Protocols for Collection of Water Quality Data from Flowing Waters (Streams and Rivers)

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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, repeatability, 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. 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. 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 used to develop the 305(b)/303(d) list.

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 waterbody under investigation. If the guidance provided in this SOP is followed, an unbiased, representative sample of the surface water should be obtained.

B. Purpose and Applicability

The purpose of this SOP is to establish uniform procedures for sampling the flowing waters of the State of Georgia. The procedures outlined in this SOP are applicable to all Branch Associates who collect, or assist in the collection of, surface water samples in support of water quality and compliance monitoring.

C. Summary of Method

Flowing water sites can refer to streams (fast or slow, intermittent, ephemeral, or perennial), canals, ditches, or to any other surface feature in which water moves unidirectionally. Flowing water samples are collected in accordance with the guidelines outlined in this SOP at intervals previously established in the Work Plan (*GAEPD SOP EPD-WPMP-1: Planning and Documentary Protocols for Water Quality Assessments*.).

In-situ water quality parameters are measured using a Sonde and the water stage is noted using either an established tapedown point, or by reading a previously installed staff gage. Water samples are collected as the Sonde stabilizes. The collected water samples may be instantaneous (grab) samples, discrete depth samples, or collected using an equal width increment (EWI) sampling methodology resulting in a composite sample. The EWI methodology is the same whether the samples are collected by wading, from a bridge, or from a boat. This composite provides a representative and homogenous water sample. Regardless of sample type, the sample is divided among one or more containers and preserved, if needed. Sample identification labels, detailing the sample location, collection date, collection time, and responsible Associate are adhered to the sample containers. Chain of Custody forms are completed, the samples are packed in ice, and then delivered to a laboratory for analysis.

D. Definitions

1. **Churn sample splitter (CSS)** – A device used to composite individual samples into one homogenous sample from flowing waters. Collected samples are poured into the splitter and homogenized into one representative cross section sample.

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 contains 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** – A sample taken over multiple points across a waterbody, or over multiple depths, representative aliquots of a surface water are collected either manually or automatically 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 waterbody. 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. **Multiparameter Water Quality Probe (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), salinity, conductivity, Chlorophyll- *a*, 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. **Peristaltic Pump** – Commercially available pump that uses flexible pump tubes on a roller to systematically sample representative aliquots of water over a period of time. These tend to be used at stationary, monitoring stations to monitor complete hydrographs over a storm event, or in long term, intensive surveys when loading or trend data are desired.

11. **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.

12. **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.
*Sampling teams should consist of a minimum of two Associates when possible.

F. Cautions

- All Associates conducting sampling from bridges or using transportation rights-of-way to access sampling sites, should wear high-visibility safety vests at all times.

- All Associates should attempt to park their vehicle on the right shoulder with traffic with flashing lights and hazards on, as well as setting out traffic cones to alert oncoming traffic of their presence.

- Concentrated acids (nitric, sulfuric) are used to preserve metals and nutrient samples. Both preservatives are corrosive and toxic. Care must be taken when handling them.

- When it is necessary to climb down bridge embankments to sample water, be extremely careful and avoid trip hazards, steep drop offs, slick terrain, and areas filled with riprap that could result in injury. It is advisable to wear closed toe, lug soled wading boots when dealing with these kinds of situations.

- 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.

- During extremely cold weather sampling, be cautious to avoid ice on bridges and on trails leading to the water's edge.

- During warm weather, pay attention to where you step to avoid contact with snakes, yellow jackets, poison ivy, and other dangerous plants and animals.

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 caps
- Stirring of bottom sediments in sampling area and subsequent introduction into sample
- Use of containers that 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 CSS with deionized and on-site water before sample collection
- Introduction of grit and dirt into sample from sampler rope lying on bridge between collections

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* (https://dnrintranet.org/hr/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

Sampling station characteristics often dictate the equipment and method of sampling to be used. The field team on site will be responsible for determining the most appropriate sampling methodology to employ. The following is a list of sampling techniques employed by the GAEPD in water quality monitoring. Each listed technique is followed by a brief overview of possible situations that could be encountered in the field in which the technique should be employed; a list of required equipment; and, procedural steps for completing the sampling activity. This list of sampling techniques, and subsequent procedures, are intended to be dynamic and will be amended as needed when new sampling conditions are encountered.

1. Preparations for Field Sampling

Before leaving for the field, ensure that all necessary materials are present and accounted for in the vehicle. The following are required for all water quality sampling events, regardless of technique employed:

Equipment and Supplies

- Sample Containers (Including spare containers)
- Churn Sample Splitter (CSS)
- Stainless-steel bucket
- Sampling gear for metals, fecal coliform, and/or pesticides (as needed)

- Rope
- Deionized (DI) water
- Sonde and Sonde guard (calibrated the morning of the planned sampling event.)*
- Handheld data logger
- Turbidimeter
- Lens grade cleaning wipe
- Sampling equipment for Ortho-phosphate sampling
- Winkler Kit
- pH Strips
- Thermometer
- Gauging equipment
- Engineer's measuring tape with weight (for tapedown)
- Safety Vests
- Disposable gloves (Latex or nitrile)
- Container Labels
- Logbook/ Field sheets printed on weatherproof paper
- Chain of Custody (COC) Forms
- Clear packing tape
- Enough coolers and ice to properly store and cool samples
- Cooler liners and bags for COC forms
- GPS, gazetteer, and written directions for the sampling route
- Spare batteries

*NOTE: Calibration procedures are outlined in *GAEPD SOP EPD-WPMP-7: Sonde Calibration*. Refer to the manufacturer's manual for specific calibration instructions if the model is different from those listed in the above referenced SOP.

