulgee River at US Hwy. 341 at Lumber City, GA	Ocmulgee	USGS	Trend Monitoring	31.91993	-82.6743	X			X				X	
RV_05_2264	Towaliga River at Highway 16 near Jackson, GA	Ocmulgee	Atlanta AMU	Probabilistic Monitoring	33.26433	-84.0713	X		X	X	X				
RV_05_2828	Rocky Creek at Johnstonville Rd nr Forsyth, GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.11236	-83.9479	X		X		X				
RV_05_2831	Tobesofkee Creek at Mountpelier Springs Road near Forsyth, GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (DW Assessment)	32.97577	-83.9306	X		X		X				
RV_05_17699	Indian Creek at LG Griffin Rd near McDonough, GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.31696	-84.1157	X		X		X				
RV_05_17991	Trib to Jordan Creek U/S WPCP near W. Railroad St. near Cochran, Ga	Ocmulgee	Tifton AMU	Targeted Monitoring (NH3)	32.38316	-83.3734	X			X					
RV_05_17992	Trib to Jordan Creek D/S WPCP near W. Railroad St. near Cochran, Ga	Ocmulgee	Tifton AMU	Targeted Monitoring (NH3)	32.38089	-83.3742	X			X					
RV_05_17993	Little Ocmulgee River U/S WPCP at Whirlhole Rd. near Scotland, Ga	Ocmulgee	Tifton AMU	Targeted Monitoring (NH3)	32.05083	-82.8117	X			X					
RV_05_17994	Little Ocmulgee River D/S WPCP near Whirlhole Rd. near Scotland, Ga	Ocmulgee	Tifton AMU	Targeted Monitoring (NH3)	32.05008	-82.8096	X			X					
RV_05_18020	Big Sandy Creek at Nathan Thaxton Road near Jackson, GA	Ocmulgee	Atlanta AMU	Probabilistic Monitoring	33.2542	-83.9997	X		X	X	X				

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RV_05_18021	Big Towaliga Creek at Barnesville-Jackson Rd near Barnesville, GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.084	-84.1545	X		X		X				
RV_05_18022	Town Creek at River North Blvd near Macon, GA	Ocmulgee	Atlanta AMU	Targeted Monitoring (DW Assessment)	32.9424	-83.6603	X		X		X				
RV_06_2846	Altamaha River near Gardi, GA	Altamaha	USGS	Trend Monitoring	31.6233	-81.7653	X			X				X	
RV_06_17977	Little Penholoway Creek at Broadhurst Rd W near Screven, GA	Altamaha	Brunswick AMU	Probabilistic Monitoring	31.47292	-81.9417	X		X		X			X	
RV_07_2962	Pudding Creek at State Road 31 near Pearson, GA	Satilla	Brunswick AMU	Targeted Monitoring (Impaired FC)	31.36472	-82.8389	X		X					X	
RV_07_2963	Satilla River at State Road 64 near Pearson, GA	Satilla	Brunswick AMU	Probabilistic Monitoring	31.33639	-82.7686	X		X		X			X	
RV_07_2976	Seventeen Mile River - Georgia Highway 64 near Pearson, GA	Satilla	Brunswick AMU	Targeted Monitoring (Impaired FC)	31.50944	-82.7517	X		X					X	
RV_07_2979	Hog Creek at County Road 467 at Bickley, GA	Satilla	Brunswick AMU	Targeted Monitoring (Impaired FC)	31.40472	-82.5731	X		X					X	
RV_07_2986	Satilla River at Georgia Hwy.15 and Hwy.121, near Hoboken, GA	Satilla	USGS	Trend Monitoring	31.2167	-82.1625	X		X	X				X	
RV_07_3004	Satilla River at Highway 17 in Woodbine, GA	Satilla	Brunswick AMU	Targeted Monitoring (Impaired FC)	30.97444	-81.7258	X		X					X	
RV_07_3099	Mill Creek at High Bluff Rock Rd nr Waycross, GA	Satilla	Brunswick AMU	Trend Monitoring (Bio Site ID: Trend10)	31.18999	-82.2028	X		X	X	X	X	X	X	
RV_07_16339	Waverly Creek at State Road 110 near Waverly, GA	Satilla	Brunswick AMU	Targeted Monitoring (Impaired FC)	31.08182	-81.7265	X		X					X	
RV_07_16397	Trib to Trib to Seventeen Mile River at 10th Street near Douglas, GA	Satilla	Brunswick AMU	Targeted Monitoring (NH3)	31.50181	-82.8417	X				X				
RV_07_16398	Trib to Trib to Seventeen Mile River at Gaskin Avenue near Douglas, GA	Satilla	Brunswick AMU	Targeted Monitoring (NH3)	31.50207	-82.8454	X				X				
RV_07_17554	Trib to Trib to Seventeen Mile River 100 m downstream of McDonald Rd near Douglas, GA	Satilla	Brunswick AMU	Targeted Monitoring (NH3)	31.50162	-82.8426	X				X				
RV_07_17976	Church House Branch at GA Hwy 110 near Horetense, GA	Satilla	Brunswick AMU	Probabilistic Monitoring	31.30636	-81.8704	X		X		X			X	

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RV_07_17978	Boggy Creek at Shed Rd near Screven, GA	Satilla	Brunswick AMU	Targeted Monitoring (DO)	31.67742	-82.1214	X				X			X	
RV_07_17979	Boggy Creek at Ingram Rd near Screven, GA	Satilla	Brunswick AMU	Targeted Monitoring (DO)	31.6607	-82.1096	X				X				
RV_07_17980	Unnamed Trib to Cowpen Creek at Fernwood Drive near Brunswick, GA	Satilla	Brunswick AMU	Targeted Monitoring (NH3 Shady Acres)	31.25206	-81.5591	X				X				
RV_07_17981	Unnamed Trib to Cowpen Creek at Oak Grove Island Road near Brunswick, GA	Satilla	Brunswick AMU	Targeted Monitoring (NH3 Shady Acres)	31.24547	-81.559	X				X				
RV_07_17982	Unnamed Trib to Cowpen Creek at Clinton Drive near Brunswick, GA	Satilla	Brunswick AMU	Targeted Monitoring (NH3 Sterling MHP)	31.26395	-81.5548	X				X				
RV_07_17983	Unnamed Trib to Cowpen Creek at Old Jesup Road near Brunswick, GA	Satilla	Brunswick AMU	Targeted Monitoring (NH3 Sterling MHP)	31.25584	-81.5557	X				X				
RV_07_17984	Crooked River near Drizzle Bluff Rd near St. Marys, GA	Satilla	Brunswick AMU	Probabilistic Monitoring	30.83924	-81.6076	X	X			X			X	
RV_07_17985	Tidal Creek off Purvis Creek near Brunswick, GA	Satilla	Brunswick AMU	Probabilistic Monitoring	31.19768	-81.5164	X	X			X			X	
RV_08_3147	Horsepen Creek at County Road 55 near Kingsland, GA	St Marys	Brunswick AMU	Targeted Mentoring (NWQI Request - FC)	30.795	-81.7947	X		X					X	
RV_09_3181	Suwannee River at US Hwy. 441 near Fargo, GA	Suwannee	USGS	Trend Monitoring	30.6806	-82.5606	X		X	X				X	
RV_09_3209	New River - U.S. Highway 82 near Tifton	Suwannee	Tifton AMU	Targeted Mentoring (NWQI Request - E.coli, DO)	31.4425	-83.4758	X		X	X					
RV_09_3212	New River at State Road 76 near Nashville	Suwannee	Tifton AMU	Targeted Monitoring (DO)	31.17694	-83.3222	X			X					
RV_09_3236	Withlacoochee River at Clyattsville-Nankin Road near Clyattsville, GA	Suwannee	USGS	Trend Monitoring	30.67472	-83.3947	X		X	X				X	
RV_09_3278	Hat Creek at CR 35 / Robert Davis Rd	Suwannee	Tifton AMU	Targeted Monitoring (DO)	31.64548	-83.6022	X			X					
RV_09_5075	Big Creek at State Road 135 near Lakeland	Suwannee	Tifton AMU	Targeted Monitoring (DO)	31.04937	-83.0696	X			X					
RV_09_5076	Big Creek at State Road 11 near Lakeland	Suwannee	Tifton AMU	Targeted Monitoring (DO)	31.04304	-83.0627	X			X					

