Lake Profiling and Composite Sample Collection

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Preface

The Watershed Protection Branch (WPB) of the Georgia Environmental Protection Division (GAEPD) has created a series of standard operating procedures (SOP) establishing uniform methods for the field collection of data, document control, quality assurance, laboratory safety, as well as other activities. These guidance documents were developed to document, and ensure, the validity of measurements, analyses, and the representativeness of samples collected. This is necessary in the event of a dispute with other parties regarding data collection techniques and the resulting quality of field information. Enforcement activities by the Branch require full documentation on particulars of data collection and the equipment used to collect it. All Branch associates who collect samples or field data must be familiar with the measures outlined in the appropriate SOP's.

Requirements pertaining to specifics of sample collection for certain parameters are specified in federal regulations under the authority of the Clean Water Act (CWA) and the National Pollutant Discharge Elimination System (NPDES) permitting program. The most widely applicable guidance at this level is *Title 40 of the Code of Federal Regulations (40 CFR)*. The procedures and techniques given in *40 CFR* are updated periodically by the United States Environmental Protection Agency and field workers are advised to consult the latest revision for proper procedures and new developments. In addition, the SOPs utilized by the Branch should be reviewed annually to certify their concurrence with federal statutes. Other references used in developing each SOP are cited at the conclusion of the individual documents.

The collection protocols in *40 CFR* are in many instances based on the concern for quality assurance. As such, each SOP will contain a section devoted to maintaining and improving the quality of data collected. 'Quality Assurance and Quality Control' sections contained within individual SOPs are not meant to replace the overall Quality Assurance Project Plan documents prepared for the Branch, but rather, are provided as supplemental data for each specific, standardized activity.

This document is dynamic and will be continually revised as new developments warrant. As the Branch assumes more responsibilities for studying and sampling in new investigational areas, it is anticipated that additional SOPs will be required.

A. Introduction

The Watershed Protection Branch (WPB) of the Georgia Environmental Protection Division (GAEPD) is responsible for managing the surface waters of the State of Georgia. The WPB works to ensure that Georgia's surface waters are of a quality and quantity sufficient for fulfilling multiple uses within the State by controlling nonpoint sources of pollution, managing storm water discharges, and regulating the amount of discharges to, and withdrawals from, surface waters. These tasks are accomplished through the issuance of National Pollutant Discharge Elimination System (NPDES)

permits to local governments and industry for the discharge of treated wastewater and to local governments, industry, farmers and subdivisions for surface water withdrawals. However, none of these tasks would be possible without the vital data collected through water quality monitoring.

Water quality monitoring is integral to the WPB's successful management of the waters of the State. Monitoring and studies conducted by the WPB can be broadly categorized as either enforcement or non-enforcement related activities. The enforcement related monitoring includes water enforcement case investigations, NPDES compliance sampling inspections (CSIs), some diagnostic evaluations of municipal and industrial wastewater treatment plant discharges, and monitoring of sewage spills into surface waters. Monitoring conducted that does not have a specific enforcement objective includes trend monitoring, surveys to verify issued permit limits, waste load allocation and model calibration studies, and other intensive surveys for documenting water quality.

Monitoring is accomplished through surface water sampling events planned in accordance with the type, amount, and time frame of data required. Surface water sampling techniques and equipment have been designed not only to minimize possible contamination of the chemical and physical integrity of the sample, but also to provide a sample that is representative of the water body under investigation. If the guidance provided in this standard operating procedure (SOP) is followed, an unbiased, representative sample of the surface water should be obtained.

> *Because studies and data derived from non-enforcement type investigations could be used for enforcement purposes at a later time, both investigations follow the procedural guidelines presented in this document.

B. Purpose and Applicability

The purpose of this SOP is to establish uniform procedures for sampling composite water samples and establishing profiles from lakes and reservoirs in the State of Georgia. This protocol is applicable to all Branch associates who sample, or assist in the sampling of lakes and reservoirs for water quality and compliance monitoring.

