DEPARTMENT OF ECOLOGY
State of Washington

# Standard Operating Procedure EAP038, Version 1.4

## Collection of Freshwater Sediment Core Samples Using a Box or KB Corer

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## Purpose of this Document

The Washington State Department of Ecology develops Standard Operating Procedures (SOPs) to document agency practices related to sampling, field and laboratory analysis, and other aspects of the agency's technical operations.

## Publication Information

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The Washington State Department of Ecology's (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 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 | Revision History | Summary of Changes | Sections | Reviser(s) |
|---|---|---|---|---|
| 10/17/11 | V1.0 | Recertified | | William Kammin |
| 08/16/12 | V1.1 | Updated hyperlink | 7.3 | Callie Mathieu |
| 07/14/15 | V1.2 | Updated sections | 6.3, 6.4, 6.7 | Callie Mathieu |
| 07/24/15 | V1.2 | Recertified | | William Kammin |
| 02/13/18 | V1.3 | Removed MSDS, updated Safety Section | 9.4 | Callie Mathieu |
| 3/14/18 | V1.3 | Recertified | | Tom Gries |
| 09/30/21 | V1.4 | Converted SOP to new template, made minor revisions to several sections, added accessibility text to all figures and tables, updated references and links | All | Callie Mathieu |

## 1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for obtaining freshwater sediment core samples using the two sediment-coring devices available through EAP. This SOP covers sediment collection for studies requiring representative, vertical sediment samples for use in chemical or biological analyses. Sediment core samples are usually divided into cross-section subsamples to provide a chronological history of analytes.

## 2.0 Applicability

2.1 This SOP should be followed for all freshwater sediment core collection activities performed within the Department of Ecology's (Ecology's) Toxics Studies Unit. This SOP does not apply to sample collection in marine or estuarine waters.

## 3.0 Definitions

3.1 Sediment Core Sample – A vertical sample of relatively undisturbed sediments obtained by a sediment corer. Ecology owns the following sediment-coring devices:

3.1.1 Box Corer – A sediment-coring device containing an 11x11x50 cm acrylic liner. This coring device has a pair of jaws at the base of the apparatus held open by a spring-loaded pin. The pin is released once the corer contacts the sediments. Upon retrieval, the jaws close and collect the sediments. The depth of the sample is controlled by weights loaded on top of the device. A fine mesh screen located at the top of the acrylic liner allows water to flow through the jaws during descent, and rubber flaps on the top side of the mesh screen block water from passing through the sediment sample upon retrieval.

3.1.1.1 The box corer is best suited for studies requiring large amounts of sediments (> 100g) when the core is sectioned into 1-cm intervals. Disadvantages of the box corer include the requirement of a winch to raise and lower the device and the immobile extruding table. Currently, these two factors limit the use of the box corer to the RV Skookum.

3.1.2 Modified KB Corer – A gravity corer containing a 6.35 cm diameter by 61 cm acrylic tube. A core sample is obtained by lowering the sampler into the sediments and sending a messenger weight to trip the spring-loaded suction cup, sealing the top of the core tube. This coring device uses suction to hold the sediment sample inside the core tube during retrieval. The depth of the sample is controlled by the distance the device is allowed to fall before entering the sediments.

3.1.2.1 The corer is deployed and recovered by hand, making it a portable sampling device. The KB corer is best suited for studies that do not require large amounts of sediments across 1-cm intervals or where the RV Skookum cannot be launched. The modified KB corer is not a good sampler choice for soupy or very soft sediments because the suction force cannot hold in the sample. It also may be difficult to obtain a core sample in extremely firm substrates, such as clay.

3.1.3 Other samplers not currently owned by Ecology include piston, chamber, freeze, vibra- hammer, and pneumatic corers.

## 4.0 Personnel Qualifications/Responsibilities

4.1 The Field Lead directing sample collection must know all aspects of the project-specific Quality Assurance Project Plan (QAPP) to ensure that credible and useable data are collected. The Field Lead should brief all Field staff on the sampling goals and objectives before arriving at the site.

4.2 All field staff must be familiar with and follow the EAP Safety Plan (Ecology 2019) and the EAP standard operating procedure EAP070, *Minimize the Spread of Invasive Species* (Parsons et al. 2018).