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RV_09_5079	Hat Creek at Airport Road near Ashburn	Suwannee	Tifton AMU	Targeted Monitoring (DO)	31.69145	-83.6329	X			X					
RV_09_5081	Hat Creek at Bussey Road near Sycamore	Suwannee	Tifton AMU	Targeted Monitoring (DO)	31.68003	-83.6252	X			X					
RV_09_16153	New River at Highway 319 near Tifton	Ochlockonee	Tifton AMU	Targeted Monitoring (NWQI Request - E.coli, DO)	31.44869	-83.4827	X		X	X					
RV_09_16154	Trib to New River at Hwy 319	Ochlockonee	Tifton AMU	Targeted Monitoring (NWQI Request - E.coli, DO)	31.45023	-83.4808	X		X						
RV_09_17995	Red Oak Creek at McKenzie Road near Penia, Ga	Ochlockonee	Tifton AMU	Probabilistic Monitoring	31.92852	-83.666	X		X	X	X				
RV_09_17998	New River at Lower Brookfield Road near Tifton	Ochlockonee	Tifton AMU	Targeted Monitoring (DO)	31.414	-83.443	X			X					
RV_10_3384	Tired Creek at County Road 151 near Reno, GA	Ochlockonee	Tifton AMU	Targeted Monitoring (Florida Stateline)	30.76361	-84.2294	X			X					
RV_10_3386	Ochlockonee River at Hadley Ferry Road near Calvary, GA	Ochlockonee	USGS	Trend Monitoring	30.73172	-84.2355	X		X	X				X	
RV_10_3389	Attapulgus Creek at U.S. Hwy 27 near Attapulgus, GA	Ochlockonee	Tifton AMU	Targeted Monitoring (Florida Stateline)	30.73278	-84.4536	X			X					
RV_10_3390	Swamp Creek at US Hwy 27 near Attapulgus, GA	Ochlockonee	Tifton AMU	Targeted Monitoring (Florida Stateline)	30.71944	-84.4114	X			X					
RV_10_3422	Little Attapulgus Creek at Faceville-Attapulgus Rd. near Attapulgus, GA	Ochlockonee	Tifton AMU	Targeted Monitoring (Florida Stateline)	30.75005	-84.5013	X			X					
RV_10_3423	Little Attapulgus Creek at State Rd 241 near Attapulgus, GA	Ochlockonee	Tifton AMU	Targeted Monitoring (Florida Stateline)	30.71806	-84.49	X			X					
RV_11_3485	Flint River at GA 92, above Griffin, GA	Flint	USGS	Trend Monitoring	33.3089	-84.3931	X		X	X				X	
RV_11_3511	Flint River at GA 26, near Montezuma, GA	Flint	USGS	Trend Monitoring	32.29295	-84.0441	X		X	X				X	
RV_11_3553	Flint River at SR 234 near Albany, GA	Flint	USGS	Trend Monitoring	31.5524	-84.1463	X		X	X				X	
RV_11_3558	Flint River at SR 37 at Newton, GA	Flint	USGS	Trend Monitoring	31.30944	-84.335	X		X	X				X	

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RV_11_3563	Flint River at US Hwy. 27-B near Bainbridge, GA	Flint	USGS	Trend Monitoring	30.91095	-84.5805	X		X	X				X	
RV_11_3789	Flint River at Sprewell Bluff Sprewell Bluff State Park	Flint	Atlanta AMU	Trend Monitoring	32.85599	-84.4768	X		X	X	X	X	X		
RV_11_3804	Lime Creek at Springhill Church Road east of Americus, Ga	Flint	Tifton AMU	Trend Monitoring	32.035	-83.9925	X		X	X	X	X	X	X	
RV_11_3807	Little Ichawaynochaway Creek at CR 3 near Shellman, Ga	Flint	Tifton AMU	Trend Monitoring	31.80353	-84.64	X		X	X	X	X	X	X	
RV_11_3823	Swift Creek at Jamestown Road near Warwick, Ga	Flint	Tifton AMU	Targeted Monitoring (E coli	31.83889	-83.8547	X		X						
RV_11_15909	Keg Creek at Georgia Highway 85 near Senoia, GA	Flint	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.30533	-84.5342	X		X		X				
RV_11_17789	Whitewater Creek at Bernhard Rd near Peachtree City, GA	Flint	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.36694	-84.5045	X		X		X				
RV_11_17996	Trib to Flint River D/S of Worthy Manor at Cordele Rd. near Albany, Ga	Flint	Tifton AMU	Targeted Monitoring (SWP WLA)	31.63821	-84.0128	X			X					
RV_11_17997	Trib to Flint River U/S of Worthy Manor at Story Rd. near Albany, Ga	Flint	Tifton AMU	Targeted Monitoring (SWP WLA)	31.6264	-83.9885	X			X					
RV_11_18014	Heads Creek at Vaughn Rd near Griffin, GA	Flint	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.2777	-84.3823	X		X		X				
RV_11_18015	Elkins Creek at Roberts Quarters Rd near Concord, GA	Flint	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.068	-84.4066	X		X		X				
RV_11_18016	Lazer Creek at GA Hwy 36 near Woodland, GA	Flint	Atlanta AMU	Targeted Monitoring (DW Assessment)	32.7597	-84.5648	X		X		X				
RV_11_18018	Sullivan Creek at Edison Dr in Atlanta, GA	Flint	Atlanta AMU	Targeted Monitoring (Dieldrin)	33.62976	-84.4655	X								
RV_12_3841	Chattahoochee River at McGinnis Ferry Road	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	34.05056	-84.0977	X		X		X				
RV_12_3859	Chattahoochee River - DeKalb County Water Intake	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	33.9731	-84.2631	X		X						
RV_12_3870	Chattahoochee River at Cobb County Water Intake near Roswell, GA	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	33.9443	-84.405	X		X						

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RV_12_3891	Chattahoochee River - Atlanta Water Intake	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	33.8278	-84.455	X		X		X				
RV_12_3899	Chattahoochee River at Duncan Bridge Road near Cornelia	Chattahoochee	Cartersville AMU	Targeted Monitoring (E coli)	34.5408	-83.6206	X		X						
RV_12_3902	Chattahoochee River at Belton Bridge Road near Lula, GA	Chattahoochee	USGS	Trend Monitoring (Lake Trib)	34.44515	-83.6842	X		X	X				X	
RV_12_3925	Chestatee River at SR 400 near Dahlonega, GA	Chattahoochee	USGS	Trend Monitoring (Lake Trib)	34.46667	-83.9689	X		X	X				X	
RV_12_3934	Chattahoochee River at Bankhead Highway	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	33.79528	-84.5078	X		X		X				
RV_12_3960	Chattahoochee River at Capps Ferry Road near Rico, GA	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	33.5778	-84.8086	X		X		X				
RV_12_3988	Chattahoochee River - Georgia Hwy 225 near Clarkesville, GA	Chattahoochee	Cartersville AMU	Targeted Monitoring (E coli)	34.6275	-83.6422	X		X						
RV_12_3989	Chattahoochee River at State Road 115 near Leaf, GA	Chattahoochee	Cartersville AMU	Targeted Monitoring (E coli)	34.57694	-83.6358	X		X						
RV_12_4003	Flat Creek at McEver Road near Gainesville, GA	Chattahoochee	USGS	Trend Monitoring (Lake Trib)	34.26583	-83.885	X		X	X				X	
RV_12_4039	New River at SR 100 near Corinth, GA	Chattahoochee	USGS	Trend Monitoring	33.23528	-84.9878	X		X	X				X	
RV_12_4041	Chattahoochee River at US Hwy. 27 near Franklin, GA	Chattahoochee	USGS	Trend Monitoring (Lake Trib)	33.2897	-85.0885	X		X	X				X	
RV_12_4049	Yellow Jacket Creek at Hammet Road near Hogansville, GA	Chattahoochee	USGS	Trend Monitoring (Lake Trib)	33.13917	-84.9753	X		X	X				X	
RV_12_4084	Chattahoochee River downstream from Columbus Water Treatment Facility	Chattahoochee	CWW	Trend Monitoring	32.4089	-84.9803	X		X						
RV_12_4091	Chattahoochee River downstream Oswichee Creek	Chattahoochee	CWW	Trend Monitoring	32.3	-84.9369	X		X						
RV_12_4093	Chattahoochee River at Hichitee Creek (River Mile 127.6)	Chattahoochee	CWW	Trend Monitoring	32.2308	-84.9232	X		X						
RV_12_4094	Chattahoochee River at Spur 39 near Omaha, GA (Seaboard Railroad)	Chattahoochee	USGS	Trend Monitoring (Lake Trib)	32.1436	-85.0453	X			X				X	

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RV_12_4110	Chattahoochee River at SR 91 near Steam Mill, GA	Chattahoochee	USGS	Trend Monitoring	30.9775	-85.0053	X			X				X	
RV_12_4123	Hillabahatchee Creek at CR 210 near Frolona, GA	Chattahoochee	Atlanta AMU	Trend Monitoring	33.31122	-85.1877	X		X	X	X	X	X	X	
RV_12_4280	Big Creek at Roswell Water Intake near Roswell, GA	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	34.01785	-84.3525	X		X	X	X	X	X		
RV_12_4292	Dicks Creek at Forest Service Road 144-1 near Neels Gap, GA	Chattahoochee	USGS	Trend Monitoring	34.6797	-83.9372	X			X				X	
RV_12_4316	Peachtree Creek at Northside Dr in Atlanta, GA	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	33.8194	-84.4078	X		X	X	X	X	X		
RV_12_5156	Turner Creek at US 129 near Cleveland, GA	Chattahoochee	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.61417	-83.7903	X		X						
RV_12_16565	Sandy Creek near Water Works Road near Newnan, GA	Chattahoochee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.35387	-84.8149	X		X		X				
RV_12_17524	Hazel Creek at Double Bridge Rd. near Clarkesville, GA	Chattahoochee	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.585	-83.518	X		X						
RV_12_17578	Sweetwater Creek at Blairs Bridge Rd near Lithia Springs, GA	Chattahoochee	Atlanta AMU	Trend Monitoring (AWW)	33.77454	-84.6146	X		X	X	X	X	X		
RV_12_17688	Trib to Snake Creek near Newnan, GA	Chattahoochee	Atlanta AMU	Targeted Monitoring (Trichlorethylene & pH)	33.39389	-84.8195	X								
RV_12_17988	Chattahoochee River at Riverwalk Trail near Columbus, Ga	Chattahoochee	Tifton AMU	Targeted Monitoring (E coli)	32.49549	-84.995	X		X						
RV_12_17989	Trib to Hitchitee Creek at Riverbend Road near Cusseta, Ga	Chattahoochee	Tifton AMU	Probabilistic Monitoring	32.24058	-84.8396	X		X	X	X				
RV_12_17990	Trib to Hodchodkee Creek at CR 14 near Georgetown, Ga	Chattahoochee	Tifton AMU	Probabilistic Monitoring	31.93982	-84.9944	X		X	X	X				
RV_12_17999	North Mosquito Creek at Smithtown Road near Faceville, Ga	Chattahoochee	Tifton AMU	Probabilistic Monitoring	30.70926	-84.7241	X		X	X	X				
RV_12_18012	Flat Creek @ Hwy 100, near Hogansville, GA	Chattahoochee	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.1432	-84.8421	X		X		X				
RV_12_18013	Chattahoochee River at Chattahoochee Bend State Park boat ramp	Chattahoochee	Atlanta AMU	Targeted Monitoring (E coli recreation)	33.42973	-85.012	X		X						

