Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Manually Obtaining Surface Water Samples

Version 1.0

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Signatures on File

Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.

Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)
10/10/2006	1.0	Formatting; signatories	all	Bill Kammin

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Water Quality Studies Unit Standard Operating Procedure (SOP) for manually obtaining representative samples from surface waters. This SOP covers the use of secondary collection devices from boats and bridges, but it does not describe the operation of unattended automated sampling devices, pelagic marine sampling or groundwater sampling. The SOPs for the EAP long-term freshwater and marine sampling programs have many similar elements in their procedures.

2.0 Applicability

2.1 This SOP should be followed for all manual collection of water samples for surface water studies. It includes procedures for collecting samples from freshwater or brackish water lotic and lentic waters (defined in Section 3.0), from wastewater treatment plant access points, and from outfalls, pipes and drains. It also describes procedures for sampling while wading on beaches and from boats and bridges.

3.0 Definitions

3.1 Composite sample: A sample in one container comprised of discrete sub-samples collected spatially or temporally or both.

3.2 Grab sample: A sample collected during a very short time period at a single location.

3.3 Halocline: The depth where salinity increases rapidly over a relatively short depth interval in a manner similar to a thermocline.

3.4 Integrated sample: A sample comprised of continuously collected sub-samples from a water column or across a cross-section of a waterbody - differentiated from a composite sample by the term ‘continuously collected’.

3.5 Lotic: Flowing water systems such as rivers and streams.

3.6 Lentic: Still water systems such as lakes and ponds.

3.7 Thalweg**:** The line defining the points along the length of a river bed with the greatest volume of moving water.

3.8 Thermocline: Any depth at which the temperature drops rapidly over a short interval, traditionally at a rate of 1º C or more for each 1 meter of depth.

4.0 Personnel Qualifications/Responsibilities

4.1 All field staff must comply with the requirements of the EA Safety Manual (EA Program, 2006). A full working knowledge of the procedures in Chapter 1 'General Field Work', especially the sections 'Working in Rivers and Streams', 'Working near Traffic and from Bridges', and 'Fall Protection' is expected. If they are sampled, Chapter 5 'Inspecting Wastewater Treatment Facilities' is required reading. Sampling from an Ecology boat requires one person onboard to be a qualified boat operator as described in Interim Ecology Policy 11-60; all persons onboard must be familiar with Chapter 3 of the EA Safety Manual, 'Boating'.

4.2 All field staff must be familiar with other standard procedures described for water quality parameters in this document. Several water quality parameters have special sample pre-treatment, filtering, post-treatment, and collection procedures applicable to this chapter. If a vertically integrated sampler is to be used, the field staff should read Chapter 4, 4.1.1 – Isokinetic Depth-Integrated Sampling Methods (USGS, 2006).

4.3 The Field Lead directing sample collection must be knowledgeable of all aspects of project's Quality Assurance Project Plan (QAPP) to ensure that credible and useable data are collected. All field staff should be briefed by the Field Lead or Project Manager on the sampling goals and objectives prior to arriving to the site.

5.0 Equipment, Reagents, and Supplies

5.1 General Equipment and Supplies

5.1.1 Intermediate sampling devices, e.g. syringe for field filtering, stainless or Teflon dipper, DH-76 integrated sampler, Van Dorn or Kemmerer sampler, appropriate ropes/cables/rods, mobile bridge crane or davit (Figure 1).

5.1.2 Glass or polypropylene bottle supplied by the laboratory with appropriate preservatives and filtering devices (Figure 2).

5.1.3 Safety equipment appropriate for the sampling sites: safety vests and lines, bridge traffic control signs and cones, or boating safety equipment.

5.1.4 Latex gloves for hygienic protection; leather gloves for handling ropes and cables.

5.1.5 Anti-bacterial hand sanitizer or soap.

5.1.6 Coolers.

5.1.7 Ice (Regular, blue, or dry –depending on shipping method).

5.1.8 Tap water.

5.1.9 Sample tags with sample numbers assigned by the Manchester Environmental Laboratory (MEL).

5.1.10 Lab Analysis Request (LAR) forms.

5.1.11 Field notebook and pens.

Figure 1. Top: DH-76 integrated sampler with bottle; Kemmerer bottle.
Bottom: Weighted bottle and DO bucket for bridges; Van Dorn sampler.

5.2 Sample Containers

5.2.1 The normal container for surface water samples are polypropylene or glass. The MEL manual describes the type of bottle and volume of sample necessary to complete the laboratory analysis. The containers usually come directly from the MEL and some may have chemicals to stabilize or neutralize the sample.