Before leaving the office, ensure that you have all containers necessary for the day's sampling events. Always bring 1-2 more containers than necessary. If the samples must be shipped, ensure the coolers are properly prepared and you have all materials necessary for shipping:

1. Make sure your office address is clearly marked on the coolers so that the lab knows where to return it.

2. Place a heavy weight plastic liner inside the cooler before filling it with ice.

3. Fill the cooler ¾ full of ice, and pour off any water that has accumulated in the cooler prior to shipping

4. Make sure you have resealable plastic bags (for the chain of custody forms), clear packing tape, and overnight shipping labels with the correct destination address.

If samples are to be collected using a stainless-steel bucket, etch or mark lines on the CSS at 1/3 and 2/3 of its total capacity to ensure equal filling from each sample point.

2. On-Site Preparation

Upon arrival at a site, park the vehicle within close proximity to your sampling point to minimize risk to you and the vehicle. If you are parking on the side of the road, ensure that the shoulder is both wide enough to allow the vehicle to be completely off of the main road and allows for staff to enter and exit the vehicle without risk of walking into incoming traffic. Turn on the vehicle's flashing and/or hazard lights before departing for the sample location and put on safety vests before exiting vehicle. Place an air thermometer near the sample location such that it is not on the ground or in direct sunlight. Associates must wear a new pair of disposable gloves at each site while conducting any of the methodologies described below.

3. Field Measurements and Field Observations

One Associate will manage the Sonde deployment, tapedown/Gage measurements, and paperwork (including the logbook/field sheets, labels, and chain of custody form), while the other Associate will collect the water samples. The suggested order of operations for the Associate collecting the field measurements and making field observations is to:

1. Deploy the Sonde.

2. Conduct the tapedown/Gage reading (if applicable).

3. Return to the vehicle and fill out/apply container labels.

4. Return to the Sonde, log in-situ measurements and record field observation including weather/stream conditions, retrieve the Sonde and return to the vehicle.

Equipment and Supplies

- Safety Vests
- Field Notebook/Field Sheets, writing instruments
- Multiparameter Water Quality Multiprobe (Sonde) and Handheld Data Logger
- Sensor guard
- Storage cup
- Winkler Kit
- pH Strips
- Bucket

Procedures

a. Collected from a Bridge

- The water quality Sonde is deployed at approximately 1 meter below the water's surface at mid-channel. If the water is less than 2 meters deep, then deploy the Sonde at mid-depth.

- The Sonde body must be fully submerged in order to collect an accurate reading.

- The Sonde may rest on the stream floor only if A) the water is too shallow to accommodate otherwise, or B) the current is too swift to allow the Sonde to remain at a depth of 1 meter.

- If the Sonde must rest on the bottom, attempt to orient it such that the sensors are facing upstream, and make a note of the Sonde location/depth in the logbook/field sheets. Indicate if the Sonde is resting on the bottom in the Activity Comments.

- If, in the event that the water quality of a shallow stream bed is drastically different from the surface (i.e., slow moving shallow streams with a heavy detrital layer at the bottom, thus producing an anoxic environment near the stream floor), then Sonde may be deployed such that the sensors are suspended just beneath the water's surface and the body is not submerged. If this method is to be used attempt to orient the unit within a shady area of the stream crossing and ensure that the sensors are fully submerged. Make a note about the changes in the activity comments of the field sheets.

- Allow the Sonde to stabilize for 5-10 minutes (depending on conditions) before recording the measurements.

b. Collected while Wading

- The water quality Sonde is deployed on the stream floor at mid-channel UPSTREAM of the Associate collecting samples.

- Attempt to orient the Sonde such that the sensors are facing upstream at an upward angle.

- The Sonde body must be fully submerged in order to collect an accurate reading.

- Take care not to disturb the stream substrate while deploying the Sonde.

- Allow the Sonde to stabilize for 5-10 minutes (depending on conditions) before recording the measurements.

c. Collected from a Boat

The water quality Sonde is deployed into water so that Sonde is located at mid-channel approximately 1 meter below the water's surface.

- Allow the Sonde to stabilize for 5-10 minutes (depending on conditions) before recording the measurements.

d. Potentially Erroneous Sonde Measurements

- If during a site visit, the Sonde is reporting water quality values that deviate substantially from typical values given at a particular site, relocate the Sonde to a different section of the sample site and check to see if the values at the new position agree with the original readings.

- If both readings agree with one another, use the field verification kit to confirm or refute the Sonde's reported values, and note the results in the logbook or on the field sheets.

e. Winkler Test of DO

- If the DO measurement is below water quality criteria of 4.0 mg/L - Determine the DO with the Winkler kit

  <u>Collecting the water sample</u>

  1. Rinse the Water Sampling Bottle with site water.
  2. Tightly cap the bottle and submerge the sampling bottle in the sampling location below the water surface to prevent obtaining surface scum in the sample.
  3. Remove the cap and allow water to fully fill the bottle, tapping the edges to allow trapped air to be released.
  4. Replace the cap underwater and double check that there are no air bubbles trapped within the bottle.

  <u>Adding the Reagents</u>

  1. Remove the cap from the bottle.
  2. Immediately add 8 drops of Manganous Sulfate Solution and 8 drops of Alkaline Potassium Iodide Azide.

3. Cap the bottle and mix the added solutions with the water by inverting several times. A precipitate will form in the bottle.
4. Allow the precipitate to settle below the shoulder of the bottle.
5. Once the precipitate has settled add 8 drops of Sulfuric Acid, 1:1 (Note: if you have a kit with Sulfamic Acid Powder add 1.0g of the powder into the bottle).
6. Cap the bottle and invert the bottle several times to mix the contents. Once the precipitate and the reagent have fully dissolved the solution should be a clear yellow to orange if the sample contains dissolved oxygen.

