

FS 2100. SURFACE WATER SAMPLING

See also the following Standard Operating Procedures:

- FA 1000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FS 2000 General Aqueous Sampling
- FS 2400 Wastewater Sampling
- FT 1000 – FT 2000 Field Testing and Calibration Procedures

1. INTRODUCTION AND SCOPE

1.1. This section presents standard operating procedures to be used to consistently collect representative surface water samples. Each collection event must be performed so that samples are neither contaminated nor altered from improper handling.

1.2. The following topics include acceptable equipment selection and equipment construction materials; and standard grab, depth-specific and depth-composited surface water sampling techniques. Information regarding sample types and flow- or time-weighted aqueous sampling is found in FS 2420.

2. GENERAL CAUTIONS

2.1. When using watercraft, take samples near the bow, away and upwind from any gasoline outboard engine. Orient watercraft so that bow is positioned in the upstream direction.

2.2. When wading, collect samples upstream from the body.

2.3. Avoid disturbing sediments in immediate area of sample collection.

2.4. Collect water samples prior to taking sediment samples when obtaining both from the same area (site).

2.5. Consider the representativeness of selected sampling locations, for example, when attempting to characterize a water body that may be stratified or heterogeneous.

2.6. Unless dictated by permit, program or order, sampling at or near structures (e.g., dams, weirs or bridges) may not provide representative data because of unnatural flow patterns.

2.7. Collect surface water samples from downstream towards upstream.

3. EQUIPMENT AND SUPPLIES

3.1. Use sampling equipment constructed of materials consistent with the analytes of interest. Refer to FS 1000, Tables 1000-1 and 1000-2 for material selection. Select equipment based on the analytes of interest, the specific equipment use and the available equipment. Refer to FS 1000, Table 1000-3 for selection of appropriate equipment.

3.2. For information on sample container size and construction, preservation and holding time requirements, see FS 1000, Tables 1000-4, 1000-5, 1000-8, 1000-9 and 1000-11.

3.3. For information on sampling equipment cleaning requirements, see FC 1000.

3.4. For information on documentation requirements, see FD 1000.

FS 2110. SURFACE WATER SAMPLING TECHNIQUES

Use the following protocols when collecting surface water samples. Adhere to all general protocols applicable to aqueous sampling detailed in FS 2000 when following the surface water sampling procedures addressed below.

1. **MANUAL SAMPLING:** Use manual sampling for collecting grab samples for immediate in-situ field analyses. Also use manual sampling in lieu of automatic equipment over extended periods of time for composite sampling, especially when it is necessary to observe and/or note unusual conditions.

1.1. Surface Grab Samples

See FS 2000, section 1.2 for discussions concerning the appropriate uses of grab samples. Collect surface grab samples within the top 12 inches of the water column. Avoid skimming the surface of the water during collection unless specifically required by the sampling plan. Very shallow water bodies require careful techniques of sample collection to avoid disturbing sediments (1.1.4 below).

Where practical, use the actual sample container as the collection device (direct grab). Sample containers attached to poles are also considered direct grabs.

The use of unpreserved sample containers is encouraged since the same container can be submitted for laboratory analysis after appropriate preservation. This procedure reduces sample handling and potential loss of analytes or contamination of the sample from other sources (e.g., additional sampling equipment, environment, etc.).

1.1.1. Direct Grab Technique

1.1.1.1. Using an unpreserved sample container to collect the sample:

- Remove the container cap and slowly submerge the container, opening first, into the water.
- Invert the bottle so the opening is upright and pointing upstream into the oncoming direction of water flow (if applicable). Allow water to run slowly into the container until filled.
- Return the filled container quickly to the surface.
- Pour out a small volume of sample away from and downstream of the sampling location. This procedure allows for addition of preservatives and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.
- Add preservatives, if required, securely cap container, label and complete field notes.

1.1.1.2. Using a sample container with premeasured preservative to collect the sample. (An unpreserved sample container may also be used with this technique.)

- Submerge the unopened sample container to the appropriate level.
- Turn the container so that the opening is upright and pointing upstream into the oncoming direction of water flow (if applicable).
- Open the container and allow the water to run into the container almost full (leave an air space).
- Cap the container and return to the surface.