4.3 Sampling from an Ecology boat requires one person on board to be a qualified Boat Operator as described in Interim Ecology Policy 11-60. All other persons on board (crew) must be familiar with Chapter 3 of the EAP Safety Manual, "Boating" (Ecology 2019). The safety responsibilities of the Boat Operator and crew are described in this chapter. Sampling from Ecology's RV Skookum requires all persons on board to be familiar with Skookum safety procedures and the operation of the winch/A-frame.

4.4 This SOP will be followed by Natural Resource Scientists, Environmental Specialists, Environmental Engineers, Hydrogeologists, and Interns and Technician staff in the Environmental Assessment Program.

## 5.0 Equipment, Reagents, and Supplies

5.1 Coring Equipment

5.1.1 In addition to all necessary equipment required for a safe and organized field outing, the following will be needed specifically for sediment core collection:

5.2 Box corer:

5.2.1 Multiple pre-cleaned acrylic liners

5.2.2 Extruding table

5.2.3 Extruding device with rubber extruder

5.2.4 Hand crank

5.2.5 Core slicer

5.2.6 Acrylic liner section

5.2.7 Lead weights

5.3 Modified KB corer:

5.3.1 Core tube

5.3.2 Extruder

5.3.3 Sectioning apparatus

5.3.4 Stage

5.3.5 Rubber stopper

5.3.6 Spatula

5.3.7 Screwdriver

5.3.8 Large plastic tub

5.4 Siphon tubing

5.5 Measuring device

5.6 Non-talc, disposable nitrile gloves

5.7 Cleaning brush

5.8 Deionized water

5.9 Ice chests with extra ice

5.10 Field logs (on Rite-in Rain paper)

5.11 Plastic bags (Ziploc, garbage)

5.12 Preprinted sample container labels with extra blank labels

5.13 Chain of Custody tags and forms

5.14 Pencils, indelible ink pens (fine and regular)

5.15 Tape (duct and masking)

5.16 Clipboard with cover

5.17 Maps, charts, aerial photographs

5.18 GPS unit

5.19 Cell phone

5.20 Stainless steel spoons and mixing bowls (if processing on boat)

5.21 Sediment Sample Containers – appropriate containers for project-specific analyses are listed in the Manchester Environmental Laboratory Lab Users Manual. The number of containers is project-specific.

Table 1. Ecology Sediment-Coring Devices.

| Sediment Corer | Construction Materials | Liner dimensions (cm) | Maximum Penetration Depth (cm) |
|---|---|---|---|
| Box corer | Stainless steel sampler; acrylic liner | 11 x 11 | 50 |
| Modified KB corer | Plexiglass core tube, stage, and sectioning apparatus | 6.35 diameter | 55 |