C. Summary of Method

Composite water samples are collected either on a quarterly or monthly basis. Lakes that have established standards are sampled once per month during the growing season (April-October) each year when primary productivity is highest. Lakes within the rotating river basin schedule are sampled once per quarter that calendar year. Samples are collected at a depth of approximately .1 meter and at one (1) meter intervals within the photic zone and homogenized so as to generate a single photic zone composite sample for analysis. From that composite sample, one (1) nutrient bottle, one (1) chlorophyll bottle, one (1) hardness bottle, and one (1) half-gallon bottle are filled. A separate fecal coliform grab sample is taken from just below the water surface. Sample identification labels, detailing the collection date, collection time, and responsible Associates are adhered to the sample

bottles. Laboratory Source Documents are completed, the samples are packed in ice, and then shipped to an appropriate, State certified laboratory.

Lake profiles are established by using a multiparametric probe and data logger. The probe should be capable of measuring depth, dissolved oxygen, temperature, pH, and conductivity. An initial measurement of each parameter is taken at 0.1 m and recorded. Parameters are then measured at discrete depths until reaching the lake bottom.

D. Definitions

1. **Van Dorn sampler** – is a device for obtaining samples of water at a discrete depth. It is a plastic tube with a 10 cm inner diameter, and open to the water at both ends. Each end is equipped with a cap and connected by an elastic rope. The sampler is lowered to a specified depth, and a weighted messenger is used to trip both caps shut and seal the tube.

2. **Clean Water Act (CWA)** – As amended in 1977, the Act established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave the U.S. EPA the authority to implement pollution control programs such as setting wastewater standards for industry. The Clean Water Act also continued requirements to set water quality standards for all contaminants in surface waters. The Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. It also funded the construction of sewage treatment plants under the construction grants program and recognized the need for planning to address the critical problems posed by nonpoint source pollution.

3. **Compliance Sampling Inspections (CSI)** – Studies which monitor permitted discharges for compliance with NPDES permits.

4. **Composite Sample** – In this case, a sample that is taken over multiple depths. Equal aliquots water are collected and combined into one, homogenous sample.

5. **Discrete Depth Sample** – A discrete depth sample collects water from a specified depth in the water column using a specialized sampling device.

6. **Grab Sample** – A grab sample is an instantaneous sample from one point in the water body. This produces a sample that is representative of the surface water's quality at the moment the sample was taken.

7. **Intensive Survey** – An intensive survey is a study that incorporates many different fields of research to fully understand the complexity of a water system. In most cases, this includes tributary and lake sampling for water quality characteristics, biotic life, sediment quality, and flow status. These studies tend to be a minimum of a year in duration.

8. **Multi-probe Data sonde –** A water quality meter consisting of multiple probes for analyzing parameters of interest. For the purposes of GAEPD's monitoring, these

probes will generally consist of ph, dissolved oxygen (DO), conductivity, and temperature.

9. **National Pollutant Discharge Elimination System (NPDES)** – As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal and other facilities must obtain permits if their discharges go directly to surface waters.

10. **Special Response Investigation** – A special response investigation is a study conducted in response to a complaint or request submitted by a member of the general public, a water treatment facility operator, a member of a municipal government, a citizen's action group….etc.

11. **Surface water(s) of the State or surface water(s)** – Any and all rivers, streams, creeks, branches, lakes, reservoirs, ponds, drainage systems, springs producing in excess of 100,000 gallons per day, and all other bodies of surface water, natural or artificial, lying within or forming a part of the boundaries of the State which are not entirely confined and retained completely upon the property of a single individual, partnership, or corporation.