1.1.1.3. If preservatives have been added, invert the container several times to ensure sufficient mixing of sample and preservatives.

1.1.1.4. Check preservation of the sample and adjust pH with additional preservative, if necessary. When a pH adjustment is made and a prepreserved container was used to collect the sample, always check all containers for proper preservation.

1.1.2. Sampling with an Intermediate Vessel or Container: If the sample cannot be collected directly into the sample container to be submitted to the laboratory, use an unpreserved sample container or an intermediate vessel (e.g., beakers, buckets or dippers) to obtain the sample. Where applicable, ensure that the bulk sample collected with the intermediate device is well mixed before distribution into individual sample containers in order to maintain homogeneity of the samples. These vessels must be appropriately cleaned and constructed including any poles or extension arms used to access the sample location.

1.1.2.1. Rinse the intermediate vessel with ample amounts of site water prior to collecting the first sample. Discard rinsate away from or downstream of the sampling location.

1.1.2.2. After adequate rinsing, fill the intermediate vessel with sample water. Minimize agitation or aeration of the sample if volatile organic compounds are to be collected.

1.1.2.3. Fill sample containers from the intermediate vessel. Minimize agitation or aeration during filling if volatile organic compounds are to be collected. Do not touch the sample container with the intermediate vessel.

1.1.2.4. Leave adequate headspace in the sample container. This procedure allows for addition of preservatives (if required) and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

1.1.2.5. Add preservatives if required, securely cap container, label and complete field notes.

1.1.2.6. Invert the container several times to ensure sufficient mixing of sample and preservatives.

1.1.2.7. Check preservation of the sample and adjust pH with additional preservative, if necessary.

1.1.3. Pump and Tubing: Use appropriate pumps, equipment, and tubing. (See restrictions listed in FS 1000 Tables FS 1000-1 through 1000-3).

Do not collect oil & grease, TRPH or FL-PRO samples with a pump. See FS 2000 for proper collection procedures for extractable organics and volatile organic compounds.

1.1.3.1. Lower tubing to a depth 6-12 inches below water surface, where possible.

1.1.3.2. Pump several tubing volumes through the system to flush the tubing prior to collecting the first sample.

1.1.3.3. Fill individual sample bottles via the discharge tubing, being careful not to remove the inlet tubing from the water.

1.1.3.4. Do not touch the discharge tubing to the sample container.

1.1.3.5. Leave adequate headspace in the sample container. This procedure allows for addition of preservatives (if required) and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

1.1.3.6. Add preservatives if required, securely cap container, label and complete field notes.

1.1.3.7. Invert the container several times to ensure sufficient mixing of sample and preservatives.

1.1.3.8. Check preservation of the sample and adjust pH with additional preservative, if necessary.

1.1.4 Sampling in shallow water

1.1.4.1. Do not collect a grab sample from water less than ten (10) cm deep due to the risk of disturbing sediment or flocculent bottom material.

1.1.4.2. Especially for waters with low or no flow, use extreme caution to avoid disturbing the sediment.

1.1.4.3. Use of an intermediate device may be appropriate to avoid creation of a sediment plume in cases of low or no flow.

1.2. Depth Grab Samples: Examples of equipment that may be used for depth grab sampling include Kemmerer, Niskin, Van Dorn and similar samplers; pumps with tubing and double check-valve bailers. See restrictions listed in FS 1000 Tables 1000-1, 1000-2 and 1000-3. Do not collect oil & grease, TRPH or FL-PRO samples with a pump. See FS 2000 for proper collection procedures for extractable organics and volatile organic compounds.

1.2.1. Kemmerer, Niskin and Van Dorn Type Devices

1.2.1.1. Many of these samplers are constructed of plastic and rubber that preclude their use for all volatile and extractable organic sampling. Some newer devices are constructed of stainless steel or are all Teflon or Teflon-coated. These are acceptable for all analyte groups without restriction.

1.2.1.2. Measure the water column to determine maximum depth and sampling depth prior to lowering the sampling device.

1.2.1.3. Mark the line attached to the sampler with depth increments so that the sampling depth can be accurately recorded.