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
RV_12_18023	Camp Creek at College Dr near Demorest, GA	Chattahoochee	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.5624	-83.5391	X		X						
RV_12_18028	Yahoola Creek at Duffy Grizzle Rd near Dahlonega, GA	Chattahoochee	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.5758	-83.9839	X		X						
RV_13_4349	Little Tallapoosa River at Georgia Hwy. 100 near Bowden, GA	Tallapoosa	USGS	Trend Monitoring	33.49278	-85.2792	X		X	X				X	
RV_13_4350	Turkey Creek at Hwy 100 (Rome St.) near Carrollton, GA	Tallapoosa	Atlanta AMU	Targeted Monitoring (DW Assessment)	33.56538	-85.2513	X		X		X				
RV_13_4353	Tallapoosa River Below Tallapoosa, GA	Tallapoosa	USGS	Trend Monitoring	33.74083	-85.3364	X		X	X				X	
RV_14_4438	Conasauga River at US Hwy. 76 near Dalton, GA	Coosa	USGS	Trend Monitoring	34.783	-84.873	X		X	X				X	
RV_14_4460	Conasauga River at Tilton Bridge near Tilton, GA	Coosa	USGS	Trend Monitoring	34.6667	-84.9283	X		X	X				X	
RV_14_4473	Ellijay River - Georgia Highway 5	Coosa	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.70084	-84.4777	X				X				
RV_14_4475	Elijay River at Goose Island Road near Cherry Log, GA	Coosa	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.78772	-84.4102	X				X				
RV_14_4518	Mountaintown Creek at SR 282 (US Hwy. 76) near Ellijay, GA	Coosa	USGS	Trend Monitoring	34.70338	-84.5398	X		X	X				X	
RV_14_4520	Coosawattee River at Georgia Hwy. 5 near Ellijay, GA	Coosa	USGS	Trend Monitoring	34.6717	-84.5002	X		X	X				X	
RV_14_4526	Talking Rock Creek at Highway 136 near Blaine, GA	Coosa	Cartersville AMU	Probabilistic Monitoring	34.5261	-84.5711	X		X		X				
RV_14_4534	Oostanaula River at Rome Water Intake near Rome, GA	Coosa	USGS	Trend Monitoring	34.2703	-85.1733	X		X	X				X	
RV_14_4549	Etowah River at SR 5 spur near Canton, GA	Coosa	USGS	Trend Monitoring (Lake Trib)	34.23972	-84.4944	X			X				X	
RV_14_4550	Shoal Creek at SR 108 (Fincher Road) near Waleska, GA	Coosa	USGS	Trend Monitoring (Lake Trib)	34.26333	-84.5956	X		X	X				X	
RV_14_4555	Little River at Georgia Hwy. 5 near Woodstock, GA	Coosa	USGS	Trend Monitoring (Lake Trib)	34.1222	-84.5043	X		X	X				X	

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
RV_14_4575	Etowah River at Hardin Bridge near Euharlee, GA	Coosa	Cartersville AMU	Targeted Monitoring (E coli)	34.18886	-84.9251	X		X						
RV_14_4586	Etowah River at Hardin Bridge (FAS 829) near Euharlee, GA	Coosa	USGS	Trend Monitoring	34.18886	-84.9251	X		X	X				X	
RV_14_4622	Coosa River - GA/Alabama State Line Monitor near Cave Springs	Coosa	USGS	Trend Monitoring	34.1983	-85.4439	X			X				X	
RV_14_4640	Chattooga River at Holland-Chattoogaville Road (FAS1363) near Lyerly, GA	Coosa	USGS	Trend Monitoring	34.3356	-85.4453	X		X	X				X	
RV_14_4825	Dozier Creek at Bells Ferry Road near Rome, GA	Coosa	Cartersville AMU	Targeted Monitoring (E coli)	34.32083	-85.1103	X		X						
RV_14_4829	Dykes Creek at Dykes Creek Crossing	Coosa	Cartersville AMU	Trend Monitoring	34.29357	-85.0855	X		X		X	X	X	X	
RV_14_4837	Jones Creek near Jones Creek Rd, Dahlonega, GA	Coosa	Atlanta AMU	Trend Biological Monitoring (SEMN)	34.6024	-84.1506	X			X	X	X	X	X	
RV_14_4851	Noonday Creek at Georgia Hwy. 92 near Woodstock, GA	Coosa	USGS	Trend Monitoring (Lake Trib)	34.08547	-84.5294	X		X	X				X	
RV_14_16660	Conasauga River at Witherow Bridge Rd near Dalton, GA	Coosa	Cartersville AMU	Probabilistic Monitoring	34.81195	-84.8616	X		X		X				
RV_14_18024	Etowah River at Forest Service Rd. 141 near Dahlonega, GA	Coosa	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.6274	-84.1058	X		X						
RV_14_18025	Long Swamp Creek at Cove Rd near Jasper, GA	Coosa	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.4667	-84.4	X		X						
RV_14_18026	Long Swamp Creek at Grandview Rd near Jasper, GA	Coosa	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.4896	-84.3809	X		X						
RV_14_18027	Darnell Creek at Long Swamp Church Rd near Marble Hill, GA	Coosa	Cartersville AMU	Probabilistic Monitoring	34.4619	-84.3534	X		X		X				
RV_14_18029	Tributary to Lick Log Creek at Aaron Road near Ellijay, GA	Coosa	Cartersville AMU	Targeted Monitoring (SWP)	34.634	-84.39	X								
RV_14_18032	Lick Log Creek at Lick Logging Road/Lick Log Lane near Ellijay, GA	Coosa	Cartersville AMU	Targeted Monitoring (SWP)	34.64259	-84.4021	X								
RV_14_18036	Town Branch at Dowdy Park near Summerville, GA	Coosa	Cartersville AMU	Probabilistic Monitoring	34.47909	-85.3468	X		X		X				

Georgia Station Number	Sampling Site	River Basin	Sampling Organization[1]	Waterbody Type/Project	Latitude	Longitude	Routine[2]	Enterococcus	*E. coli*	Orthophosphate s	Metals	Macroinvertebrates[3]	Periphyton[3]	Discharge	Chlorophyll
RV_14_18037	Two Run Creek at Highway 41 near Cassville, GA	Coosa	Cartersville AMU	Probabilistic Monitoring	34.2611	-84.8604	X		X		X				
RV_15_4918	West Chickamauga Creek - Georgia Highway 146 near Ringgold, GA	Tennessee	USGS	Trend Monitoring	34.9572	-85.2056	X		X	X				X	
RV_15_4961	E. Chickamauga Creek at Lower Gordon Springs Rd	Tennessee	Cartersville AMU	Trend Monitoring	34.74717	-85.1243	X		X		X	X	X	X	
RV_15_18030	Unnamed tributary to Hemptown Creek at Old US Hwy 76 near Morganton, GA	Tennessee	Cartersville AMU	Targeted Monitoring (SWP)	34.876	-84.24	X								
RV_15_18031	Unnamed tributary to Hemptown Creek at Forge Mill Road near Morganton, GA	Tennessee	Cartersville AMU	Targeted Monitoring (SWP)	34.893	-84.245	X								
RV_15_18033	Bullard Branch at Michaels Road / Highway 5 near Trenton, GA	Tennessee	Cartersville AMU	Targeted Monitoring (SWP)	34.839	-85.567	X								
RV_15_18034	Lookout Creek at Hwy 136 near Trenton, GA	Tennessee	Cartersville AMU	Targeted Monitoring (E coli & metals)	34.86285	-85.5006	X								
RV_15_18035	Mount Vernon Creek at Lafayette Road near Rocky Face, GA	Tennessee	Cartersville AMU	Targeted Monitoring (SWP)	34.7875	-85.0474	X								

Routine field and chemical parameters include: gage height / tape down or discharge measurement, air temperature, water temperature, dissolved oxygen, pH, specific conductance, turbidity, 5-day BOD, alkalinity, hardness, suspended solids, ammonia, nitrate-nitrite, Kjeldahl nitrogen, total phosphorus, and total organic carbon.

Lakes/estuaries field, chemical and biological parameters include: water depth, secchi disk transparency, photic zone depth, air temperature, depth profiles for dissolved oxygen, temperature, pH, and specific conductance, and chemical analyses for turbidity, specific conductance, 5-day BOD, pH, alkalinity, hardness, suspended solids, ammonia, nitrate-nitrite, Kjeldahl nitrogen, total phosphorus, total organic carbon, and chlorophyll *a.*

[1] **Sampling Organization:** Atlanta WP = GAEPD Atlanta office; Brunswick WP = GAEPD Brunswick Regional office, Cartersville WP = GAEPD Cartersville Regional Office Tifton WP = GAEPD Tifton Regional office.

[2] **Routine field and chemical parameters include:** gage height/tape down or discharge measurement, air temperature, water temperature, dissolved oxygen, pH, specific conductance, turbidity, 5-day BOD, alkalinity, hardness, suspended solids, ammonia, nitrate-nitrite, Kjeldahl nitrogen, total phosphorus, total organic carbon, and fecal coliform.