Titrate Sample

1. Fill the titration tube to the 20ml line with the fixed sample. Cap the tube.
2. Depress plunger of the titrator.
3. Insert the titrator into the plug in the top of the Sodium Thiosulfate, 0.025N titrating solution.
4. Invert the bottle and slowly withdraw the plunger until the large ring on the plunger is opposite the zero (0) line on the scale. Note: If small air bubbles appear in the titrator barrel, expel them by partially filling the barrel and pumping the titration solution back into the reagent container. Repeat until bubble disappears.
5. Turn the bottle upright and remove the titrator Note: If the sample is a very pale yellow, go directly to step 9.
6. Insert the tip of the titrator into the opening of the titration tube cap
7. Slowly depress the plunger to dispense the titrating solution until the yellow- brown color changes to a very pale yellow. Gently swirl the tube during the titration to mix the contents.
8. Remove the titrator and cap. DO NOT disturb the titrator plunger.
9. Add 8 drops of starch indicator solution. The sample should turn blue.
10. Cap the titration tube. Insert the tip of the titrator into the opening of the titration tube cap.
11. Continue titrating until the blue color disappears and the solution becomes colorless.
12. Read the test result directly from the scale where the large ring on the titrator meets the titrator barrel. Record as ppm Dissolved Oxygen. Each minor division on the titrator equals 0.2 ppm.

f. Bucket Method for pH

- If the pH measurement is outside water quality criteria of 6.0 SU or 8.5 SU
    - Use pH strips to check Sonde reading. If possible, dip the pH strip directly into the waterbody being sampled.

    - Collect an additional water sample in a bucket, the location of this water sample should be where the Sonde was collecting in-situ readings. Place

the Sonde directly into the bucket and allow the Sonde to stabilize for 5-10 minutes before recording the pH measurement.

4. Tapedown

Equipment and Supplies

- Safety vest
- Latex or nitrile gloves (optional)
- Field Notebook/Field Sheets, writing instruments
- Engineer's measuring tape and weight (for tapedown)

Procedures

- A tapedown should be conducted using a weighted Engineer's tape from the preselected mark on the bridge, culvert, or other monument to the water's surface.

- In some instances, a staff gage will have been installed prior to the commencement of the water monitoring study. In these cases, all that is required is reading the gage at the point where the surface of the water makes contact.

- If the tapedown/gage reading cannot be performed without standing in the stream, wait until the samples are collected before conducting this task.

- See the Stream Gauging SOP (*EPD-WPMP-6: Streamflow Measurement*) for the tapedown methodology.

5. Bridge Sampling

Equipment and Supplies

- Safety vests
- Latex or nitrile gloves
- Turbidimeter
- Sample containers – appropriate bottles for parameters of interest and laboratory conducting analyses
- Stainless-steel bucket
- Rope
- Churn sample splitter (CSS)
- Writing instruments
- Sample container labels, clear tape or tape strips for sealing labels
- Coolers with ice

a. Composite Sampling from a Bridge

If a representative sample is required from a large, non-wadeable surface water, or access to the waterway itself is not possible due to hazardous conditions or private property concerns, bridge sampling is often the only way to proceed. A stainless-steel bucket is lowered from the bridge at 3 points across the horizontal width of the surface water and homogenized in the CSS.

Procedures

- Before heading to the water collection location, the stainless-steel bucket and CSS should be first be rinsed with DI water.

- At the sampling location three subsurface grabs will be collected to rinse the stainless-steel bucket and then the CSS. Lower and fill the bucket at most halfway with water, swirl for 3-4 seconds, and pour the water out downstream. Repeat the collection process two more times. Conduct the same rinsing process three additional times for the CSS. This is a very important step in lessening the chance of cross contamination between sample sites.

- Three samples are collected across the waterbody; one at the horizontal midpoint of the stream, and one each at points halfway between the midpoint and the edge of downstream flow (see Fig. I-1). If the flowing portion of the wetted width is less than 1.5 meters wide, then three center-channel pulls may be collected. Avoid sampling in areas that are stagnant or contain backflow. Collect sample on the side of the bridge (up- or downstream) that was determined to be most feasible during the site reconnaissance. If an unforeseen event occurs that renders the usual sample side unsafe or infeasible (i.e. new beaver dam, shoulder closed for construction, etc.), then collect the samples from the opposite side of the bridge and note the change in location within the log books/field sheets.

- Collect each sample by lowering the stainless-steel bucket to just below the water surface. Take care to minimize the bucket or rope's contact with the side of the bridge while collecting samples (see Fig I-2).

- Pour a volume of the retrieved sample equivalent to 1/3 of the CSS's capacity (pre-marked) into the compositor after each collection. Ensure that the lid remains on the CSS in between the transfer of samples to prevent contamination from foreign debris.

- Once the samples have been collected, they are composited by churning action in the CSS, and dispensed into the various required sample containers. Maintain a slow but constant rate of churning while filling each of the sample containers. Do not allow the nozzle to contact the container while filling.

- Collect the turbidity sample prior to filling the other containers, so that the temperature of the water within the cuvette has time to equilibrate with the air. See section I.9 for turbidimeter procedures.

- Ensure that the labels attached to each sample container indicate the correct site location, time, date, and Associate that conducted the sampling. If the labels are not waterproof, then they must be sealed with clear tape. Place the samples in the cooler such that they are completely covered by ice.

Figure I-1. Three samples are collected across the waterbody: one at the horizontal midpoint of the stream, and one each at points halfway between the midpoint and the edge of downstream flow. Avoid sampling in areas that are stagnant or contain backflow.