5.22 Box Corer

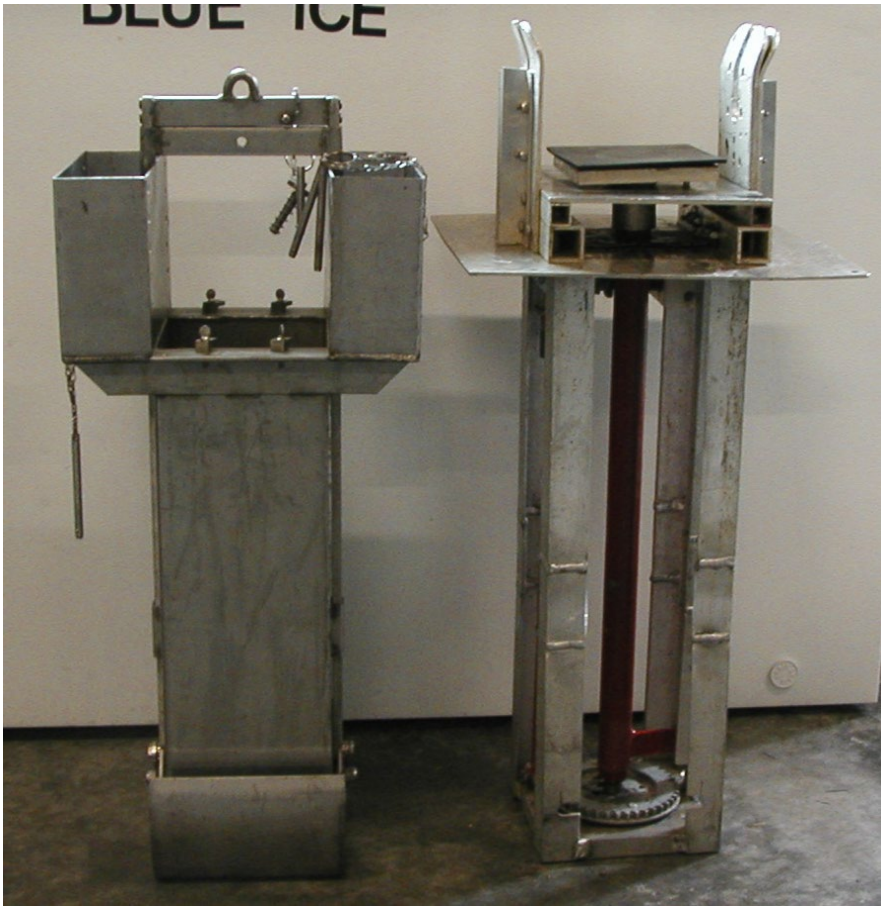

Figure 1. Box corer and extruding device pictured left to right.

**Figure 2.** Pictured left to right acrylic liner (50 cm), acrylic liner section, lead weight, slicing plate, and hand crank.

5.23 Modified KB Corer

**Figure 3.** Pictured left to right are extruder, core tube with sectioning apparatus, and sampling housing apparatus.


**Figure 4**. Modified KB corer with suction cup engaged.

5.24 Decontamination Equipment

5.24.1 Acetone

5.24.2 Hexane

5.24.3 10% Nitric Acid

5.24.4 Liquinox

5.24.5 Deionized Water

5.24.6 Decontamination chemicals will be specific to the target analytes of the study. Consult EAP Standard Operating Procedure EAP090: Decontaminating Field Equipment for Sampling Toxics in the Environment (Friese 2021) for decontamination protocols.

5.24.7 Scrub brushes

5.24.8 Nitrile Gloves

5.24.9 Butyl Gloves

| | |
|---|---|
| 5.24.8.1 | For information on selecting appropriate gloves for protection from specific chemicals, consult the table posted in the Ecology Headquarters Cleaning Room. Heavy gloves may also be necessary for handling rope or wire used to lower and retrieve grab samplers. |
| 5.24.9 | Wash bottles |
| 5.24.10 | Waste bottles |
| 5.24.11 | Small funnel to pour chemicals into wash/waste bottle |
| 5.24.12 | Cellular Sponges (3"x 5") - must be new, uncontaminated |
| 5.24.13 | Large tub |
| 5.25 | Safety Equipment |
| 5.25.1 | Life vests and other boat safety equipment (see "Boat Checklist" in the EAP Safety Manual) |
| 5.25.2 | Safety goggles |
| 5.25.3 | First aid kit |
| 5.25.4 | Steel-toed boots |
| 5.25.5 | Hard hats (required for deck work on the RV Skookum) |
| 5.25.6 | Drinking water |
| 5.25.7 | Communications equipment (cell phone or radio) |

## 6.0 Summary of Procedure

| | |
|---|---|
| 6.1 | The box corer and modified KB corer are operated from a boat platform. Due to the weight of the box corer and the custom-built extruding apparatus, the RV Skookum is the only boat equipped for the box corer, and further discussion relating to the box corer applies to this scenario. |
| 6.2 | The KB corer can be used from any boat providing adequate workspace and the ability to reach 2 – 3 feet into the water to plug the core tube. Therefore, it is essential to have a working area close to the water surface. Summaries involving the KB corer apply to this scenario. |
| 6.3 | Pre-sampling Trip Preparation |
| 6.3.1 | Reserve a boat and make arrangements for qualified Boat Operator. |
| 6.3.2 | Prepare all sample containers, ice chests, and buckets. |
| 6.3.3 | File a field and float plan. |
| 6.3.4 | When using the box corer, mount the extruder table on the Skookum before launching. To secure the table, you need to work under the stern. |
| 6.3.5 | Pre-clean the acrylic liners, core tube (for modified KB corer), core slicers, and any other devices coming into contact with sediments before use in the field. The following cleaning procedure is suggested for sediment core sampling. However, depending on |

the analytes of interest, individual projects may require additional or different decontamination procedures. Staff should follow EAP Standard Operating Procedure EAP090: Decontaminating Field Equipment for Sampling Toxics in the Environment (Friese 2021).