[3] **Biomonitoring:** conducted for invertebrates and periphyton using Georgia EPD protocols.

2. COASTAL SHELLFISH MONITORING STATIONS

Station Number	Sampling Site	Latitude	Longitude
1049	Southernmost tributary off Romerly Marsh Creek	31.92866	-81.01839
1050	Northern mouth of Habersham Creek	31.92503	-81.0086
1052	Northernmost tributary off Romerly Marsh Creek	31.94317	-81.00914
1152	Old Romerly Marsh Creek	31.92557	-80.9852
1153	Romerly Marsh Creek Chatham	31.92993	-80.98919
1154	Halfmoon River at Beard Creek	31.97741	-80.9679
1155	Tybee Cut South	31.95172	-80.9853
1159	Pa Cooper Creek	31.96792	-80.936
1200	Mouth of House Creek Chatham	31.946	-80.93
1201	North of House Creek/Wassaw Sound Chatham	31.955	-80.933
1222	Cut Oyster Creek to Bull River Chatham	32.015	-80.924
1223	North Fork Oyster Creek Chatham	32.014	-80.916
1224	North Junction Lazaretto & Oyster Creeks Chatham	31.998	-80.912
1225	South Junction Lazaretto & Oyster Creeks Chatham	31.995	-80.91
1337	Bull River upstream of Betz Creek	32.02829	-80.9473
1338	Betz Creek	32.02005	-80.94529
1352	Priest Landing Chatham	31.96058	-81.01186
3242	Medway River Near Sunbury	31.685	-81.296
3249	Halfmoon East	31.686	-81.277
3255	Mouth of Jones Hammock Creek	31.734	-81.194
3273	Bear River across from Newell Creek	31.741	-81.161
3275	Bear River across from Kilkenny	31.771	-81.17
3285	Dickinson Creek Mouth	31.7568	-81.2724
3286	Jones Creek Mouth	31.74765	-81.2541
3288	Medway River East of Sunbury Creek	31.728	-81.22028
3291	Van Dyke Creek Mouth	31.6894	-81.194
3319	Walburg Northwest	31.68713	-81.1563
4092	Eagle Creek, McIntosh	31.51	-81.278
4100	Back River at July Cut	31.53	-81.33
4120	Mud River at Dog Hammock	31.52777	-81.25732
4122	Little Mud River at Barbour Island River	31.59343	-81.2612
4123	Sapelo Sound at Highpoint	31.53432	-81.2243
4175	Old Teakettle Creek, McIntosh	31.442	-81.306
4177	Shellbluff Creek, McIntosh	31.476	-81.332
4178	Creighton Narrows, McIntosh	31.488	-81.323

Station Number	Sampling Site	Latitude	Longitude
4179	New Teakettle Creek, McIntosh	31.485	-81.295
4180	Front River, McIntosh	31.523	-81.291
4184	Juliention River, McIntosh	31.554	-81.314
4185	Little Mud River, McIntosh	31.5636	-81.25778
4186	South Mouth Barbour Island River, McIntosh	31.55775	-81.2329
4187	Middle Barbour Island River, McIntosh	31.593	-81.236
4188	Middle Wahoo River, McIntosh	31.615	-81.214
4190	South Swain River, McIntosh	31.632	-81.224
4191	North Swain River, McIntosh	31.634	-81.237
4195	Todd River, McIntosh	31.56232	-81.21815
4196	Crescent River, McIntosh	31.503	-81.335
4197	Crescent River, South-end of Creighton, McIntosh	31.491	-81.332
4304	Julienton River mouth, McIntosh	31.559	-81.274
4305	Julienton River middle, McIntosh	31.548	-81.308
4306	Four Mile Island southwest, McIntosh	31.539	-81.302
4330	Jolly Creek	31.555	-81.29
4333	South end of Sapelo Island	31.38741	-81.28912
4400	Julienton River, middle, McIntosh	31.557	-81.294
5069	Jointer River Mouth, Glynn	31.055	-81.469
5105	Jointer River - Mac's Basin	31.1	-81.516
5198	Mouth Cedar Creek, Glynn	31.089	-81.479
5199	Jointer River, Glynn	31.08	-81.506
5200	Cobb Creek, Glynn	31.071	-81.483
5322	Jointer Island West, Glynn	31.091	-81.515
5357	Jointer Creek at Sage Dock, Glynn	31.102	-81.527
5358	Jointer Creek upstream of Sage Dock, Glynn	31.106	-81.533
5359	Little Satilla River at Honey Creek, Glynn	31.064	-81.526
6201	Little Satilla River Camden	31.039	-81.491
6210	Cabin Bluff Camden	30.892	-81.512
6212	North Brickhill River, Camden	30.904	-81.461
6213	Delaroche Creek Mouth, Camden	30.863	-81.497
6214	South Brickhill River, Camden	30.85	-81.477
6215	Mouth Black Point Creek, Camden	30.858	-81.541
6216	Crooked River Camden	30.849	-81.542
6217	Crooked River South Camden	30.841	-81.521
6218	South Crooked River Mouth Camden	30.823	-81.498
6300	Cumberland River-Marker #39 Camden	30.927	-81.452
6317	Cumberland River East Shellbine Camden	30.910	-81.485
6318	Delaroche Creek Headwaters Camden	30.861	-81.508

Station Number	Sampling Site	Latitude	Longitude
6323	Brickhill River Upstream 6214 Camden	30.855	-81.467
6343	Brickhill River West Bend, Camden	30.868	-81.485
6344	Mumford Creek at Brickhill River, Camden	30.883	-81.479
6360	Maiden Creek	31.0693	-81.545
6361	Honey Creek	31.0547	-81.539
6411	Downstream from Cabin Bluff @ marker 51A, Camden	30.881	-81.511
6412	Upstream from Delaroche ck @ marker 55, Camden	30.87	-81.499

3. COASTAL BEACH MONITORING STATIONS

Station ID	Beach Name	County	Frequency*
SIN	Saint Simons Island - North Beach at Goulds Inlet	Glynn	Weekly
SIM	Saint Simons Island - Middle Beach (aka East Beach Old Coast Guard Station)	Glynn	Weekly
SIMA	Saint Simons Island - Massengale Park Beach	Glynn	Weekly
SIF	Saint Simons Island - 5th Street Crossover Beach	Glynn	Weekly
SIS	Saint Simons Island - South Beach at Lighthouse	Glynn	Weekly
JICC	Jekyll Island - Clam Creek Beach	Glynn	Quarterly
JIDW	Jekyll Island – Driftwood Beach	Glynn	Weekly
JIN	Jekyll Island - North Beach at Dexter Lane	Glynn	Weekly
JIWY	Jekyll Island - Captain Wylly Road Crossover Beach	Glynn	Weekly
JIM	Jekyll Island - Middle Beach at Convention Center	Glynn	Weekly
JISD	Jekyll Island - South Dunes Picnic Area Beach	Glynn	Weekly
JIS	Jekyll Island - South Beach at 4-H Camp	Glynn	Weekly
JISA	Jekyll Island - St. Andrews Beach	Glynn	Quarterly
BIRP	Blythe Island Sandbar Beach	Glynn	Monthly
REIM	Reimolds Pasture Beach	Glynn	Monthly
SEN	Sea Island - North Beach	Glynn	Monthly
SES	Sea Island - South Beach	Glynn	Monthly
CNBF	Contentment Bluff Sandbar Beach	McIntosh	Monthly
DALL	Dallas Bluff Sandbar Beach	McIntosh	Monthly
TYP	Tybee Island - Polk Street Beach	Chatham	Weekly
TYN	Tybee Island - North Beach at Gulick Street	Chatham	Weekly
TYM	Tybee Island - Middle Beach at Center Terrace	Chatham	Weekly
TYST	Tybee Island - Strand Beach at Pier	Chatham	Weekly
TYS	Tybee Island - South Beach at Chatham Street	Chatham	Weekly
SKID	Skidaway Narrows County Park Beach (aka Butterbean Beach)	Chatham	Monthly
KING	Kings Ferry County Park Beach	Chatham	Quarterly
BOSS	Ossabaw Island – Bradley Point	Chatham	Monthly
SOSS	Ossabaw Island – South Beach	Chatham	Monthly

*Stations sampled monthly are monitored April – October.
Stations sampled weekly are monitored March – October, every other week November-February.

4. DNR STATE PARKS LAKE BEACH MONITORING STATIONS

In 2018 and 2019, the following park beaches are sampled four times during the month of April each calendar year for *E. coli* bacteria to calculate a geometric mean. If the bacterial geometric mean exceeds water quality standards, the beach is not opened in May for public access and sampling continues until the water quality standards are met.
Starting in 2020, the following beaches were sampled weekly during the recreational season. A swim advisory was issued if a single sample exceeded the Beach Action Level of 252 counts/100 mL or the 30-day geomean exceeded the water quality standard of 126 counts/100 mL. If a single sample exceeded the Beach Action Level, they were resampled within the same week.