Figure I-2. Take care to minimize rope contact with the side of the bridge when collecting samples.

b. Grab Sampling from a Bridge

If a single-point sample is required from a large, non-wadeable surface water, or if the waterway itself is rendered inaccessible due to hazardous conditions or private property concerns, bridge sampling is often the only way to proceed. If any grab samples are to be collected in conjunction with composite samples, collect the grab samples after collecting the composite sample. If only grab samples are to be collected, in-situ readings and tapedown/gage measurements must still be obtained; follow the Sonde deployment and division of labor directions listed in the composite bridge sampling protocol above.

Procedures

- Put on latex or nitrile gloves and walk towards the center channel of the stream.
- Attach the container to the holder, and check that the container cannot slip out. Remove the cap.
- Lower the container to the water, ensuring the rope is held away from the bridge to prevent debris from falling into the open container (Fig I-2).
- Submerge the container to just below the water's surface and allow it to fill completely.
- Replace the cap, tape the label directly to the container, and immediately place in the cooler, completely covered in ice.

6. Sampling while Wading

Equipment and Supplies

- Latex or nitrile gloves
- Turbidimeter
- Sample containers – appropriate bottles for parameters of interest and laboratory conducting analyses
- Stainless-steel bucket
- Churn sample splitter (CSS)
- Writing instruments
- Sample container labels, clear tape or tape strips for sealing labels
- Coolers with ice
- Wading Gear

a. Composite Sampling while Wading

If the water depth is below thigh height and the stream velocity is not too fast, then composite samples can be collected by wading.

Procedures

- Before heading to the water collection location, the stainless-steel bucket and CSS should be first be rinsed with DI water.
- Proceed to the water's edge by the safest route possible.
- At the sampling location three subsurface grabs will be collected to rinse the stainless-steel bucket and then the CSS. Lower and fill the bucket at most halfway

with water, swirl for 3-4 seconds, and pour the water out downstream. Repeat the collection process two more times. Conduct the same rinsing process three additional times for the CSS. This is a very important step in lessening the chance of cross contamination between sample sites.

- Three samples are collected across the waterbody; one at the horizontal midpoint of the stream, and one each at points halfway between the midpoint and the edge of downstream flow (Fig. I-1). If the flowing portion of the wetted width is less than 1.5 meters wide, then three center-channel grabs may be collected. Dip the stainless-steel bucket beneath the surface of the water just upstream of your position and fill the churn splitter to 1/3 of its capacity. If the churn splitter is left at the bank, take care to walk downstream of your sample line while walking to and from the splitter (Fig. I-3). Repeat this at the other two points. Note: Make sure that the first two points sampled are not located directly downstream of the Sonde. This will allow time for any sediment introduced into the water from its placement to travel downstream beyond the sampling region.

- If the site is experiencing higher-than-normal flow and it is impossible to judge the depth of the water, DO NOT collect samples via wading. Deploy the Sonde and collect the samples from the bank and note the change in procedure in the logbook. If you are sampling an urban stream during a rain event, DO NOT collect samples via wading, as flash flooding can occur.

- Once the samples have been collected, they are composited by churning action in the CSS, and dispensed into the various required sample containers. Maintain a slow but constant rate of churning while filling each of the sample containers. Do not allow the nozzle to contact the container while filling.

- Collect the turbidity sample prior to filling the other containers, so that the temperature of the water within the cuvette has time to equilibrate with the air. See section I.9 for turbidimeter procedures.

- Ensure that the labels attached to each sample container indicate the correct site location, time, date, and Associate that conducted the sampling. If the labels are not waterproof, they must be sealed with clear tape. Place the samples in the cooler such that they are completely covered by ice.