Figure 2. Sample containers commonly used for water samples.

5.2.2 Check bottles for loose lids. Damaged or leaking containers should be discarded.

5.2.3 Containers left-over from previous projects should be closely inspected before using. Bottles smaller than 500 mL with lost or discolored preservative should be discarded. Suspect bottles larger than 500 mL can be sent back to MEL for cleaning.

5.2.4 Holding times for sterilized microbiological sample bottles are:

5.2.4.1 3 months without thiosulfate/EDTA
5.2.4.2 1 month with thiosulfate/EDTA

5.2.5 For efficiency, some analyses can be performed from one container. The MEL manual describes these combinations.

6.0 Summary of Procedure

6.1 Pre-sampling Trip Preparation

6.1.1 File a 'Field Work Plan & Contact Person Form'. In addition, an 'Ecology Float Plan' must be filed if a boat will be used.
6.1.2 Obtain proper sample bottles from the laboratory and arrange for sample analyses.
6.1.3 Obtain ropes, extension poles, meters, and intermediate sampling devices through equipment check-out procedures.
6.1.4 If the laboratory needs to make special preparations for your sample analyses, it is especially important that sampling is prearranged with the lab. Two weeks is the preferred amount of notice.
6.1.5 Sampling on Thursday through Sunday must be pre-approved with the laboratory for bacteria and other analyses with short holding times.
6.1.6 If the range of concentrations can be estimated before sampling (from past samples or otherwise), inform the lab beforehand or write it on the sample tags so the proper set of dilutions can bracket the range.

6.1.7 If the water is extremely turbid (<25 mL can be filtered) the laboratory may need to modify its analytical method. Call the lab as soon as possible so they can prepare for adjustments.

6.1.8 Prior to collecting sample, have sample tags prepared containing the project name, sample number, site, date, and space for time. Also have field lab book or page prepared with similar information.

6.2 General Considerations and Cautions

6.2.1 Never compromise your personal safety or that of a field partner to collect a water sample. Always plan ahead to avoid falling and drowning hazards.

6.2.2 If only one sample is taken from a site in a lotic system, collect it in, or as close as safely possible, to the thalweg or predominant downstream current. Avoid back eddies and side channels that would not be representative of the water quality affecting downstream sites. If stratification is present, consider sampling the strata individually.

6.2.3 If a collecting vertically integrated samples along a transect while wading, set-up a tag line for safety and to help keep a straight transect.

6.2.4 If only one sample is taken from a site in a lentic or estuarine system, determine the most representative site to safely sample and achieve the goal of the project. Determine if stratification is present with a thermistor, salinometer, or by other means. If stratification is present, consider sampling the strata individually. Note the depth of the halocline or thermocline in the field notebook and the depth where the sample(s) were collected.

6.2.5 Do not rinse a sample container that has preservative or one that is sterilized.

6.2.6 If wading into the water body and samples can be stored in a cool and dark container, collect water samples first before conducting discharge measurements, macroinvertebrate sampling or sediment sampling. If water samples cannot be immediately cooled and stored in the dark, collect water samples last upstream from the disturbed area of the other sampling tasks.

6.2.7 Be careful not to disturb sediment from the stream bed, particularly in slower moving waters. For slow moving streams with easily disturbed sediment, collect sample from stream bank using sampling extension pole and avoid touching the stream bottom.

6.2.8 If sampling from a bridge, determine the thalweg by visual inspection or by measuring velocities on the cross-section. Also determine if the current is too strong to allow a weighted bucket or intermediate sampling device to sink and obtain a representative sample.

6.2.9 If sampling from a boat, avoid gas and oil contamination. Collect the sample from near the bow while the boat moves upstream or upwind.

6.2.10 Direct Sampling Surface Water

6.2.10.1 Remove stopper/lid from container just before sampling. Be careful not to contaminate the cap, neck, or the inside of the bottle with your fingers, wind-blown particles, or dripping water from your clothes, body, or overhanging structures.

6.2.10.2 If no preservative is present in the container, face upstream in lotic waters and upwind in lentic waters and proceed as follows:

6.2.10.4.1 Place yourself facing away from the shore, pier, or the side of the sampling platform or boat.

6.2.10.4.2 Hold the container near its base, reach out in front of yourself as far a possible, and plunge it (mouth down) below the surface to about elbow depth if the sediments will not be disturbed.

6.2.10.4.3 Fill the bottle to the appropriate level depending on the analyte to be tested.

6.2.10.4.4 Pour out a small volume if needed to create a headspace for mixing in the lab. Do not create a headspace for some analytes like volatile organics.