A.H. Stephens State Park Group Camp Beach	Laura Walker State Park Day Use
Don Carter State Park	Little Ocmulgee State Lodge Park
Elijah Clark State Park	Mistletoe State Park
Fort Mountain State Park	Red Top Mountain State Park and Lodge
Fort Yargo State Park: Day Use Beach	Reed Bingham State Park
George T. Bagby State Park and Lodge	Richard B. Russell State Park
Georgia Veterans State Park	Rocky Mountain Public Fishing Area
Hard Labor Creek State Park: Camp Rutledge Beach	Seminole State Park
Hard Labor Creek State Park: Camp Daniel Morgan Beach	Tallulah Gorge State Park
Hard Labor Creek State Park: Day Use Camp Beach	Tugaloo State Park
Kolomoki Mound State Park	Unicoi State Park Day Use Beach
Laura S. Walker State Park Boat Ramp	Vogel State Park

5. GROUNDWATER MONITORING WELLS

Well ID	Well Name	Owner	Address	Aquifer	Well Depth (ft.)	Year Monitored
GW_05_2766	Unadilla #3	City of Unadilla	P.O. Box 307 Unadilla, GA 31091	Claiborne	315	2022-2023
GW_11_2466	Flint River Nursery Office Well	Flint River State Nursery	9850 River Road Byromville, GA 31007	Claiborne	90	2022-2023
GW_11_2673	Plains Well #8	Water and Sewer City of Plains	P.O. Box 190 Plains, GA 31780	Claiborne	230	2022-2023
GW_11_2791	Weathersby house well	Randy & Judi Weathersby		Clayton	80	2022-2023
GW_11_5032	Briar Patch MHP Well	David Miller		Clayton	Currently Unknown	2022-2023
GW_11_5033	City of Andersonville Well #1	Jim Copeland		Clayton	230	2022-2023
GW_11_17617	Dawson Crawford Street Well	City of Dawson	PO Box 190 Dawson, GA 39842	Clayton	367	2022-2023
GW_11_17618	Cuthbert Well #3	City of Cuthbert	PO Box 100 Cithbert, GA 39840	Clayton	355	2022-2023
GW_01_2523	Hephzibah/Murphy Street Well	City of Hephzibah	Hephzibah City Hall P.O. Box 250 Hephzibah, GA 30815-0250	Cretaceous	484	2022-2023
GW_01_15178	City of Keysville Well #1	City of Keysville	P.O. Box 159 Keysville, GA 30816-0159	Cretaceous	Currently Unknown	2022-2023
GW_02_2704	Sandersville Well #7B	City of Sandersville	Sandersville Annex Building 110 South Hospital Rd. Sandersville, GA 31082	Cretaceous	697	2022-2023
GW_02_15200	Town of Mitchell Municipal Well #3	Town of Mitchell	P.O. Box 32 Mitchell, GA 30820	Cretaceous	Currently Unknown	2022-2023
GW_03_17616	Irwinton Well #4	City of Irwinton	PO Box 359 Irwin, GA 31042	Cretaceous	400	2022-2023
GW_05_2474	Fort Valley Well #6	Fort Valley Utility Commission	P.O. Box 1529 Fort Valley, GA 31030	Cretaceous	600	2022-2023
GW_05_2560	Jones County #4	Jones County Water System	Jones County Water System 270 Highway 49 Macon, GA 31211	Cretaceous	128	2022-2023
GW_05_2564	KaMin Well #6	KaMin, LLC.	822 Huber Road Macon, GA 31217	Cretaceous	400	2022-2023
GW_05_2669	Perry/Holiday Inn Well	City of Perry	ESG, Inc. P.O. Box 2030 Perry, GA 31069	Cretaceous	550	2022-2023
GW_05_2778	Warner Robins #2	City of Warner Robins	ESG, Inc. 202 North Davis Dr., PMB 718 Warner Robins, GA 31093	Cretaceous	~540	2022-2023
GW_11_2607	Marshallville Well #2	Marshallville Water and Sewer Dept.	111 Main Street West Marshallville, GA 31057	Cretaceous	550	2022-2023
GW_11_2672	Plains Well #7	Water and Sewer City of Plains	P.O. Box 190 Plains, GA 31780	Cretaceous	1000	2022-2023
GW_11_5030	Unimin Well #1	Unimin Georgia Co., LLC	1333 Sandpit Rd. Mauk, GA 31058	Cretaceous	150	2022-2023
GW_11_5031	Whitewater Creek Well	Whitewater Creek Park	165 Whitewater Rd. Oglethorpe, GA 31068	Cretaceous	Currently Unknown	2022-2023
GW_12_5037	Camp Darby Well near Cussetta, GA	Columbus Water Works	P.O. Box 1600 Columbus, GA 31902-1600	Cretaceous	Currently Unknown	2022-2023
GW_12_5046	Louvale Community Well	Stewart County. Water. & Sewer	P.O. Box 157 Lumpkin, GA 31815-0157	Cretaceous	Currently Unknown	2022-2023

		Authority				
GW_12_17615	Georgetown Well #3	Quitman County	Georgetown Public Works PO Box 297 Georgetown, GA 31754	Cretaceous	Currently Unknown	2022-2023
GW_01_2763	Tybee Island #1	City of Tybee Island	City of Tybee Island Water & Sewer Dept. Tybee Island, GA 31328	Floridan	402	2022-2023
GW_02_2526	Hinesville #5	City of Hinesville	CH2MHILL-OMI/Hinesville 613 E.G. Miles Parkway Hinesville, GA 31313	Floridan	806	2022-2023
GW_02_2546	Interstate Paper #1	Interstate Paper, LLC	Interstate Paper, LLC 2366 Interstate Road Riceboro, GA 31323-3933	Floridan	810	2022-2023
GW_02_2615	Metter #2	City of Metter	Metter Public Works Dept P.O. Box 74 Metter, GA 30439	Floridan	540	2022-2023
GW_02_2620	Millen #1	City of Millen	919 College Ave. Millen, GA 30442-1633	Floridan	500	2022-2023
GW_02_2707	Savannah #13	City of Savannah	208 Agonic Rd. Savannah, GA 31406	Floridan	1004	2022-2023
GW_02_2736	Statesboro #4	City of Statesboro	Hill St. at Mulberry St. (office/shop) P.O. Box 348 Statesboro, GA 30459	Floridan	413	2022-2023
GW_02_2741	Swainsboro #7	City of Swainsboro	(ofc) CH2M Hill 574 Industrial Way Swainsboro, GA 30401	Floridan	260	2022-2023
GW_02_5005	Sapelo Gardens S/D #1	South Atlantic Utilities, Inc.	P.O. Box 13705 Savannah, GA 31416-3705	Floridan	660	2022-2023
GW_02_5006	Hampton River Marina	Hampton River Marina	1000 Hampton Pointe Drive St Simons Island GA 31522	Floridan	750	2022-2023
GW_05_2450	Eastman #4	City of Eastman	Eastman City Hall 410 Main Street Eastman, GA 31023	Floridan	410	2022-2023
GW_05_2611	McRae Well #3	City of McRae	McRae City Hall P.O. Box 157 McRae, GA 31055-0157	Floridan	600+	2022-2023
GW_05_17478	McRae Well #1	City of McRae	McRae City Hall P.O. Box 157 McRae, GA 31055-0157	Floridan	Currently Unknown	2022-2023
GW_05_17479	McRae Well #2	City of McRae	McRae City Hall P.O. Box 157 McRae, GA 31055-0157	Floridan	Currently Unknown	2022-2023
GW_05_17480	McRae Well #4	City of McRae	McRae City Hall P.O. Box 157 McRae, GA 31055-0157	Floridan	Currently Unknown	2022-2023
GW_06_2772	Vidalia #1	City of Vidalia	ESG, Inc., 111 Brinson Rd. Vidalia, GA 30474	Floridan	808	2022-2023
GW_07_2561	Jowers Crossing (Well #2)	City of Ambrose	96 Curtis Vickers Road Ambrose, GA 31512	Floridan	600	2022-2023
GW_07_2623	Miller Ball Park North East Well	Glynn County Board of Education	200 Emory Dawson Road Brunswick, GA 31520	Floridan	1211	2022-2023
GW_07_2785	Waycross #3	City of Waycross	ESG, Inc. P.O. Drawer 99/512 Alice Street. Waycross, GA 31502-0099	Floridan	775	2022-2023
GW_07_5024	Hofwyl-Broadfield Well	Hofwyl-Broadfield Plantation Historic Site	5556 US Highway 17N Brunswick, GA 31525	Floridan	Currently Unknown	2022-2023