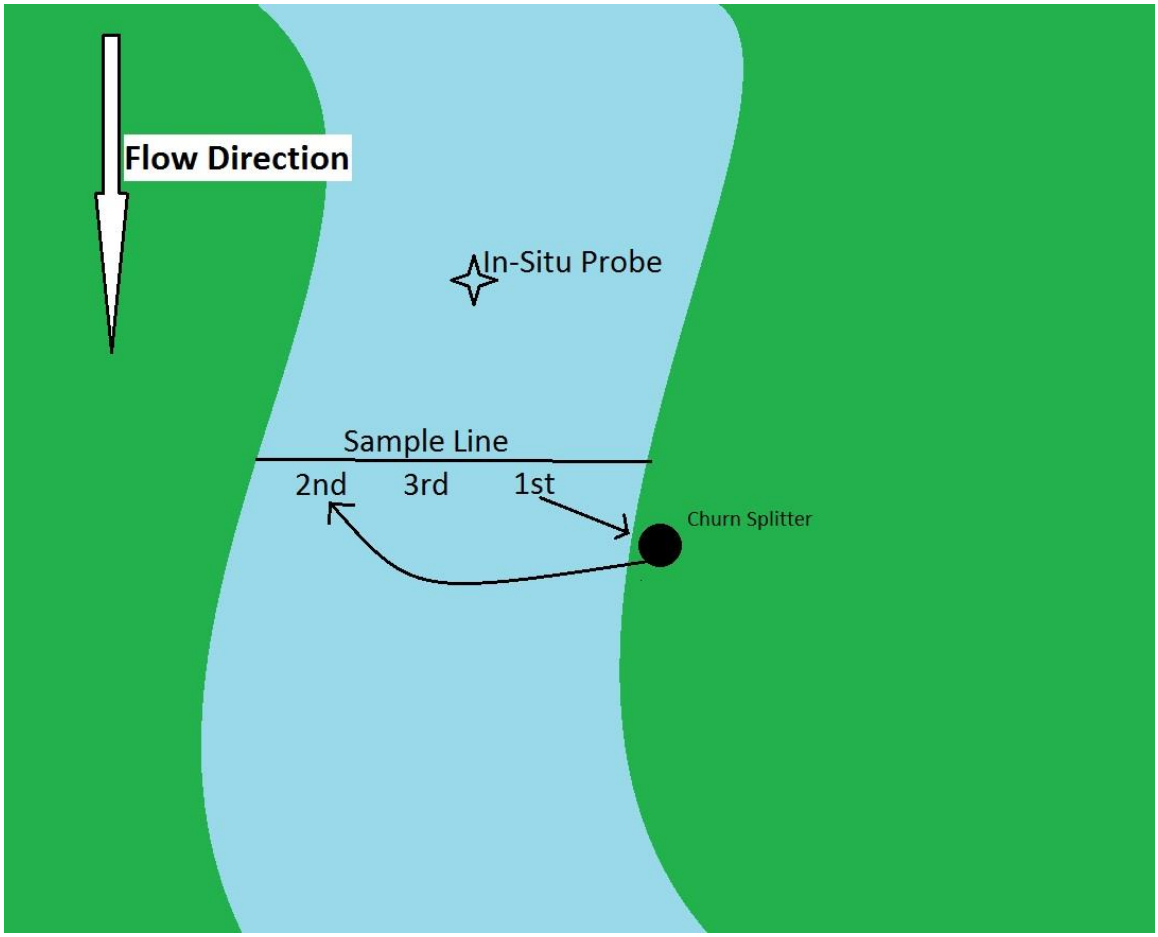

Figure I-3. If the churn splitter is left at the bank, take care to walk downstream of your sample line while walking to and from the splitter. Make sure that the first two points sampled are not located directly downstream of the Sonde.

b. Grab Sampling while Wading

When an instantaneous sample is required, a grab sample is taken from the surface water's midstream point using the sample container. The following protocol applies to all constituents that are to be collected at a single point. If any grab samples are to be collected in conjunction with composite samples, collect the grab samples after the composite, but before the Sonde is retrieved.

Procedures

- Before heading to the water collection location, the stainless-steel bucket and CSS should be first be rinsed with DI water.

- Associates should proceed to water's edge by the safest route possible.

- One Associate will collect the water sample while the other Associate is deploying the Sonde and conducting the tapedown. Because the Sonde is typically deployed at the mid-stream point, make sure the Associate collecting the grab sample allows for any sediment introduced by the Sonde placement to flow downstream prior to sampling.

- The Associate collecting the grab sample should submerge the bottle facing upstream of the river. Open the bottle and allow water to fill it entirely.

- Ensure that the labels attached to each sample container indicate the correct site location, time, date, and Associate that conducted the sampling. If the labels are not waterproof, they must be sealed with clear tape. Place the samples in the cooler such that they are completely covered by ice.

7. Sampling of a River from a Boat

If sampling of a large, non-wadeable surface water, and bridge sampling is not an option, field measurements and samples collection from a boat will be necessary.

1. Prior to departing in a boat, all Associates should don their high-visibility, U.S. Coast Guard approved personal flotation devices.

2. Associates then proceed to the sampling location(s) by the safest route possible.

3. The division of labor when sampling from a boat will depend on the type of boat used and the physical condition of the stream sampled. If only two Associates are on the boat, one may have to devote their full attention to maintaining boat position while the other performs all other facets related to sampling. If an anchor is available, one Associate can deploy the Sonde and fill out the labels while the other collects the water samples.

4. If applicable, depth can be determined using a boat-mounted depth finder, or in some instances, a staff gage will have been installed on a bridge pylon prior to the commencement of the water monitoring study. In these cases, all that is required is reading the gage at the point where the surface of the water makes contact.

Equipment and Supplies

- Personal floatation devices
- Latex or nitrile gloves
- Field Notebook, writing instruments
- Multiparameter Water Quality Probe (Sonde) and Handheld Data Logger
- Sensor guard
- Storage cup

- Sample collection device (i.e. stainless-steel bucket, Van Dorn, etc.)
- Turbidimeter
- Sample containers – appropriate bottles for parameters of interest and laboratory conducting analyses
- Churn sample splitter
- Stainless-steel scoop
- Sample container labels, clear tape or tape strips for sealing labels
- Coolers with ice

a. Composite Sampling from a Boat

A water sampler is lowered from the boat and samples are collected from multiple points across the horizontal width of the stream and homogenized.

Procedures

- Before heading to the water collection location, the stainless-steel bucket and CSS should be first be rinsed with DI water.

- At the sampling location three subsurface grabs will be collected to rinse the stainless-steel bucket and then the CSS. Lower and fill the bucket at most halfway with water, swirl for 3-4 seconds, and pour the water out downstream. Repeat the collection process two more times. Conduct the same rinsing process three additional times for the CSS. This is a very important step in lessening the chance of cross contamination between sample sites.

- Three samples are collected across the waterbody: one at the horizontal midpoint of the stream, and one each at points halfway between the midpoint and the edge of downstream flow. Avoid sampling in areas that are stagnant or contain backflow. Sample the mid-channel last as the Sonde readings are to be reflective of conditions at the mid-channel. Allow the Sonde to stabilize at mid-channel while the sample containers are filled, labeled, and stored.

- If the water is too swift to collect a depth-integrated sample, then a sub-surface grab may be collected with a stainless-steel bucket.

- Pour the retrieved sample into the CSS after each collection. Ensure that the top remains on the CSS at all times to prevent sample contamination from foreign debris.

- Once the samples have been collected, they are composited by churning action in the CSS, and dispensed into the various required sample containers. Maintain a slow but constant rate of churning while filling each of the sample containers. Do not allow the nozzle to contact the container while filling.