E. Health and Safety Warnings

Collection and analysis of surface water samples can involve significant risks to personal health and safety. The sampler should treat all water samples as if they contain a chemical contaminant or biological agent that could cause illness and minimize exposure to both the sample and sampling medium. The sampler should wear appropriate personal protective equipment and appropriate clothing when conducting sampling events. Planning for any type of field sampling should include extensive health and safety considerations including required training (CPR, First Aid, Boating Safety), personal protective equipment, and degree of personal, physical condition in accordance with Federal, State, or organizational requirements. Boat safety equipment should readily available on all boats including: extra keys, flares, throw cushion, horn, life jackets, paddles, flashlight, toolbox, and boat notebook with service/fuel record.

F. Cautions

All Associates conducting sampling from boats should wear personal flotation devices while the boat is in motion.

During extremely hot weather, be sure to pack plenty of fluids and drink often to ward off the risk of heat exhaustion and heat stroke. Associates should also wear sunscreen, especially on sunny days.

*Field sampling should **NEVER** be conducted alone. Sampling teams should always consist of a minimum of two Associates.

G. Interferences

The purpose of representative sampling is to characterize the true picture of the surface water at the time of sampling. Contaminants introduced into the sample containers through careless handling, or by using "dirty" preservatives can bias the true picture. Common contaminants include, but are not limited to:

- Careless handling of sample container lids
- Use of bottles which have been lying unprotected in work vehicle for extended periods of time
- Use of previously used sample containers without proper cleaning and rinsing
- Careless transfer of sample from one container to another
- Failure to pre-rinse sample compositor with sample water between sites
- Low batteries or loose connections between sonde and data logger

H. Personnel Qualifications

All Branch associates who collect surface water samples or field data must be familiar with the procedures outlined in this document. In all aspects of water quality planning and field assessment activities, safety is to be addressed and treated as a critical element. The Georgia DNR *Safety Manual* is to be consulted and its policies, protocols, and procedures are to be incorporated and implemented in WPB field activities.

I. Procedural Steps

1. Photic zone composite from boat – Nutrient and other chemical samples are collected from a composite water sample that encompasses the entire photic zone. The depth of the photic zone is measured using a photometer. Once the photic zone has been determined, samples are taken at one (1) meter intervals until the edge of the photic zone is reached. Samples are then homogenized to create a depth-integrated composite.

<u>Equipment and Supplies</u>
Vehicle capable of carrying or towing boat
Boat that meets the size requirements of the lake, equipment, and/or staff
Boat safety equipment, including extra keys, flares, throw cushion, horn, life jackets, paddles, flashlight, toolbox, and boat notebook with service/fuel record.
Field Notebook, writing instruments
Carboy for mixing integrated sample
Meter stick
Thermometer
Underwater photometer to establish the photic zone
Secchi Disk

Water collection device (e.g.Van Dorn)
Rope for Van Dorn marked off in half meters
Cooler(s) with wet ice
Cooler(s) with dry ice
Chain of custody form (green sheet) to be filled out for each sample**.**
½-Gallon sample containers
Nutrient bottles
Fecal coliform bottles

Procedure

1 Boat is loaded with all listed gear.
2 Prior to departing in a boat, all staff should have on high-visibility; U.S. Coast Guard approved personal flotation devices. Once the boat is launched, proceed to the sampling location, and anchor at the sample site.
3 At the site, take an ambient air temperature reading.
4 Take a Secchi disk reading. See below for details.
5 Remove the photometer (e.g. Li_Cor) from the storage case. There are two sensors, one for the surface and an underwater sensor, which is attached to a metal weight. **(**If a photometer is not available use Secchi disk to estimate photic zone. See below.)**
6 The surface sensor should be plugged into I1 and the underwater sensor into I2 on the data logger. Turn the data logger on and set it to I2.
7 Lower the underwater sensor into the water until the data logger reads 100. At that point, you have reached where 1/100 of the amount of surface light can penetrate and the edge of you photic zone. Measure and record this depth (e.g. 6.23 m).
8 Determine the number of composites needed by rounding the measured depth to the nearest whole number. For example, a depth of 6.23 m equates to 7 samples (1 subsurface + 6 grabs at 1 meter intervals). A depth of 6.63 would necessitate 8 grabs (1 subsurface + 7 grabs at 1 meter intervals). If the photic zone is greater than 10 meters, adjust water volume from each grab accordingly as it is deposited into carboy to guarantee that total volume for sample does not exceed the volume of the carboy (Currently 20L). Alternatively, one must collect a minimum of three grabs, so if the photic zone is less than 1.5 meters deep, collect 1 subsurface sample, one at the mid-depth of the photic zone, and one just above the bottom of the photic zone (CHECK).
9 Lower your sample-collecting device to just below the surface of the water, or approximately .1 meters deep, and collect a sample. Pour into composite carboy.
10
11 Repeat this process, lowering one meter at a time until you reach the bottom of the photic zone and have collected a sample from each meter throughout it.
12 Once the composite sample has been completed, shake vigorously to assure even mixing.