6.2.10.3 If an extension pole is used from a pier, a dock or from shore, securely attach the sample container (with its lid in place) to the holder with the clamps or bands. Remove the container lid being careful not to contaminate the container and follow the above procedure. Do not use this method for samples that already have preservative in the container; use methods outlined in 6.2.2 - Sampling with Intermediate Equipment or Containers.

6.2.10.4 If preservative is present in the container and you can reach the water with your hand, use the following procedure:

6.2.10.4.1 Hold the container upright and place the lid over the mouth so that only a small area forms an opening (Figure 3).

6.2.10.4.2 Immerse the bottle 15 cm (6 in) while holding the cap in position with your fingers as far away from the opening as possible.

6.2.10.4.3 Carefully observe the rate the container is filling and remove it from the water before the headspace area is reached or overfilling occurs.

6.2.10.4.4 This procedure does not work well in forceful jets of water from drains and outfalls.

6.2.10.5 Sample free-falling water from drains, pipes and outfalls by using an intermediate sampling device, or by carefully placing the sample bottle in the stream of water away from any pipe or bank surface.

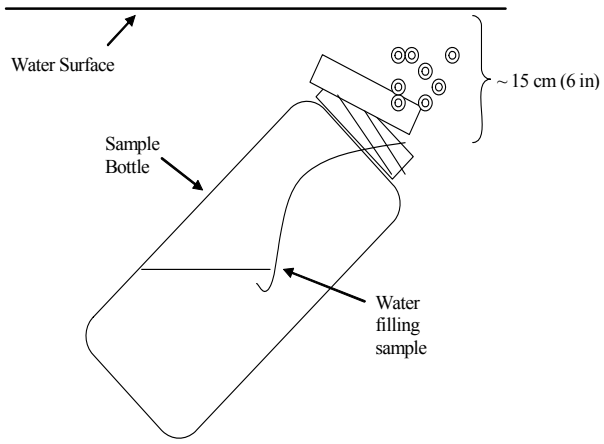

Figure 3. Illustration of the cap position on a sample container being filled that already contains a preservative.

6.2.10.6 Securely replace the lid of the container. Invert it several times to evenly mix preservative with the sample.

6.2.10.7 Rinse any large amount of dirt or debris from the outside of the container.

6.2.10.8 Attach the ID tag. Place in appropriate storage.

6.2.11 Sampling with Intermediate Equipment or Containers

a)  b) 

Figure 4. a) Syringe and filter used for dissolved nutrient samples. b) Dipper used from bank.

6.2.11.1 Rinse a large syringe, dipper (Figure 4), DH-76, or intermediate container (Figure 1) with site water and pour the rinsate away from or downstream of the sampling location. If a dipper or bucket has been used in a contaminated environment (e.g. wastewater treatment plant, stormwater drain), it should be washed with soap and water and rinsed off-site before use. Some organic and micronutrient sampling procedures require acid and distilled water rinses as well. For especially turbid sites, be sure to inspect and rinse-out any sediment or organic debris that may have collected at the bottom of the container.

6.2.11.2 Fill the intermediate container with water following the technique described above (6.2 – 6.2.1) as closely as possible. Submerge the container to a depth that does not disturb bottom sediments, but also avoids sampling the surface layer.

6.2.11.3 For vertically integrated samples, raise and lower the sampler at a constant rate and avoid disturbing bottom sediments. If the sample container is overfilled or underfilled, dump the sample and adjust the transit rate or try a different nozzle size (USGS, 2006).

6.2.11.4 Kemmerer or Van Dorn bottles should be lowered to an appropriate depth and triggered with a messenger. Be aware that messengers may not work if the messenger is too light for the transit depth to the bottle.

6.2.11.5 Sticks and leaves can be removed from the bucket or dipper if contamination of the sample can be avoided. Gently mix the water in the intermediate container by swirling before pouring it into the sample containers. From the intermediate container, carefully fill the sample containers that have preservatives and other sample containers, leaving adequate headspace as needed. Do not overfill. Put a note in the field notebook if you suspect that sand or other heterogeneous materials were not adequately represented in the sample.

6.2.11.6 Release the first 50 - 100 mL from the Kemmerer or Van Dorn sampler outlet before beginning to fill sample containers. Avoid contaminating the sample with your hands or with the outlet extension tube.

6.2.11.7 Securely replace the stopper/lid of each sample container. Invert several times to evenly mix preservative with the sample.