GW_07_5025	Jekyll Island	City of Jekyll Island	100 James Road Jekyll Island GA 31527	Floridan	850	2022-2023
GW_07_5026	Ft. Morris Well	Ft. Morris Historic Site	2559 Fort Morris Road Midway, GA 31320	Floridan	500	2022-2023
GW_09_2308	Adel #6	City of Adel	City of Adel Water & Sewer Dept. 404 Poplar St. Adel, GA 31620	Floridan	405	2022-2023
GW_09_2580	Lakeland #2	City of Lakeland	Lakeland City Hall 64 South Valdosta Road Lakeland, Georgia 31635	Floridan	340	2022-2023
GW_09_2639	Moultrie #1	City of Moultrie	2701 1st Ave. SE P.O. Box 3368	Floridan	750	2022-2023
GW_09_2653	Ocilla #3	City of Ocilla	P.O. Box 626 Ocilla, GA 31774-0626	Floridan	637	2022-2023
GW_09_2743	Sycamore #2	City of Sycamore	Sycamore City Hall 2529 US Highway 41 Sycamore, GA 31790- 2201	Floridan	501	2022-2023
GW_09_2746	Sylvester #1	City of Sylvester	Sylvester Water, Gas, & Light Dept. P.O. Box 370 Sylvester, GA 31791-0370	Floridan	196	2022-2023
GW_09_2756	Tifton #6	City of Tifton	80 Old Brookfield Rd P.O. Box 229 Tifton, GA 31793	Floridan	652	2022-2023
GW_09_5015	Ashburn #4	City of Ashburn	Ashburn Water Department 291 Mill St. Ashburn, GA 31714	Floridan	600	2022-2023
GW_10_2425	Davis Ave. (Well #1)	City of Whigham	P.O. Box 71 Whigham, GA 39897	Floridan	604	2022-2023
GW_10_2753	Thomasville #6	City of Thomasville	Mr. Bill Gerber 411 W. Jackson Street Thomasville, GA 31792	Floridan	400	2022-2023
GW_10_5029	Waverly/Four Corners #1	City of Thomasville	P.O. Box 1540 Thomasville, GA 31799- 1540	Floridan	900	2022-2023
GW-10_17585	Cairo #11	City of Cario	Cairo City Hall P.O. Box 29 Cairo, GA 39828	Floridan	450	2022-2023
GW_11_2376	Camilla Ind. Pk. Well	City of Camilla	P.O. Box 328 Camilla, GA 31730	Floridan	360	2022-2023
GW_11_2433	Donalsonville / 7th St. Well	City of Donalsonville	P.O. Box 308 Donalsonville, GA 31745	Floridan	174	2022-2023
GW_11_16636	Smith House Well	Gerald Smith	7983 Malone Drive Donalsonville, GA 31745	Floridan	Currently Unknown	2022-2023
GW_11_16637	Radium Spring	City of Albany	2501 Radium Springs Rd Albany, GA 31705	Floridan	0	2022-2023
GW_01_2383	Cecchini Bored Well	Mr. Charles Cecchini		Piedmont/ Blue Ridge	47	
GW_01_2384	Cecchini Deep Well	Mr. Charles Cecchini		Piedmont/ Blue Ridge	400	2022-2023
GW_01_2465	Fizer well	Mr. Alan Fizer	1079 Oak Ct. Lincolnton, GA 30817	Piedmont/ Blue Ridge	220	2022-2023
GW_01_2627	Mistletoe SP Cottage Area Well	Ga. DNR Parks & Historic Sites	Mistletoe State Park 3725 Mistletoe Road Appling, GA 30802	Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_01_2645	Mt Airy City Hall Well	City of Mt Airy	P.O. Box 257 Mt Airy, GA 30563-0257	Piedmont/ Blue Ridge	500	2022-2023
GW_01_2655	O’Connor house well	Dr. Bruce O'Connor		Piedmont/ Blue Ridge	150	2022-2023
GW_01_4993	Beaverdam MHP #1	Ms. Toronnia Stephens		Piedmont/Blue Ridge	250	2022-2023
GW_01_4994	Victoria Bryant SP #101	Victoria Bryant State Park	1105 Bryant Park Road Royston, GA 30662	Piedmont/Blue Ridge	320	2022-2023

GW_01_4999	Windy Acres MHP #1	Windy Acres Mobile Home Park	630 South Old Belair Rd. Lot 30 Grovetown, GA 30813	Piedmont/Blue Ridge	180	2022-2023
GW_01_4997	City of Ila Well #1	City of Ila	P.O. Box 46 Ila, GA 30647-0046	Piedmont/Blue Ridge	650	2022-2023
GW_01_5000	Lake Harbor Shores #4	Lake Harbor Shores	433 Seminole Trail Martin, GA 30557	Piedmont/Blue Ridge	380	2022-2023
GW_01_5003	City of Rayle Well #1	Town of Rayle	PO Box 67, Rayle GA 30660-0067	Piedmont/Blue Ridge	Currently Unknown	2022-2023
GW_01_15196	Grovetown Municipal Well #1	City of Grovetown	PO Box 120 Grovetown, GA 30813-0120	Piedmont/Blue Ridge	600	2022-2023
GW_01_15197	Harlem Municipal Well #4	City of Harlem Public Works	PO Box 99, 320 N Louisville Road Harlem, GA 30814-0099	Piedmont/Blue Ridge	250	2018-2021
GW_01_15198	Tradewinds Marina well	Tradewinds Marina	5577 Marina Parkway Appling, GA 30802	Piedmont/Blue Ridge	60	2022-2023
GW_01_15732	Wilson Family Well	Roger Wilson		Piedmont/ Blue Ridge	80	2022-2023
GW_01_17637	Gold Mine Landing Well	Gold Mine Landing	Clayton, GA 30525	Piedmont/Blue Ridge	Currently Unknown	2022-2023
GW_02_5008	Hamburg State Park	Hamburg State Park	6071 Hamburg State Park Road Mitchell, GA 30820	Piedmont/Blue Ridge	340	2022-2023
GW_03_2357	Bragg Well	City of Gray	Gray City Hall P.O. Box 443 Gray, GA 31032-0443	Piedmont/ Blue Ridge	405	2022-2023
GW_04_2047	Siloam #2	City of Siloam	P.O. Box 9 Siloam, GA 30665	Piedmont/ Blue Ridge	300	2022-2023
GW_04_5016	Love is Love Farm Well	East Lake Commons	East Lake Commons 900 Dancing Fox Rd. Decatur, GA 30032	Piedmont/ Blue Ridge	300	2022-2023
GW_05_2540	Indian Spring	Ga. DNR Parks & Historic Sites	Indian Springs State Park 678 Lake Clark Road Flovilla , GA 30216	Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_05_2541	Indian Springs New Main Well	Ga. DNR Parks & Historic Sites	Indian Springs State Park 678 Lake Clark Road Flovilla , GA 30216	Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_05_5017	Jarrell Plantation Staff House Well	Ga. DNR Parks & Historic Sites	695 Jarrell Plantation Road Juliette, GA 31046	Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_05_17465	Reeves House Well	Ms. Collie Reeves	1129 Crawford Road Barnesville, GA 30204	Piedmont/Blue Ridge	445	2022-2023
GW_11_2487	Gay #1	City of Gay	18762 Highway 85 P.O. Box 257 Gay, GA 30218-0257	Piedmont/ Blue Ridge	600	2022-2023
GW_11_2600	Well #3	City of Luthersville	104 Wortham Rd. P.O. Box 10 Luthersville, GA 30251-0010	Piedmont/ Blue Ridge	185	2022-2023
GW_11_2748	The Gates #1	Mr. Derek Bunch		Piedmont/ Blue Ridge	705	2022-2023
GW_11_5035	Country Village SD Well#13	SOS Enterprises	205 East Gordon Street Thomaston GA 30266	Piedmont/Blue Ridge	Currently Unknown	2022-2023
GW_11_16635	Lone Oak Well	Mr. Derek Bunch		Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_11_17619	Warm Spring at FD Roosevelt SP	Ga. DNR Parks & Historic Sites	FD Roosevelt State Park BOX 2970 Hwy 190 East Pine Mountain, GA 31822	Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_11_17962	Hampton #6	City of Hampton	233 Richard Petty Blvd Hampton GA 30228	Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_12_2468	Flowery Branch Well #1	City of Flowery Branch	Flowery Branch Water & Sewer Dept. P. O. Box 757 Flowery Branch, GA	Piedmont/ Blue Ridge	240	2022-2023

			30542			
GW_12_2532	Rahbar house well	Mr. Bijan Rahbar		Piedmont/ Blue Ridge	200	2022-2023
GW_12_2700	Roopville #1	City of Roopville	284 S. Old Highway 27 P.O. Box 165 Roopville, Georgia 30170	Piedmont/ Blue Ridge	230	2022-2023
GW_12_2740	Suwanee #1	Suwanee Public Works Division	330 Town Center Avenue Suwanee, GA 30024	Piedmont/ Blue Ridge	600	2022-2023
GW_12_5041	Well #1 Leisure Lake Village	Leisure Lake Condo Association	PO Box 1706 Gainesville, GA 30503-1706	Piedmont/Blue Ridge	380	2022-2023
GW_12_5042	Valley Inn and RV Park Well	VIOH, LLC	524 South Main Avenue Pine Mountain, GA 31822	Piedmont/Blue Ridge	Currently Unknown	2022-2023
GW_12_5043	FD Roosevelt Spring	FD Roosevelt State Park	2970 Highway 190 East Pine Mountain, GA 31822	Piedmont/Blue Ridge	Currently Unknown	2022-2023
GW_12_5049	Sweetwater Coffeehouse	Sweetwater Coffeehouse	P.O. Box 381 Sautee Nacoochee, GA 30571	Piedmont/Blue Ridge	Currently Unknown	2022-2023
GW_14_2650	Nix Spring	Chatsworth Water Works Commission	P.O. Box 100 Chatsworth, GA 30705	Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_14_5050	Willow Court Well	Mr. Derek Bunch		Piedmont/ Blue Ridge	220	2022-2023
GW_14_17589	Jasper Spring	Public		Piedmont/Blue Ridge	0	2022-2023
GW_14_17638	Jacobs House Well	Tommy Jacobs		Piedmont/Blue Ridge	Currently Unknown	2022-2023
GW_14_17739	Voudy House Well	Christine Voudy	335 Bethesda Trail Ball Ground GA 30107	Piedmont/ Blue Ridge	525	2022-2023
GW_15_2806	Young Harris Swanson Road Well	Young Harris Water Department	P.O. Box 122 Young Harris, GA 30582	Piedmont/ Blue Ridge	265	2022-2023
GW_15_5052	Brasstown Bald Spring	USFS Brasstown Ranger District	2042 Highway. 515 W, Blairsville, GA 30512	Piedmont/Blue Ridge	Currently Unknown	2022-2023
GW_15_5053	Bryant Cove SD Well #2	Appalachian Water Inc	PO Box 2381 Blairsville GA 30514	Piedmont/Blue Ridge	605	2022-2023
GW_15_17462	Young Harris College Well	Young Harris Water Department	P.O. Box 122 Young Harris, GA 30582	Piedmont/ Blue Ridge	Currently Unknown	2022-2023
GW_15_17742	Young Harris Main St. Well	City of Young Harris	PO Box 122 Young Harris, GA 305	Piedmont/Blue Ridge	Unknown	2022-2023
GW_15_17759	Willer House Well	Gary Willer	81 Dallas Collins Rd Blairsville, GA 30512	Piedmont/Blue Ridge	Unknown	2022-2023
GW_01_2801	Wrens #4	City of Wrens	415 W. Walker Street Wrens, GA 30833	Jacksonian	200	2022-2023
GW_01_2803	Wrightsville #4	City of Wrightsville	2566 East Elm Street Wrightsville, GA 31096	Jacksonian	520	2022-2023
GW_02_2562	Kahn House Well	Lee and Thelma Kahn		Jacksonian	40	2022-2023
GW_02_2610	McNair House Well	Bob and Ann McNair		Jacksonian	~90	2022-2023
GW_02_15202	City of Bartow Municipal Well #1	City of Bartow	PO Box 248 Bartow, GA 30413	Jacksonian	345	2022-2023
GW_02_17261	Henley 1 Lousiville	Geneda Henley	1082 Darisaw Circle Louisville, GA 30434	Jacksonian	~90	2022-2023
GW_02_17262	Henley 2 Bartow	Geneda Henley	1082 Darisaw Circle Louisville, GA 30434	Jacksonian	~90	2022-2023
GW_05_2398	Cochran #3	City of Cochran	Cochran City Hall 108 NE Dyke Street Cochran, Georgia 31014	Jacksonian	307	2022-2023
GW_06_5019	City of Harrison Well #1	Town of Harrison	P.O. Box 31 Harrison, GA 31035-0031	Jacksonian	Currently Unknown	2022-2023
GW_06_5020	City of Riddleville Well #1	City of Riddleville	9019 Highway 242 Harrison, GA 31035	Jacksonian	330	2022-2023
GW_01_2730	Springfield Egypt Road Test Well	Ga. DNR & Effingham County Engineer	601 North Laurel Street Springfield, GA 31329	Miocene	120	2022-2023
GW_02_5009	Liberty County East District Fire Station	Liberty County	2630 Fort Morris Rd Midway, GA 31320	Miocene	400	2022-2023