- Collect the turbidity sample prior to filling the other containers, so that the temperature of the water within the cuvette has time to equilibrate with the air. See section I.9 for turbidimeter procedures.

- Ensure that the labels attached to each sample container indicate the correct site location, time, date, and Associate that conducted the sampling. If the labels are not waterproof, then they must be sealed with clear tape. Place the samples in the cooler such that they are completely covered by ice.

b. Grab Sampling from a Boat

Procedures

- One Associate will collect the water sample while the first Associate is deploying the Sonde and reading the depth finder, or staff gage. An instantaneous grab sample should be taken from the surface water's mid-channel point.

- To collect the sample, the Associate first dons nitrile, or latex, gloves and moves to midchannel of the stream. While facing upstream in the bow section of the boat (away from the engine) submerge the sample container on either the left or right side of the boat with the cap on. The sample should be taken below the surface to eliminate chance of collecting surface film. Position the container so the opening is facing upstream and remove the cap under water, allowing it to fill. once the container is filled to the shoulder, replace the cap. Once the container cap has been replaced, the container is removed from the water.

- Alternatively, a stainless-steel scoop may also be used to reach away from the side of the boat into the water. The sample is still collected with the scoop's opening facing upstream and the subsequent sample is then transferred to the sample container.

- Once the sample has been collected, the Associate attaches a label with the time, date, and Associate making the collection marked on the label. The label is sealed with clear tape, and the sample is placed in the cooler of ice for shipment.

8. Discrete Depth Sampling from Boat (one depth)

When only one depth has been specified for sampling, and samples must be collected from a boat, a discrete depth sampler (i.e. Van Dorn) should be employed. A discrete depth sampler is lowered from the boat to the desired depth and a sample is collected. This technique can also be employed at multiple points across the horizontal width of the surface water at the same depth to collect a composite, discrete depth sample.

Equipment and Supplies

- Personal floatation device
- Latex or nitrile gloves
- Field Notebook/ Weatherproof paper, writing instruments
- Multiparameter Water Quality Probe (Sonde) and Handheld Data Logger
- Weighted sensor guard
- Cable
- Storage cup
- Sample containers – appropriate bottles for parameters of interest and laboratory conducting analyses
- Kemmerer or Van Dorn style sampler
- Churn sample splitter (CSS)
- Sample container labels, clear tape or tape strips for sealing labels
- Coolers with ice

Procedures

- Associate will collect the water sample while the first Associate is deploying the Sonde and reading the depth finder, or staff gage. The sample is to be collected by lowering the discrete depth sampler, to the desired depth in the waterbody.

- If a Van Dorn style sampler is used, first release the messenger to trip the sampler's doors closed, and then retrieve to the surface.

- The first three pulls will be used to rinse the sampler and the CSS. This is a very important step in lessening the chance of cross contamination between sample sites.

- After the rinse sample has been completed, three samples are collected across the horizontal width of the stream at the same specified depth, in the same, previously described manner.

- Once the samples have been collected, they are composited by churning action in the compositor, and dispensed into the various required sample containers.

- Labels are attached to each sample container with the time, date, and Associate making the collection marked on the label.

- The labels are sealed with clear tape, and the samples are placed in the cooler of ice for shipment.

9. Turbidimeter Reading

Turbidity should be conducted first when returning to the vehicle for sample distribution

Equipment and Supplies

- Latex or nitrile gloves
- Turbidimeter
- Lens grade cleaning wipe
- Silicone oil
- Oil cloth

Procedures

- Once the composite has been slowly churned, rinse the cuvette three times (This procedure is done to remove any water that may be left in the cuvette from a previous sampling event or previous site sampled that day).
- After rinsing the cuvette, pour water in the cuvette until it reaches the marked line.
- Allow the water in the cuvette to stabilize with the air conditions otherwise condensation on the cuvette will skew results.
- Wipe the water off of the sides of the cuvette with a lens grade cleaning wipe to prevent water from entering the turbidimeter.
- At the first site of the day, put a dab of the silicone oil on the cuvette and wipe the oil around the cuvette with the oil cloth (This step is to fill any microfractures in the glass with an oil residue that has the same reflective properties as the glass cuvette) Note: Sites after the first just need the oiled cloth wiped around the cuvette. Every fifth turbidity measurement should receive the oil treatment.
- Turn on the turbidimeter and put the oiled cuvette into the turbidimeter with the arrows on the cuvette and turbidimeter lining up with each other and close the lid.
- Press read on the turbidimeter and write down the results.
- Pour out the sample from the cuvette and place the cuvette into the foam holder.

10. Sampling Procedures for Specific Parameters

a. Ortho-Phosphate

Composite samples are used to collected ortho phosphate samples. The analyte must be filtered in the field.

Equipment and Supplies

- Latex or nitrile gloves
- Filters (Filters specifications: 0.45µ pore size with a cellulose acetate membrane and a glass fiber prefilter which will connect with a Luer Lock connector)
- 60 mL syringe (plastic 60 cc Luer Lock syringes)
- Sample containers and cap

Procedures

- Take one sterile syringe and pull out the plunger.
- Screw the filter onto the syringe.
- Fill the syringe with sample water. Take care not to let the nozzle of the churn splitter touch the syringe.
- Place the plunger into the syringe.
- Place the filter over the open ortho-phosphate collection bottle and plunge the sample water through the syringe until it is empty, or the filter is clogged. If the filter clogs, hold the syringe so that the filter points upward, remove the old filter, and attach a new one.
- Filter two syringes worth of water, at least 100ml. When finished, dispose of the used filters and separate the used syringes from the sterile.
- Ensure that the labels attached to each sample container indicate the correct site location, time, date, and Associate that conducted the sampling. If the labels are not waterproof, they must be attached prior to filling the containers and sealed with clear packing tape. Place the samples in the cooler such that they are completely covered by ice.

b. Bacteria and Pesticides

Grab samples are used to collect bacteria and pesticides.