6.3.5.1 Wash using Liquinox detergent.

6.3.5.2 Rinse three times with tap water.

6.3.5.3 Wash with 10% nitric acid (for metals analyses).

6.3.5.4 Rinse with deionized water.

6.3.5.5 In fume hood, rinse with hexane (for most organics analyses).

6.3.5.5.1 This step is intended to remove trace organics from the sampling equipment, although EPA (2001) also recommends it for field samples of "unknown composition." Many sources, including EPA (2001), recommend only an acetone rinse. Because the acetone molecule has both polar and non-polar components, it is a good solvent for a broad range of chemicals. However, acetone may damage acrylic material and should not be used on the acrylic liners. Hexane is a good solvent for organic compounds and is recommended particularly for analyses of dioxins and PCBs.

6.3.6 Air dry in fume hood and wrap with aluminum foil (shiny side of the foil facing out)

6.3.7 Note: Sediment core subsamples are generally processed in the laboratory. If mixing or compositing is done in the field, make sure to include stainless steel spoons and bowls in the decontamination procedure.

6.4 Sample Collection

6.4.1 Box Core Sample Collection

6.4.1.1 In general, sediment cores should be taken from deep and flat areas of the lake, particularly if an age/depth profile will be calculated. The following is a step-by-step procedure for collecting a core with the box corer.

6.4.1.1.1 Deployment

6.4.1.1.1.1 Ensure that the box corer is secured to the cable operated by the winch at the stern of the boat. The winch/A-frame is used to control movement of the corer.

6.4.1.1.1.2 Secure the acrylic liner inside the box corer by tightening the threaded liner stopper. Tightening this will not allow the liner to move while penetrating the sediment. Secure the mesh screen onto the top of the acrylic liner.

6.4.1.1.1.3 Open the jaws on the box corer and set the spring-loaded pin to deploy when the device contacts the sediments.

6.4.1.1.1.4 Lower the box corer gently into the sediments until there is slack in the cable. Quickly put tension back on the line by retrieving the device.

6.4.1.1.2 Retrieval

6.4.1.1.2.1 Using the winch/A-frame, place the box core, with the jaws closed, on top of the extruding device so that the bolts on the box corer slide into open slots of the extruding device. Remove any weights placed in the corer and open the jaws quickly so the liner falls over the extruding plate. Leave the mesh screen on during this process. (Figure 5).

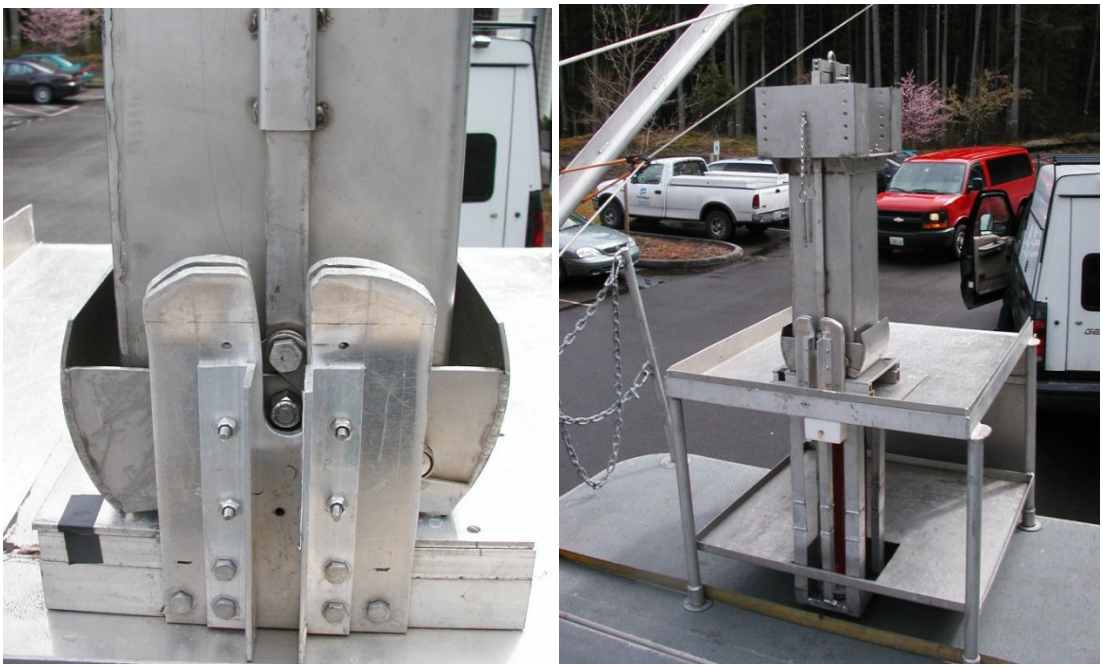

Figure 5. Sediment corer placed over the extruding device.