GW_06_5021	Raintree TP Main Well	Raintree Trailer Park	669 Spring Grove Rd. Jesup, GA 31545	Miocene	400	2022-2023
GW_09_2310	McMillan House Well	Mr. Willie McMillan		Miocene	220	2022-2023
GW_09_2354	Boutwell House Well	Mr. Stacey Boutwell		Miocene	70	2022-2023
GW_10_2373	Calhoun House Well	Ms. LaRue Calhoun		Miocene	150	2018-2021
GW_10_2646	Murphy Garden Well	Ms. Dartha Murphy		Miocene	22	2022-2023
GW_11_2350	Blakely Well #4	City of Blakely	Blakely Water Treatment Dept. P.O. Box 350 Blakely, GA 39823	Providence	1025	2022-2023
GW_11_2676	Preston Well #4	Unified Government of Webster County	P.O. Box 29 Preston, GA 31824	Providence	205	2022-2023
GW_11_5036	Weston Well #1	Chris Shannon		Providence	Currently Unknown	2022-2023
GW_12_2473	Fort Gaines Well #2	City of Ft. Gaines	Fort Gaines City Hall P.O. Box 251 Fort Gaines, GA 39851-0251	Providence	456	2022-2023
GW_12_5047	Providence Canyon SP well	Providence Canyon State Park	218 Florence Rd. Omaha, GA 31821	Providence	Currently Unknown	2022-2023
GW_14_2385	Cedartown Spring	Cedartown Water/Wastewater Dept.	P.O. Box 65 Cedartown, GA 30125-0065	Ridge & Valley	Currently Unknown	2022-2023
GW_14_2460	Eton Spring	Chatsworth Water Works Commission	P.O. Box 100 Chatsworth, GA 30705	Ridge & Valley	Currently Unknown	2022-2023
GW_14_2570	Kingston Rd. Well	Floyd County Water Dept.	Floyd County Water Dept. P.O. Box 1169 Rome, GA 30162-1169	Ridge & Valley	280	2022-2023
GW_14_2576	LaFayette Lower Big Spring	Lafayette Water Department	Lafayette Water Department P.O. Box 89 Lafayette, GA 30728	Ridge & Valley	Currently Unknown	2022-2023
GW_14_2725	South Well	Chemical Products Corp.	Chemical Products Corp. P.O. Box 2470 Cartersville, GA 30120	Ridge & Valley	300	2022-2023
GW_14_17588	Cave Spring	City of Cave Spring	PO Box 365 Cave Springs, GA 30124	Ridge & Valley	Currently Unknown	2022-2023
GW_15_2414	Crawfish Spring	City of Chickmauga	Water Dept., City of Chickamauga P.O. Box 369 Chickamauga, GA 30707	Ridge & Valley	Currently Unknown	2022-2023

Standard field parameters include: water temperature, dissolved oxygen, pH, specific conductance.
Standard chemical parameters include: VOCs, chloride, sulfate, nitrate-nitrite, phosphorus, chromium, nickel, copper, zinc, arsenic, selenium, molybdenum, silver, cadmium, tin, antimony, barium, thallium, lead, uranium, aluminum, beryllium, calcium, cobalt, iron, potassium, magnesium, manganese, sodium, titanium, vanadium, fluorine.

6. PARAMETERS FOR FISH TISSUE TESTING PROGRAM

Antimony	a-BHC	Heptachlor
Arsenic	b-BHC	Heptachlor Epoxide
Beryllium	d-BHC	Toxaphene
Cadmium	g-BHC (Lindane)	PCB-1016
Chromium, Total	Chlordane	PCB-1221
Copper	4,4-DDD	PCB-1232
Lead	4,4-DDE	PCB-1242
Mercury	4,4-DDT	PCB-1248
Nickel	Dieldrin	PCB-1254
Selenium	Endosulfan I	PCB-1260
Silver	Endosulfan II	Methoxychlor
Thallium	Endosulfan Sulfate	HCB
Zinc	Endrin	Mirex
Aldrin	Endrin Aldehyde	Pentachloroanisole
		Chlorpyrifos

7. MUNICIPAL/INDUSTRIAL WATER POLLUTION CONTROL FACILITIES COMPLIANCE SAMPLING INSPECTION SCHEDULE (INDUSTRIAL PRETREATMENT FACILITIES)

Facility	Pretreatment Permit	Year Sampled	Facility	Pretreatment Permit	Year Sampled
Aluminum Finish. Pl. 1	GAP050065	2023	Graphic Packaging	GAP050182	2023
American Egg Products	GAP050237	2023	Herty Advanced Materials	GAP050302	2023
American Railcar Ind.	GAP050286	2023	Howard Sheppard	GAP050252	2023
Ameripride Services (114)	GAP050114	2023	Howard Sheppard (Sandersville)	GAP050317	2023
Ameripride Uniform Services (278)	GAP050278	2023	Interfor U.S. Inc. - Perry Division	GAP050307	2023
Augusta Coating & Manufacturing	GAP050318	2023	JAC Products	GAP050328	2023
Bensons Bakery	GAP050285	2023	JCB, Inc.	GAP050228	2023
Blue Sky Biomass	GAP050126	2023	Jinsung Georgia	GAP050291	2023
Browning Metal Fin.	GAP050279	2023	Kerry Banks Crossing Facility	GAP050325	2023
BTD (311) Dawsonville	GAP050311	2023	KIA Motors Manuf.	GAP050268	2023
BWAY Corp	GAP050016	2023	KOYO Bearings (Cairo)	GAP050028	2023
Cal Maine Foods	GAP050238	2023	KOYO Bearings (Sylvania)	GAP050008	2023
Cartwright Industries	GAP050298	2023	Kubota Industrial Equipment	GAP050263	2023
Chicken of the Sea	GAP050315	2023	Langboard MDF	GAP050245	2023
Coastal Processing	GAP050305	2023	Lanza Tech. Freedom	GAP050299	2023
D.L. Lee & Sons	GAP050130	2023	Latexco (Lavonia)	GAP050277	2023
Diamond Crystal	GAP050234	2023	Lawter (Hexion)	GAP050056	2023
DRT America	GAP050304	2023	Lexington Components	GAP050319	2023
Duramatic Products	GAP050051	2023	M F & H Textiles	GAP050011	2023
Dynamic Paint Solutions	GAP050308	2023	M.I. Metals Inc. Millen	GAP050309	2023
Edwards Interiors (Rincon)	GAP050324	2023	Miller Transport	GAP050134	2023
Firth Rixson Forgings	GAP050310	2023	Mission Foods	GAP050209	2023
Fries Farms, LLC - Tattnall Hatchery	GAP050320	2023	N.W. Fries (Sylvania Debone)	GAP050334	2023
Georgia Pacific (Warrenton)	GAP050312	2023	Owens Corning Savannah Roofing	GAP050166	2023
Glennville Hatchery	GAP050243	2023	Pilgrim’s Pride (Elberton)	GAP050073	2023
Gold Creek Foods	GAP050270	2023	Precision Protective Coatings	GAP050297	2023