1.2.1.4. Lower the sampler slowly to the appropriate sampling depth, taking care not to disturb the sediments.

1.2.1.5. At the desired depth, send the messenger weight down to trip the closure mechanism.

1.2.1.6. Retrieve the sampler slowly.

1.2.1.7. Rinse the sampling device with ample amounts of site water prior to collecting the first sample. Discard rinsate away from and downstream of the sampling location.

1.2.1.8. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described in sections 1.1.3.3 – 1.1.3.8 above.

1.2.2. Double Check-Valve Bailers: Collect samples using double check-valve bailers if the data requirements do not necessitate a sample from a strictly discrete interval of the water column. Bailers with an upper and lower check-valve can be lowered through the water column and water will continually be displaced through the bailer until the desired depth is reached, at which point the bailer is retrieved.

1.2.2.1. Sampling with this type of bailer must follow the same protocols outlined in section 1.2.1 above except that a messenger weight is not applicable.

1.2.2.2. Although not designed specifically for this kind of sampling, a bailer is acceptable when a mid-depth sample is required.

1.2.2.3. Note: This sampler does not perform as well as the devices described above or the pump and tubing described in section 1.2.3 below.

1.2.2.4. As the bailer is dropped through the water column, water is displaced through the body of the bailer. The degree of displacement depends upon the check-valve ball movement to allow water to flow freely through the bailer body.

1.2.2.5. Slowly lower the bailer to the appropriate depth. Upon retrieval, the two check-valves seat, preventing water from escaping or entering the bailer.

1.2.2.6. Rinse the sampling device with ample amounts of site water prior to collecting the first sample.

1.2.2.7. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described in sections 1.1.3.3 – 1.1.3.8 above.

1.2.3. Pump and Tubing: Use appropriate pumps, equipment and tubing. (See restrictions listed in FS 1000 Tables 1000-1, 1000-2 and 1000-3). Do not collect oil & grease, TRPH or FL-PRO samples with a pump. See FS 2000 for proper collection procedures for extractable organics and volatile organic compounds.

1.2.3.1. Measure the water column to determine the maximum depth and the sampling depth.

1.2.3.2. Tubing will need to be tied to a stiff pole or be weighted down so the tubing placement will be secure. Do not use a lead or metallic weight if collecting metals samples. Any dense, non-contaminating, non-interfering material will work (brick, stainless steel weight, etc.). Tie the weight with a lanyard (braided or monofilament nylon, etc.) so that it is located below the inlet of the tubing.

1.2.3.3. Pump several tubing volumes through the system to flush the tubing prior to collecting the first sample.

1.2.3.4. Fill the individual sample bottles via the discharge tube, being careful not to remove the inlet tubing from the water. Do not touch the discharge tubing to the sample container.

1.2.3.5. Leave adequate headspace in the sample container. This procedure allows for addition of preservatives (if required) and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

1.2.3.6. Add preservatives if required, securely cap container, label and complete field notes.

1.2.3.7. Invert the container several times to ensure sufficient mixing of sample and preservatives.

1.2.3.8. Check preservation of the sample and adjust pH with additional preservative, if necessary.

2. **AUTOMATIC SAMPLERS**: Use automatic samplers when several sites are to be sampled at frequent intervals or when a continuous sample is required. Composite samplers can be used to collect time composite or flow proportional samples (see FS 2000, section 1.3 for discussions on types of composite and appropriate use of composite sampling). Use appropriate equipment and tubing. (See restrictions listed in FS 1000 Tables 1000-1, 1000-2 and 1000-3). Do not collect VOC, oil & grease, TRPH or FL-PRO samples with automatic samplers, unless required by the sampling plan. See FS 2000 for additional restrictions for composited analytes and for proper collection procedures for extractable organics and volatile organic compounds.

The use of automatic samplers for collecting surface water samples will more frequently run into situations where sampling equipment is deployed on-site for a long term or dedicated to the site.

2.1. Installing and Programming the Composite Sampler

2.1.1. Use all new or precleaned pump tubing each time the sampler is brought to the field and set up. If the automatic sampler is deployed in the field for extended periods, it is recommended to replace the tubing at a minimum of every six months. Other replacement schedules may be required, depending on the specific installation and project requirements. Inspect the tubing each time the composite-sample container is picked up. If there is evidence of loss of elasticity or discoloration or other conditions that would impact the quality of the sample (such as algal growth), or the pumping flow rate, then replace the tubing. Select the tubing for the pump head and sampling train according to the analytes of interest and the allowable construction materials specified in FS 1000 Table FS 1000-1, 1000-2 and 1000-3.