6.4.1.1.2.2 Remove the mesh screen and place the acrylic liner section on top of the box corer. After loosening the liner stopper, remove the box corer from the acrylic liner by having two people on either side of the box corer simultaneously push down on the liner section with their fingers while pulling upwards on the box corer. NOTE. **Don't forget to loosen the knob securing the liner to the coring device.**

6.4.1.1.2.3 Once the bottom of the acrylic liner is exposed, a third person can insert the nail pins into the bottom of the extruder apparatus to firmly hold the liner against the extruder table while the coring device is lifted off. This will allow the liner to stay in position over the extruding plate while removing the box coring device.

6.4.1.1.2.4 At this point, it may be helpful to wash the outside of the acrylic liner to get a better view of the sediments. If sufficient depth is achieved and the sediment water interface appears undisturbed, proceed to sample processing.

6.4.1.1.3 Tips for sample collection:

6.4.1.1.3.1 Avoid penetrating sediments at a high speed. Adjust depth by adding or removing lead weights from the top of the box corer.

6.4.1.1.3.2 Handle the sample extremely carefully while transferring it to the sediment extruding device.

6.4.1.1.3.3 Try to work when the winds are calm, particularly if the lake is deep. If winds are high, it may be difficult to drop the sampling device straight down. If sediments are sloped in

the acrylic liner, then the device entered the sediments at an angle, or the lake bottom is sloped.

6.4.1.1.3.4 Keep the core that provides sufficient depth for the project while preserving the sediment water interface.

6.4.2 Modified KB Core Sample Collection

6.4.2.1 The following outlines the step-by-step procedure for collecting a sediment core with a modified KB corer.

6.4.2.1.1 Deployment

6.4.2.1.1.1 Determine the water column depth of the sampling location using a depth finder or weighted line.

6.4.2.1.1.2 Place the core tube inside the sampling housing apparatus and tighten the hose clamps around the tube. Make sure the tube is held tightly in the housing apparatus.

6.4.2.1.1.3 Lower the corer through the water column while keeping the messenger weight on board. Keep track of the depth of the corer by counting the meters on the calibrated line.

6.4.2.1.1.4 When the bottom of the corer reaches approximately 0.5 m above the substrate, let the line drop quickly and allow the corer to settle into the sediments.

6.4.2.1.1.5 To prevent the corer from tilting and disturbing the sample, keep a slight tension on the line when the corer is settling into the sediment.

6.4.2.1.1.6 Release the messenger weight down the line.

6.4.2.1.2 Retrieval

6.4.2.1.2.1 Once the messenger hits the corer, slowly lift the corer up through the water column until the core tube and rubber seal are just below the water surface.

6.4.2.1.2.2 One crew member should hold the corer while another reaches under the water surface to plug the core tube with the rubber stopper. Make sure to keep the core tube and rubber seal under the water surface while plugging the bottom of the tube.

6.4.2.1.2.3 It may be necessary to tilt the corer slightly to reach the bottom of the tube. In order to keep the sample intact, do not tilt the corer more than 45 degrees when placing the rubber stopper at the bottom of the corer.

6.4.2.1.2.4 Once the bottom of the liner is plugged, slowly lift the corer into the boat and place it in a large tub.

6.4.2.1.2.5 While the housing apparatus is still on the core tube, check to make sure that sufficient depth was achieved and that the sediment water interface is undisturbed.

6.4.2.1.2.6 Loosen the hose clamps, and lift the sampling housing apparatus off of the core tube. One person should hold the core tube while another crew member takes the housing apparatus off.

6.4.2.1.2.7 Tips for sample collection:

6.4.2.1.2.7.1 Adjust the line release height to attain different core depths. For firmer substrates, it may be necessary to release the line at a height greater than 0.5m above the sediment to allow deeper penetration.