Equipment and Supplies

- Latex or nitrile gloves
- Sample container and cap
- If collecting sample from a bridge, weighted sample container holder

Procedures

i. Bacteria and Pesticides Collected while Wading

- Associate dons nitrile, or latex, gloves and moves to midchannel of the stream.
- While facing upstream, the Associate will submerge the container with the cap on at mid-depth. This is done to eliminate the chance of collecting surface film while avoiding disturbance to the stream bed.
- Position the container so the opening is facing upstream and remove the cap under water, allowing to fill completely.
- Once the container is filled, replace the cap and remove the container from the water.

ii. Bacteria and Pesticides Collected from a Bridge

- Associate dons nitrile, or latex, gloves and moves to midchannel of the stream.
- Samples are collected by lowering the sample container housed in a weighted container holder into the waterbody at mid-channel.
- The container holder for bacteria samples may be made from any easily washable material, but it must be able to firmly grip the sample container and pull it under water.
- For pesticides, the container holder must be made entirely out of metal; or, it must be coated with Teflon. DO NOT use a container holder with plastic components.

c. Metals

Grab samples are used to collect metals. Sampling metals requires use of the Dirty Hands/Clean Hands technique.

Sample contact with air must be kept to a minimum. It is important that bags be sealed or rolled immediately after opening to keep air out. In addition, the sample container should not be opened at any time except when submerged in the stream.

"Clean Hands" (wearing gloves) should not touch any surface other than the outside of the sample container or the inner bag.

A clean metals field blank should be collected on each sampling date.

Equipment and Supplies

- Latex or nitrile gloves
- Dirty Hand/Clean Hand sample bag with sample container and cap
- If collecting sample from a bridge, weighted sample container holder

Procedures

These procedures are adapted from EPA method #1669 (EPA July 1996 & EPA June 1999):

- Samplers decide who will be the "Clean Hands" and who will be the "Dirty Hands".
- "Dirty Hands" person opens the outer bag of the metals sampling kit.
- "Dirty Hands" reaches in and retrieves one pair of gloves from the outer bag.
- "Dirty Hands" puts on first pair of gloves.
- "Dirty Hands" retrieves second pair of gloves from outer bag. "Dirty Hands" should only touch cuff portion of Clean Hands gloves.
- "Dirty Hands" rolls top of bag and holds under arm.
- "Dirty Hands" puts second pair of gloves on "Clean Hands." Contact with outside surface of Clean Hands gloves should be limited to the clean sample container.
- "Dirty Hands" then unrolls container bag.

- "Clean Hands" unseals the inner container bag and retrieves metals container from inner bag with minimal contact with bags.

- "Dirty Hands" rolls the bag up and places under arm.

i. Metals Samples Collected while Wading

- "Clean Hands" moves to mid channel of stream and facing upstream submerges metals container with cap on. Sample should be taken well below the surface to eliminate chance of collecting surface film.

- "Clean Hands" removes top from container allowing it to fill then recaps container before bringing it back to surface.

- "Dirty Hands" unrolls container bags and "Clean Hands" places filled sample container in inner bag and seals it.

- "Dirty Hands" compresses bags to expel air and closes outer bag.

- Sample label is prepared prior to sampling and taken to sample location.

- Sample label is placed on the container. Sample is put on ice.

ii. Metals Samples Collected from a Bridge

Metals sampling utilizes a variation of the Clean Hands technique illustrated above. DO NOT use a sample container holder with any metal components.

- "Clean Hands" inserts bottle into holder while "Dirty Hands" stabilizes and secures bottle to holder WITHOUT touching the bottle.

- "Clean Hands" removes cap and holds it within gloved hand to help prevent contamination from airborne metals.

- "Dirty Hands" lowers the sample to the water, taking care not to let the rope touch the sides of the bridge (Fig I-2). Sample should be taken well below the surface to eliminate chance of collecting surface film.

- "Dirty Hands" retrieves and stabilizes holder, taking care not to touch the bottle in the process.

- "Clean Hands" removes bottle from holder, and replaces cap.

- "Dirty Hands" unrolls container bags and "Clean Hands" places filled sample container in inner bag and seals it.

- "Dirty Hands" compresses bags to expel air and closes outer bag.

- Sample label is prepared prior to sampling and taken to sample location.

- Sample label is placed on the container. Sample is put on ice.

11. QC Sampling

a. Replicate Samples

- In accordance to the Georgia Quality Assurance Project Plan(QAPP) section B5.2 (located at *https://epd.georgia.gov/watershed-protection-branch/monitoring#toc-sops-and-qapp-*), Georgia EPD associates will collect replicate samples at 10% of all sample events (this is subject to change based on the project plan and/or lab constraints).

- The exception to this rule is metal sample blanks, which are collected once per sampling date.

- For each day of sampling that requires a replicate QC sample, the site to receive the replicate QC sample should be determined prior to going out in the field.

- Replicates must be obtained by repeating the entire sampling procedure after the initial sample event is processed; that is, the sampler and churn splitter (if used) must be rinsed, and the samples are collected in the same manner and location as the initial sample.

b. Metals Field Blanks

Metals Field Blank should replicate the field sampling procedures as close as possible. At a site metals are collected, an Associate should prepare the metals blank bag (prepared by the GAEPD laboratory) and conduct an adapted version of the "Dirty Hands" – "Clean Hands" technique.