13 Once the sample is completely mixed, fill one (1) nutrient bottle, one (1) ½-gallon bottle, one (1) chlorophyll bottle, and one (1) hardness bottle. If ortho-phos samples are required at the site, they are also collected from the composite.
14 Take a fecal coliform grab sample from approximately 0.1 m depth. Take care not to touch the inside of the bottle.
15 Place all samples on ice immediately.
16 Repeat this process at each site.

****Estimating photic zone using Secchi disk –** If a photometer is not available, a Sechhi disk reading can be used to estimate photic zone. The Secchi disk depth is a measure of water clarity and a basic water quality diagnostic tool. The Secchi disk is lowered slowly on the shaded side of the boat until the disk is not visible. Raise the disk slowly until it is barely visible. Lower and raise the disk again. Lower the disk a third time until it is just beyond visibility. This is the Secchi disk depth, and is measured from the water surface to the disk. Measure and record this depth. Now that the Secchi disk depth has been determined, multiply that depth by three (3). That calculated depth is your estimate of the photic zone depth.

It should be noted that using a Secchi disk is very subjective, and different staff may get very different results. For this reason, it is not recommended that a Secchi disk be used for determination of photic zone on a regular basis.

2. Establishing lake profile – Dissolved oxygen, temperature, pH, and conductivity are taken at discrete depths to establish a lake profile.

Equipment and Supplies
Multiparametric probe with data logger

Procedure

1 Remove multiprobe from storage container, place protective guard over sensors, and attach to data logger.
2 An initial reading should be made at 0.1 m.
3 Measurements are then taken every meter from 1.0 to 20.0 m
4 Below 20.0 m depth, measurements are taken every two (2) meters to 30.0 m
5 Below 30.0 m depth, measurements are taken every five (5) meters until the lake bottom is reached.
6 Once a measurement is made at the lake bottom, raise the mulitprobe place in a container with water until reaching the next site.
7 After all sites have been visited, return multiprobe back in storage container.

****Calibration of all parameters on multiprobe should be done prior to leaving for the field. An ending calibration should also be down upon returning from the field.**

Sample Handling

After collection, all sample handling should be minimized. Investigators should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, investigators should ensure that melted ice cannot cause the sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as Zip-Lock® bags or similar plastic bags should be used when small sample containers (e.g., VOC vials or bacterial samples) are placed in ice chests to prevent cross-contamination.

J. Data and Records Management

Data and records will be managed according to the policies outlined in the GAEPD SOP# EPD-WPMP-1. Any deviation from the policies outlined in the SOP should obtain prior permission from first the Unit manager, and then the Program manager, and be documented accordingly.

K. Quality Assurance and Quality Control

For each day of sampling, beginning and ending blanks are filtered and processed identically to samples. This is to determine if there has been any cross contamination in processing chlorophyll-*a* samples.

*Additional quality assurance and quality control information regarding surface water monitoring may be found in the GAEPD's Quality Assurance Program Plan (2008-12) available online at www.gaepd.org.

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