6.4.2.1.2.7.2 Keep spare rubber stoppers on board. They are easily dropped when plugging the core tube.

6.5 Field Decontamination

6.5.1 For most sampling applications, rinsing the equipment between grabs with site water is normally sufficient (PSEP, 1997), using a scrub brush to remove any sediment that does not rinse off easily. Rinsing can be performed by dipping the grab in the water or using pumped water.

6.5.2 When changing waterbodies or sampling in severely contaminated sediments, decontaminate with acid washes described in pre-sampling preparation.

6.6 Collecting Sediment from the Sampler

6.6.1 After retrieving the core sample, check the sample for acceptability. A sample is considered acceptable if it is not over-filled with sediment, overlying water is present and not excessively turbid, the sediment surface is relatively flat, and the desired core length has been retrieved. It is important that the sediment-water interface remains intact while processing the sample.

6.6.2 Unacceptable samples should be dumped overboard at a location away from the station. Acceptable samples should be sub-sampled using the following techniques:

6.6.2.1 Begin by measuring the penetration depth of the coring device and the length of the core. For penetration depth, measure from the bottom of the corer to the highest point on the outside of the device where sediments exist. To measure core length, record the length of the sediment core inside the liner. These two measurements can be used to estimate core shortening.

6.7 Box Corer

6.7.1 Siphon as much of the overlying water as possible without disturbing the sediments. Extrude the sediment core until it is level with the top of the liner by turning the crank on the table. Take the nail pins out while securing the liner with your hands until the extruder foot has risen above the pin holes in the liner.

6.7.2 For sectioning, hold the acrylic liner piece flush against the sediment-filled liner, and extrude the desired amount of sediment into the liner piece by turning the cranking wheel. Seventeen turns of the crank equals 1 cm. Carefully slice the extruded sediment against the liner using the slicing plate and the liner piece to hold the sample (Figure 6).

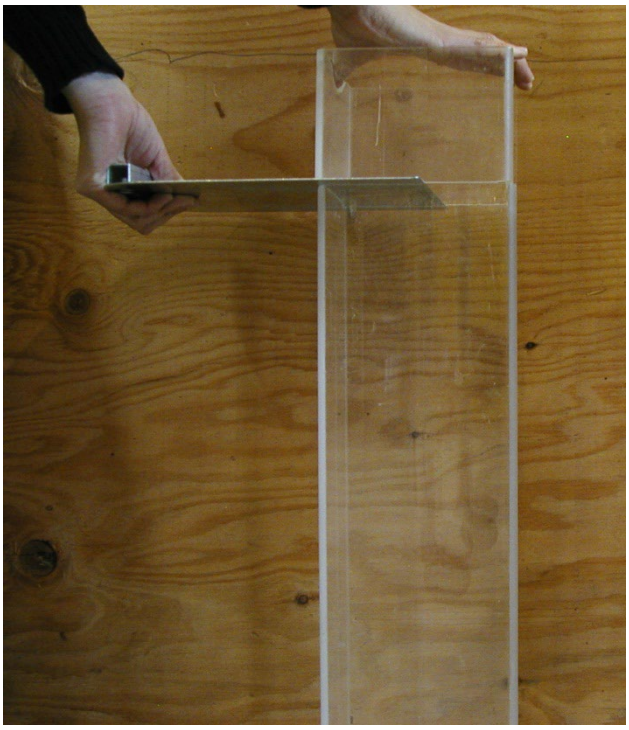

Figure 6. Slicing sediment intervals using the plate slicer and the acrylic liner section.

6.7.3 Remove sediments coming in contact with the liner, and fill sample jars with the remaining sediment. Clean the plate slicer with ambient water after slicing each section.

6.8 Modified KB Corer

6.8.1 Position the extruder under the rubber stopper at the bottom of the core tube, and extrude the water into the large tub by gently pressing down on the core tube.

6.8.2 Siphon off the rest of the water without disturbing the sediment, and place the stage and sectioning apparatus on top of the core tube.

6.8.3 Hold the extruder in place and gently press down on the core tube so that the core sample is extruded up into the sectioning apparatus. For 1 cm sections, extrude the sediment core up to the 1 cm calibration on the sampling apparatus.

6.8.4 Slide the sampling apparatus onto the adjacent surface of the stage and transfer to the sample container using a spatula.