6.2.11.8 Rinse any large amount of dirt or debris from the outside of the container.

6.2.11.9 Attach the ID tag. Place in appropriate storage.

6.2.12 Samples Collected from Bridges

6.2.12.1 Before collecting a sample, follow the guidelines in the Safety Manual chapter, 'Working near Traffic and from Bridges'. Sample from the bridge only if all safety precautions are taken and the risk of injury is negligible.

6.2.12.2 Pick a spot on the downstream side of the bridge and observe the following:

6.2.12.2.1 Are you over the thalweg of the water body?

6.2.12.2.2 Is the current too swift for the weight of your sampler? Do you have enough rope/rods/cables to break the water's surface and overcome the downstream current velocity? Will you be able to pull a weighted bucket up against the force of the current?

6.2.12.2.3 Are debris moving downstream or is there boat traffic moving upstream or downstream? If conditions warrant, post an observer with a clear view of upstream and downstream conditions.

6.2.12.2.4 If you do not know the depth of water at the site, roughly measure it so the sampling device will not disturb bottom sediments when deployed.

6.2.12.2.5 Clear any loose debris from the bridge railing and make sure the path from the railing to the water's surface is clear of obstructions.

6.2.12.3 If the DH-76 or other vertical integrated sampling device is being used, measure both depth and velocity at the transect points on the bridge. Mark transect points or stretch a tape along the bridge for easier reference.

6.2.12.4 Assemble and secure the sampler with ropes/rods/cables - untangled and keep clear all ropes/rods/cables from feet and bridge traffic.

6.2.12.5 If the DH-76 or other integrated sampling device is being used, install the correct nozzle size for the depth and velocities at the site.

6.2.12.6 Place clean intermediate container or sterilized bottle into the sampler and secure carefully.

6.2.12.7 Remove stopper/lid just before lowering the sampler-with-bottle down on the rope, and set it somewhere free of dirt or other sources of contamination.

6.2.12.8 Wear canvass or leather gloves to protect your hands from rope burns. Lower the sampler in such a manner so as not to contaminate the open bottle with dirt or dripping water.

6.2.12.9 When approaching the water surface, drop the sampler quickly through the surface to avoid the micro-layer to a depth of 15 cm (6 in) or more unless contact will be made with the substrate.

Figure 5. Various methods of collecting water samples from bridges**.**

6.2.12.10 Keep the bottle submerged long enough for the container or bucket to fill.

6.2.12.11 For vertically integrated samples, raise and lower the sampler at a constant rate and avoid disturbing bottom sediments. If the sample container is overfilled or underfilled, dump the sample and adjust the transit rate or try a different nozzle size (USGS, 2006).

6.2.12.12 Be aware that if Kemmerer and Van Dorn bottles are being used from bridges and the river current is swift, the messenger may not be able to trigger the closing mechanism.

6.2.12.13 Pull up the sampler and bottle, careful not to contaminate the sample with dirt or water from either the rope or bridge, or other sources of contamination.

6.2.12.14 Pour out sample to allow for the air space needed for proper mixing at the lab (unless bottle contains preservative).

6.2.12.15 Securely replace the aluminum covered stopper/lid.

6.2.12.16 Rinse any large amount of dirt or debris from the outside of the container.

6.2.13 Samples collected from wastewater/point source effluent

6.2.13.1 All staff must read and have a working knowledge of Chapter 5. 'Inspecting Wastewater Treatment Facilities' in the Safety Manual before collecting samples from a facility.

6.2.13.2 Conduct a reconnaissance of potential sampling sites with assistance from facility personnel. Attend to all safety precautions. Avoid confined spaces.

6.2.13.3 Locate an appropriate sampling location representative of water being discharged to the receiving water body. In particular, the location should be below any chlorination or ultra-violet (UV) application.

6.2.13.4 Use a sampling extension pole or dipper (Figure 4) to collect samples without contacting the effluent with your hands.

6.2.13.5 Note residual chlorine concentrations on lab sample tags.

6.2.14 Samples collected from marine water bathing beach

6.2.14.1 (Taken from the Beach Environmental Assessment, Communication and Health (BEACH) program guidance). More beach sampling information is available from the: Quality Assurance Project Plan: BEACH Program (Schneider, 2004).

6.2.14.2 Wade into roughly 2.5 feet of water.

6.2.14.3 Fill a water bottle at each of three sampling sites by wading into knee deep water. Follow procedures 6.2.1 or 6.2.2 as appropriate. If possible use a sampling extension pole (Figure 4) to avoid collecting disturbed sediment.