2.1.1.1. Cut the proper length of precleaned Teflon or Tygon tubing.

2.1.1.2. Equipment Blanks: Autosampler tubing equipment blank can be collected prior to installation in sampler, including bulk tubing lengths later installed in multiple samplers. If tubing is changed at every sampling event a blank must be collected at a frequency of 5% of tubing changes. If tubing is not changed at every sampling event, collect a blank at each tubing change. Collect the blank by passing analyte-free water through the equipment that is exposed to the sample.

- Composite sample containers may be cleaned either in the field or in a fixed base operation. Demonstrate cleaning effectiveness by collecting equipment blanks on the composite sample containers according to the frequency specified in FQ 1000.

- Collect sample container equipment blanks by adding analyte-free water to the cleaned sample container, mix the water thoroughly within the container and then pour off an aliquot for analysis.

2.1.1.3. Put the collection sieve and tubing in the appropriate sample location, using conduit if necessary to hold it in place. Ensure the supporting conduit does not contaminate the incoming sample water.

2.1.1.4. Program the sampler per manufacturer's directions and as required in the permit or work plan conditions.

2.1.1.5. Automatic Sampler Security: Place a lock or seal on the sampler to prevent or detect tampering. This procedure, however, does not prevent tampering with the sampler tubing. See additional discussions on sample security in FS 2410, section 2.3.2.

2.2. Sample Acquisition

2.2.1. At the end of each sampling period, stir the contents of the composite jug and transfer the contents into the respective containers. If the sampler was configured to collect discrete samples, ensure that the contents of each container are adequately mixed while pouring the sample into the sample container.

2.2.2. Immediately preserve the sample, if required, securely cap container, label and complete field notes.

2.3. Long Term Deployment of Automatic Composite Samplers: In certain sampling situations, automatic composite samplers are permanently installed at surface water stations and remain in the field for months or even years. Under these conditions, there are specific sampling issues that need to be addressed.

2.3.1. Sample Preservation

2.3.1.1. If the only analyte of interest is Total Phosphorus and the project is unrelated to an NPDES permit, the sample must be chemically preserved with sulfuric acid (H_2SO_4) but it need not be cooled to $\leq 6^\circ C$ in wet ice.

2.3.1.2. The acid must be in the container prior to drawing the first composite sample into the container.

2.3.1.3. When using large (i.e., 3 gallon) composite sample containers, and there is potential for the sample size to vary greatly due to variable flow rates at the site, the volume of acid for preservation should be small (e.g., 1 to 2 mL of 50% H₂SO₄). **Do not over acidify the sample.** Upon sample pick-up, if needed, add additional acid to achieve the proper pH adjustment for preservation.

2.3.1.4. If parameters other than total phosphorus are to be analyzed, appropriate additional preservation (e.g., cooling with ice or refrigeration) is required.

2.3.1.5. Deviations from these SOPs concerning preservation and holding times relating to remote and long term deployments due to site specific considerations must be agreed upon by project management.

2.3.2. Cleaning Requirements

2.3.2.1. Clean composite sampler containers after collection of each composite sample using cleaning solutions and procedures specified in FC 1140, sections 5 through 9.

2.3.2.2. Composite sample containers may be cleaned either in the field or in a fixed based operation. Demonstrate cleaning effectiveness by collecting equipment blanks on the composite sample containers according to the frequency specified in FQ 1000. Collect sampler container equipment blanks by adding analyte-free water to the cleaned sample container, mix the water thoroughly within the container and then pour off an aliquot for analysis.

2.3.2.3. Inspect and replace tubing at a minimum of every six months or when applicable, as discussed in section 2.1.1 above. Collect equipment blanks as specified in section 2.1.1.2 above. If the tubing is being replaced for multiple autosamplers at the same time, one equipment blank may be collected on the entire length of replacement tubing. Collect this equipment blank by passing analyte-free water through the entire length of new tubing.