6.8.5 The sectioning apparatus can be calibrated to obtain different sediment core section depths.

## 7.0 Records Management

7.1 Complete the field log for each station sampled. Include a visually descriptive assessment of each acceptable sample (sediment interval) and any unusual characteristics such as odor, debris, and color. An example of a sediment-coring log is included in Figure 7.

| Lake: | | Water Conditions: | | |
|---|---|---|---|---|
| Date and Time: | | Coring Device: | | |
| Crew: | | Core Length: | | |
| Sampling Depth: | | Corer Penetration: | | |
| Latitiude/Longitude: | | | | |
| Section (cm) | Description | Chemical Analyses | Field ID | MEL Sample Number |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
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Figure 7. Sediment core field log.

7.2 Close out the Field Plan with the designated contact at the end of the sampling work.

7.3 The Field Plan can be obtained from EAP's SharePoint site.

7.4 There are three forms for ordering laboratory services from Manchester Environmental Laboratory (MEL):

7.4.1 Pre-Sampling Notification (PSN) form

This form is used to give the laboratory notice of what you are planning to collect and submit and the analyses required. You can obtain this form from the MEL Laboratory User's Manual (MEL, 2016) or MEL SharePoint site.

7.4.2 Sample Container Request Form

This form is used to order sample containers needed for your sampling event(s) and is usually submitted along with the Pre-Sampling Notification form. You can copy this form from the MEL Laboratory User's Manual (MEL, 2016) or use the form on the MEL SharePoint site.

7.4.3 Laboratory Analyses Required (LAR) form

The LAR is the formal request of the sampler for specific analytical work, and this form must accompany all samples entering the laboratory. The LAR also serves to document the chain-of-custody. This form is available on the MEL SharePoint site.

7.5 The Manchester Environmental Laboratory User's Manual (MEL, 2016) also includes instructions for filling out these forms.

## 8.0 Quality Control and Quality Assurance

8.1 Chain-of-custody procedures should follow those recommended by the PSEP (1996). They should be initiated when the first sample is collected and followed until all samples are relinquished to the analytical laboratory. Chain-of-Custody forms should provide an unbroken trail of accountability that ensures the physical security of samples, data, and records. The Laboratory Analyses Required (LAR) form will serve as the Chain-of-Custody Form. At the end of each day, all sample containers should be checked against the Chain-of-Custody forms. It is important to verify the station identification number, collection date, collection time, and, if applicable, lab numbers as part of the QA/QC procedures.

## 9.0 Safety

9.1 Never compromise your personal safety or that of a field partner to collect a sample. Always plan ahead to avoid falling and drowning hazards. Always wear appropriate safety gear, such as life vests. When working with winches, cables, and similar machinery, gloves, hard hats, safety glasses, and steel-toed boots are also important safety items.

9.2 When deploying the coring device from an overhead crane (as on the RV Skookum), wear a life vest and protective helmet whenever the grab is suspended from the deck or at the water's surface. Do not touch the cable while the grab is being raised or lowered.

9.2.1 Knowledge of the contents of this standard operating procedure is required.

9.2.2 The EAP Field Plan must be completed to document field personnel, sampling locations, overnight lodging, itinerary, contact person(s), and emergency contacts.

9.3 Boat Safety

9.3.1 A qualified EAP boat operator will be required for all sampling from a boat. Boat operations will conform to all requirements in Chapter 3 (Boating) of the EAP Safety Manual (Ecology 2019). It is the responsibility of the boat operator to brief the crew on their responsibilities for the safe operation of the boat and use of its sampling gear. Crew members must have current First Aid/CPR certification.

9.4 Chemical Safety Data Sheets (SDSs) for all chemicals used in the decontamination procedures outlined in this SOP can be found on the EAP SharePoint site. Also, binders containing SDSs can be found in all field vehicles, vessels, Ecology buildings, or other locations where potentially hazardous chemicals may be handled. EAP staff following Ecology SOPs are required to familiarize themselves with these SDSs and take the appropriate safety measures for these chemicals.

## 10.0 References


10.1 Ecology. 2019. Environmental Assessment Program Safety Manual. Washington State Department of Ecology. Olympia, WA. http://teams/sites/EAP/safety/FieldOpsandSafetyManual.docx

10.2 EPA. 2001. Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA Office of Water. EPA-823-B-01-002. Available at www.epa.gov/ocean-dumping/methods-collection-storage-and-manipulation-sediments-chemical-and-toxicological.

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