Facility	Pretreatment Permit	Year Sampled	Facility	Pretreatment Permit	Year Sampled
Golden Peanut	GAP050265	2023	Price Industries of Winder	GAP050326	2023
QualaWash Holdings	GAP050300	2023	Atlanta R.M. Clayton WRC	GA0039012	2023
Sandler Nonwoven Corp	GAP050344	2023	GA Power Plant Hammond	GA0001457	2023
Shaw Industries (Decatur Co.)	GAP050140	2023	GA Power Vogtle Plant, Units 1 & 2	GA0026786	2023
SK Battery America	GAP050342	2023	GA Power Vogtle Plant, Units 3 & 4	GA0039420	2023
SNF Holding Company	GAP050246	2023	International Paper Company (Rome)	GA0001104	2023
Southern States	GAP050136	2023	Lockheed Martin Aeronautics	GA0001198	2023
Synergy Recycling	GAP050303	2023	Olin Corporation	GA0003719	2023
Tricorn USA, Inc.	GAP050323	2023			
Trojan Battery	GAP050266	2023			
Venus Thread	GAP050146	2023			
Verescence	GAP050251	2023			
Wind River Environmental	GAP050269	2023			
YKK AP America	GAP050119	2023			

APPENDIX E

Example Forms

1. **Example Sample Label**
2. **Chain of Custody Record - AMU**
3. **Chain of Custody Record - FMU**
4. **Monitoring Audit Report Form**

1. Example Sample Label

Facility/Site Name:____

Station ID ____

Date: ___________________________ Time: _______________________

Sample Type: Influent__________ Effluent ___________ Surface Water ________

Analyses: Inorganic ___________ Organic _____________ Metals ___________

Collector's Name: ______________________________________

SPECIAL INSTRUCTIONS/NOTES:
____

2. CHAIN OF CUSTODY RECORD - AMU

GA Department of Natural Resources

EPD Laboratory
5804 Peachtree Corners East
Norcross, GA 30092

000000000
000000000

Collected By:_________________________________

Office	Date Collected (m m d d y y y y)	Time	Monitor Location Number	QA/QC	Project Office Codes

Project: ____
Site: ____

Field Data

PARAMETER		Value
H2O Temperature	deg. C	
Air Temperature	deg. C	
Sp. Conductance	umho/cm	
Dissolved Oxygen	mg/L	
pH	units	
Depth	ft.	
Gage Height	ft.	
Photic Zone	m.	
Secchi Disk	m.	
Tapedown	ft.	
Stream Flow	cfs	
Salinity	mg/mL	
Turbidity	NTU	
Chlorophyll filtration volume	mL	

Laboratory Data:

	PARAMETER	
	Ammonia	mg/L (N)
	Biochemical Oxygen Demand	mg/L
	Conductivity	umho/cm
	Laboratory pH	units
	Nitrate/ Nitrite	mg/L (N)
	Suspended Solids	mg/L
	Total Alkalinity (pH 4.5)	mg/L, CaCO3
	Total hardness by ICP	mg/L, CaCO3
	Total Kjeldahl Nitrogen	mg/L (N)
	Total Organic Carbon	mg/L
	Total Phosphorous	mg/L (P)
	Turbidity	NTU
	Metals Scan (TMDL)	
	Ortho-Phos	
	Pesticides (chlorinated)	
	E. coli	MPN/100mL
	Chlorophyll-a (non-acidified)	
	Volatile Organic Compounds	

U	Parameter Code	
	Chloride	mg/L
	Sulfate	
	Metals ICP	
	Metals ICMP (U and As)	
	Fluoride	
	Oil and Grease (HEM)	
	Color	PCU
	E. coli	MPN/100mL
	Anions	
	Total Dissolved Solids	mg/L
	Nitrite Nitrogen	mg/L
	Nitrate Nitrogen	mg/L
	Silica	mg/L
	Total Dissolved Solids	mg/L
	Mercury	mg/L
	Benthic Chl a	

Type & Number of Samples:	Delivered by & Date:	Received by & Date:	**Comments:**

Laboratory Sample Label

For Laboratory Use ONLY

Preservative Confirmed
pH <2 ______ > 12_____
Temp ____________

_____ Half Gallons ____ Amber Bottles _____ Sulfides
_____ Nutrients ____ Cyanide ____ Oil and Grease
_____ FCOL Bottles ____ Sulfates ____ OPHOS
_____ Metal Bottles ____ VOC Vials ____ Chlorophyll

3. Chain of Custody Record – FMU

COLLECTED BY:_________________________________

AWS87P322

LAB	LAB NUMBER	DATE COLL (mm/dd/yy)	TIME		QA/QC	PROJECT OFFICE CODES
					___ BLANK	WPCP FMU - 7 MLK Jr. Drive, Suite 450
					___ REPLICATE	

PROJECT:	Composite Date/Tim -
SAMPLE SITE DESCRIPTION:	Grab Date/Time -

FIELD DATA:

PARAMETER	STORET CODE	Value
H2O Temperature deg. C	00010	
Air Temperature deg. C	00020	
Sp. Conductivity umho/cm	00094	
Dissolved Oxygen mg/L	00300	
pH Std. Units	00400	
Depth ft	00003	
Gage Height ft	00065	

LABORATORY DATA:

	PARAMETER	STORET CODE	Grab or Composite	Grab Time
	Turbidity NTU	00076		
	Color PCU	00080		
	Specific Cond. umho/cm	00095		
	BOD – 5-day mg/L	00310		
	pH Units	00403		
	Tot. Alkalinity mg/L CaCO3	00410		
	Hardness mg/L CaCO3	00900		
	Suspended Solids mg/L	00530		
	Tot. Dissolved Solids mg/L	70300		
	Ammonia mg/L (N)	00610		
	Nitrate + Nitrite mg/L (N)	00630		
	Tot. Kjeldahl Nitrogen mg/L (N)	00625		
	Tot. Phosphorous mg/L (P)	00665		
	Chloride mg/L	00940		
	COD mg/L	00335		
	Tot. Organic Carbon mg/L	00680		
	E. coli MPN/100mL	31615		

* Laboratory pH

	PARAMETER	Grab or Composite	Grab Time
	Metals (MPP DL)		
	Mercury		
	Semi-Volatiles		
	VOCs		
	Pesticides		
	PCBs		
	Ortho Phosphorus		
	Cyanide (Total)		
	Oil and Grease		
	VOCs BLANK		
	Date Collected		
	Time Collected		

Type & Number of Samples:	Delivered by & Date:	Received by & Date:	Comments:

4. MONITORING AUDIT REPORT FORM

Staff:	**Date:**		
Do staff have access to the most current version of these documents?			**Comments:**
Quality Assurance Project Plan (QAPP)	Yes ☐	No ☐	
Monitoring Strategy	Yes ☐	No ☐	
Monitoring SOPs	Yes ☐	No ☐	
303(d) List of Impaired Waters	Yes ☐	No ☐	
Rules & Regulations for Water Quality Control	Yes ☐	No ☐	
Safety Manual	Yes ☐	No ☐	
Field Monitoring Equipment			**Comments:**
Are field probes working properly?	Yes ☐	No ☐	
Are calibration standards available and used?	Yes ☐	No ☐	
Are chemicals stored properly?	Yes ☐	No ☐	
Are pre-calibrations and post drift checks being performed each day of use?	Yes ☐	No ☐	
Is calibration logbook maintained?	Yes ☐	No ☐	
Are all calibration details recorded properly in the logbook?	Yes ☐	No ☐	
Chemical/Bacteriological Sample Collections:			**Comments:**
Are SOPs being followed for sample collection?	Yes ☐	No ☐	
Is a Chain of Custody being maintained?	Yes ☐	No ☐	
Are gloves being worn for the collection of bacteria and nutrient samples?	Yes ☐	No ☐	
Are sterile sampling devices being used to collect bacteria samples?	Yes ☐	No ☐	
Are proper field cleaning procedures being used for reusable equipment?	Yes ☐	No ☐	
Are samples being delivered to the Laboratories for analyses within holding time?	Yes ☐	No ☐	
Biological Sample Collection:			**Comments:**
Are SOPs being followed for sample collection?	Yes ☐	No ☐	
Are all sample collection forms filled out correctly	Yes ☐	No ☐	
Are field parameters recorded when biological samples are collected?	Yes ☐	No ☐	
Is discharge being measured at time of sample?	Yes ☐	No ☐	

Flow Meters: Are SOPs being followed for discharge measurement? Are flow meters working properly? Are flow measurements being recorded on field form?	 Yes ☐ Yes ☐ Yes ☐	 No ☐ No ☐ No ☐	**Comments:**
Data Management: Are data report files accessible? Are station IDs being assigned to all sampling locations? Are station IDs sent to sample collection subcontractors before collections begin?	 Yes ☐ Yes ☐ Yes ☐	 No ☐ No ☐ No ☐	**Comments:**

Additional comments:

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Auditor Signature Date Manager Signature Date

APPENDIX F

Standard Operating Procedures and Quality Assurance Plans

(Available on GA EPD website or CD-R disk)

SOP# EPD-WQMP-1: Planning and Documentary Protocols for Water Quality Assessments (April 2020)
SOP# EPD-WQMP-2: Surface Water Sampling (Rivers/Streams) (May 2020)
SOP# EPD-WQMP-3: Chlorophyll-*a* Sample Collection and Processing (May 2020)
SOP# EPD-WQMP-4: Lake Profiling and Composite Sample Collection (September 2020)
SOP# EPD-WQMP-5: Wastewater Sampling (August 2020)
SOP# EPD-WQMP-6: Streamflow Measurement (May 2020)
SOP# EPD-WQMP-7: Data Sonde Calibration and Maintenance (April 2011)
SOP: Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia (May. 2007)
SOP: EPD-Fish Tissue Projects: Processing and Handling of Tissue Samples for Fish Consumption Guidelines (November 2020)
US EPA R4: SESDPROC-301-R3, Operating Procedure for Groundwater Sampling (March 2013)
QA Plan: Laboratory Quality Assurance Plan EPD Laboratory (April 2017)
QA Plan: UGA Laboratory Quality Assurance Plan (March 2018)

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