One sample container will have no water inside of it and will be the "Clean Container". The other one sample container will contain the "Blank" water sample.

Procedures

- "Dirty Hands" unseals the outer container bag and "Clean Hands" will retrieve the empty sample container from outer bag with minimal contact with bags.

- "Dirty Hands" rolls the bag up and places under "Clean Hands" arm.

- "Clean Hands" inserts bottle into holder while "Dirty Hands" stabilizes and secures bottle to holder WITHOUT touching the bottle.

- "Clean Hands" removes cap and holds it within gloved hand to help prevent contamination from airborne metals.

- "Dirty Hands" lowers the sample to the water line without immersing the sample container in the water. Taking care not to let the rope touch the sides of the bridge (fig I-2).

- "Dirty Hands" retrieves and stabilizes holder, taking care not to touch the bottle in the process.

- "Clean Hands" unseals the inner container bag and retrieves the sample container containing the "Blank" water sample from the inner bag with minimal contact with bags.

- "Clean Hands" will pour the "Blank" water sample into the sample container that has been lowered to the water line.

- "Clean Hands" replaces cap on the newly filled botte and then removes it from the opened sampler.

- "Dirty Hands" unrolls container bags and "Clean Hands" places filled sample container in inner bag and seals it.

- "Dirty Hands" compresses bags to expel air and closes outer bag.

- The newly filled container is considered the Field Blank QC sample and should be put into the inner bag, labeled, and then the bag should be sealed.

12. Post-Sampling Activities

Once all samples for the day have been collected, three primary tasks must be finished before the end of the field day: the cooler must be prepared for shipping or overnight storage; the Sonde must be post-calibrated; and the equipment must be cleaned.

a. 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.

- Resealable plastic bags should be used when small sample containers (e.g., VOC vials) are placed in ice chests to prevent cross-contamination.

- Trace metals sampling is to be conducted according to the WPB document, *Interim Protocol: Clean Laboratory and Sampling Techniques for Determination of Trace Metals*, and U.S. EPA trace metal sampling protocols.

b. Complete the Chain of Custody

- Before leaving for the field and printing the Chain of Custody, click all the parameters that are to be sampled at each site.

- In the field, fill out on the Chain of Custody who sampled, date, and time.

- If chlorophyll sample is collected, write down the amount filtered in the space provided on the Chain of Custody.

c. Shipping/Storage Preparations

- If the samples are to be hand delivered, but will have to be stored overnight before delivery, observe the following steps:

- Bring the cooler(s) into a climate-controlled facility for storage. (Do not leave them in a vehicle overnight.)

- Drain excess water from the cooler.

- Add more ice until the cooler is full and all samples are completely covered.

- If the samples are to be shipped, observe the following steps:

- Drain excess water from the cooler and add ice until the samples are completely covered. (This is especially important during warm weather months).

- Twist the bag opening several times and wrap tape around the twisted portion.

- Place the completed chain of custody forms in a resealable plastic bag and seal. Fold the seal and tape the bag to the inside lid of the cooler.

- Use clear tape to seal the cooler. Vertically wrap the cooler in at least two locations.

- Place the overnight shipping label on top of the cooler.

d. Sonde Post-Calibration

- The Sonde used for in-situ measurements must be post-calibrated at the end of each field day.

- If the Sonde is to be used the following day, then it may be calibrated the next morning, which would serve as both a post-check for the current day's sampling and pre-calibration for the next day.

- If the Sonde will not be used the next day, then it must be post-checked that evening.

- Information regarding Sonde calibration and care is in *GAEPD SOP EPD-WPMP-7: Sonde Calibration*.

e. Equipment Cleaning

Upon returning from the field, CSS, Van Dorns, stainless-steel buckets, mixing carboys, and single-point sampling equipment must be cleaned.

- Using a soft brush and phosphate-free detergent (i.e. Liquinox or Citrinox), scrub both the inside and outside of each sampler, and thoroughly rinse with DI water.

- If ortho-phosphate samples were collected, the syringes will need to be sterilized using the following method:

    - Make sure the plungers are separated from the syringes and fully immerse both in a water bath containing 5% HCl.

    - Allow the syringes to soak for at least two hours.

    - While wearing gloves, remove and rinse the syringes and plungers using two stations DI water (this is to ensure that all of acid has been rinsed off the syringes. Check with pH strips).

- Allow to air dry before placing in a resealable plastic bag for storage.

J. Data and Records Management

- Data and records will be managed according to the policies outlined in the *GAEPD SOP EPD-WPMP-1: Planning and Documentary Protocols for Water Quality Assessments*. Any deviation from the policies outlined in the SOP should have prior approval from first the Unit manager, and then the Program manager, and be documented accordingly.

- If the data collected in the field is to be entered into a database, do so as soon as possible after each sampling day, so as to minimize the loss of information in the event that the field sheets/log book is lost or destroyed.

K. Troubleshooting and Error Management

1. Field Sheets/Logbook and Chain of Custody Recordings

- If an error is made while recording information within either the logbook or COC form, draw a single line through the erroneous entry, write the correct information next to it, and initial the correction.

- Do not attempt to erase or "scratch out" the erroneous information.

2. Damage to the Sonde

- If any damage occurs to the Sonde that impairs its ability to function (i.e., the case or one of the sensors is physically cracked, the pH bulb is broken), do not continue to use it in the field.

3. Loss of equipment

- In the event that a piece of equipment falls into the water from a bridge, only retrieve it if you can locate it and it is easily retrievable via wading.

- DO NOT attempt to swim or dive after lost equipment.

- Report any instance of lost or broken equipment to your supervisor immediately upon returning from the field so that replacements may be obtained as quickly as possible.

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