6.3 Sample Labeling and Storage

6.3.1 After collecting sample, immediately loop the string attached to the proper sample tag over stopper/lid until secure (at least three loops for 250 mL and at least two loops for 500 mL). Make sure to attach sample tag beneath, not on top of, the aluminum foil cover of microbiology bottles, as the covers can be easily separated from the sample during transport and handling.

6.3.2 Check the tag to ensure accurate location and analytical information. Record the time the sample was collected on the tag and enter relevant data into the field notes. Use waterproof ink.

6.3.3 Place labeled sample bottle in a cooler with a tight-fitting lid. It is important to cool most samples to 4°C immediately and store them in the dark.

6.4 Sample Transport

6.4.1 Samples transported from the EAP Operations Center (OC) by MEL courier:

6.4.1.1 Pack samples in regular cubed or crushed ice. Deliver samples to walk-in cooler at EAP OC and leave Lab Analysis Requested (LAR) forms in the "Out" box near the walk-in cooler. Make sure the LAR form contains the project name, station names, sample numbers, date, times, and parameters at a minimum.

6.4.2 Samples shipped via air or ground freight service:

6.4.2.1 Samples must be collected in polypropylene containers, not glass. Pack samples using blue or dry ice (check with airline for restrictions on dry ice). Cool to 4°C and store in dark cooler. In warmer weather (80°F and above) use ten to twelve blue ice packs per cooler. In cooler weather (below 80°F) use six to eight blue ice packs, to avoid freezing samples. Tape Lab Analysis Requested (LAR) form to the inside of the cooler and tape coolers shut after inspection.

7.0 Records Management

7.1 Each sample collection will be fully described in the field notebook with waterproof ink, e.g. date, time, location identification, sample laboratory identification number, sample type, analyses to be performed, and ancillary data. Entries will be kept neat and concise. Measures will be taken to avoid losing the field notebook.

7.2 Sample locations will be described in enough detail to find on a USGS 7.5 minute map or an Environmental Information Management (EIM) System map cover. Otherwise, a global positioning system (GPS) unit will be used to record an accurate location. Coordinates will be recorded as per EIM requirements.

7.3 Complete information for each laboratory sample will be entered onto a Request for Analysis form when the samples are submitted to Manchester Environmental Laboratory or other analytical facility.

8.0 Quality Control and Quality Assurance

8.1 QA/QC procedures will be addressed thoroughly on a project-by-project basis in the QAPP for the project.

9.0 Safety

9.1 All field staff must comply with the requirements of the EA Safety Manual, especially Chapter 1 'General Field Work' that include special circumstances like fall protection, working on bridges, and working in rivers and streams. A review of 'Chapter 5 'Inspecting Wastewater Treatment Facilities' is required if the plan calls for collecting samples from a facility. Sampling from an Ecology boat requires one person onboard to be a qualified boat operator as described in Interim Ecology Policy 11-60; all persons onboard must be familiar with Chapter 3 of the EA Safety Manual, 'Boating'.

9.2 For further field health and safety measures refer to the Environmental Assessment Program (EAP) Safety Manual

9.3 Canvass or leather gloves will protect hands from rope burns when lowering intermediate sampling equipment from bridges. Care is necessary on bridges to keep lines, ropes, and cables clear of other equipment, legs, and traffic.

9.4 Preferably, latex gloves should be worn to avoid bacterial or chemical exposure while performing direct sampling. If gloves are not worn, hands should be cleaned using anti-bacterial soap or hand sanitizer after each sampling station. Before ingesting food or drink, dirty over-clothes should be changed and hands should be washed.

10.0 References

10.1 APHA, 1998. Standard Methods for the Examination of Waste and Wastewater. 20th Edition.

10.2 Environmental Assessment Program, 2006. Environmental Assessment Program Safety Manual. March 2006. Washington State Department of Ecology. Olympia, WA.

10.3 MEL, 2005. Manchester Environmental Laboratory Lab Users Manual Eighth Edition. Environmental Assessment Program. Washington State Department of Ecology. Manchester, WA.

10.4 Schneider, Lynn, 2004. Quality Assurance Project Plan: BEACH Program. Environmental Assessment Program of the Washington State Department of Ecology. Olympia, Washington.

10.5 USGS, 2006. National Field Manual for the Collection of Water-Quality Data. U S Geological Survey, Water Resources Office of Water Quality. Chapter 4.1 Surface Water Sampling: Collection methods at flowing-water and still-water sites. **http://water.usgs.gov/owq/FieldManual/chapter4/html/4.1.1.html**