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THIS IS ONE VOLUME OF A SIX VOLUME SET WHICH INCLUDES:

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Category 2	Organization:	Enviromental Restoration

POND AND RESERVOIR BOTTOM SEDIMENT SAMPLING

Approved By:

M. B. Arndt for R.L. Benedetti 9/25/92

Associate General Manager
Environmental Restoration
Date

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1. PURPOSE

The purpose of this document is to establish approved procedures for obtaining core samples of pond and reservoir bottom sediments using hand-held corers, gravity corers, US-BM60, and dredge bottom-material samplers. Sample collection, preparation, and preservation are described herein.

2. SCOPE

This procedure will be used to obtain bottom sediment samples from ponds located on the Rocky Flats Plant (RFP) and reservoirs located off plant site. The devices used to obtain these samples are gravity corers and hand-held corers, for obtaining core samples of bottom material, and US-BM60 and Eckman Grab (dredge) samplers for obtaining grab samples from the top several centimeters of pond and reservoir bottom sediments. Sample collection and preservation as well as other data-collection activities associated with bottom material sampling are addressed herein. Procedures described herein provide detailed instruction of general procedures described in SOP SW.6, Sediment Sampling. Therefore, this SOP should be used in conjuction with SW.6 as appropriate; depending on the type of sample desired.

3. REFERENCES

3.1 Primary References

3.1.1 5-21000-ADM-FO.02, Transmittal and Field QA Records.

3.1.2 3-21000-ADM-17.01, Quality Assurance Records Management.

3.1.3 5-21000-ADM-FO.03, General Equipment Decontamination

3.1.4 5-21000-ADM-FO.04, Heavy Equipment Decontamination

3.1.5 5-21000-ADM-FO.06, Handling of Personal Protective Equipment

3.1.6 5-210000-ADM-FO.07, Handling of Decontamination Water and Wash Water

3.1.7 5-21000-ADM-FO.09, Handling of Residual Samples

3.2 Secondary References

3.2.1 Benthos Corporation Instruction Manual for the Benthos Model 2171 Gravity Corer

3.2.2 Guy, H.P., and Norman, V.W., 1982, "Field Methods for Measurement of Fluvial Sediment," Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 3, Chapter C2, GPO, Washington.

3.2.3 U.S. Geological Survey, Water Resources Division, Colorado District, 1992, oral and written communications.

3.2.4 EM Department Environmental Requirements Manual, 1-21000-ERM-SW.02.

3.2.5 Edmondson, W.T. and Winberg, G.G., 1971, "A Manual for the Assessment of Secondary Productivity in Fresh Waters," Allard and Son, Ltd, Bartholomew Press, Osney Mead, Oxford.

3.2.6 Ben Meadows Company 1992 Catalog.

3.2.7 Welch, P.S., 1948, "Limnological Methods," McGraw-Hill, New York, pp 176-178.

4. LIMITATIONS AND PRECAUTIONS

4.1 Personnel shall consider the potential hazards of boating and mechanical hazards of working with heavy equipment such as weights, cables, reels, and pipes. Personnel shall not put themselves or others at undue risk.

4.2 Personnel who implement this procedure must be physically capable of hoisting a 150 kilogram sampler using a USGS E-type sounding reel and 6 foot boom.

5. PREREQUISITES

5.1 Personnel shall be familiarized/trained in implementing this procedure and with the use of the equipment described herein prior to implementing the following procedures for sample collection. Personnel logging cores will be trained as required by 5-21000-OPS-GT.01.

5.2 Personnel engaged in the activities described by this procedure shall be instructed in safe boating practices; including the use of personal floatation devices (PFD).

5.3 Obtain Core Sample Data Form(s) (CSDF) and/or Sediment Sample Collection Form(s) (SSCF). All sections of the form must be completed.

6. INSTRUCTIONS

6.1 <u>Core Sampling: Large Gravity Corer</u>

6.1.1 Initiation of the Core Sampling Activity

NOTE

A large gravity corer might not be appropriate for coring a small, shallow pond such as an RFP detention pond. In this case, a hand-held, zero-contamination corer is used (see Section 6.2).

6.1.1.1 If a grab sample is require go to Section 6.3. This type of sample requires a Sediment Sample Collection Form (SSCF) rather than the Core Sample Data Form (CSDF) required for core samples.

6.1.1.2 Review the CSDF(s) to determine if it is complete and the locations are clear. If not contact your supervisor or designee for additional information and revise the CSDF(s) as needed consistent with the requirements of 3-21000-ADM-17.01, Quality Assurance Records Management. The Sample Tracking Representative will assign the unique datasheet numbers.

6.1.1.3 If the CSDF(s) do not have a unique sample number record one on the datasheet. If no other instruction are provided this number can be generated per Appdendix 8.

6.1.1.4 Record your name and the date on the CSDF(s), if not already present.

6.1.1.5 If a small shallow pond is to be sample go to Section 6.2.

6.1.2 Equipment Preparation and Assembly

6.1.2.1 Obtain the coring equipment. Typical equipment is shown and labeled in Appendix 1, Figures A and B. Typical coring equipment consists of the parts listed in Appendix 1.

6.1.2.2 Only major equipment components are listed in Appendix 1, obtain the required supporting supplies which include: electrical tape, duct tape, chain wrenches, bolt drivers, screw drivers, spatulas, core slicers, teflon sheets, parafilm, markers, sample jars. In addition, obtain other miscellaneous supplies needed to complete this procedure.

CAUTION

The corer should be assembled before launching the boat for convenience and safety.

6.1.2.3 Assemble the coring equipment. Guidance for assembly can be found in Appendix 2. The Figures A and B in Appendix 1, are an illustration of typical coring equipment.

6.1.2.4 Verify that all core liners to be used to take the samples have been decontaminated as per 5-21000-OPS-FO.03, General Equipment Decontamination. If this has not been accomplished decontaminate all core liner to be used per 5-21000-OPS-FO.03. Decontaminate the boat and anchor prior to sampling as required by 5-21000-OPS-SW.06, Field Sampling at Rocky Flats Plantsite. No decontamination is required for offsite sampling.

CAUTION

At no time shall personnel touch or otherwise introduce contaminants to the insides of the core liners and caps following decontamination.

6.1.2.5 Document completion/verification of core liner decontamination on the CSDF.

6.1.2.6 Verify that the core sampling equipment is secured to the boat.

6.1.2.7 **Don personal flotation devices**, and then launch the boat.

6.1.3 Core Sampling

6.1.3.1 Proceed to the approximate sampling location and then drop anchor at the desired coring location.

6.1.3.2 Record the relative positions to the shoreline, islands, or other landmarks on the CSDF. Surveying or telemetry equipment may also be used to reference the sampling location.

6.1.3.3 Determine the approximate depth. A fathometer (depth-finder) may be used to determine the approximate depth to the bottom. Sounding with a tape measure may also be used. This measurement is solely for estimating when the corer will contact the bottom.

6.1.3.4 Carefully deploy the corer off the side of the boat.

6.1.3.5 If a liner is already installed go to 6.1.3.7.

6.1.3.6 Determine the necessary liner type from the Core Sample Data Form (CSDF) (Appendix 3):

i) If the sampling is for inorganic constituents verify that a plastic core liner was used.

ii) If the sampling is for organic constituents verify that a steel core liner was used.

6.1.3.7 Check the valve assembly to make certain that the valve is free to operate against its spring pressure.

6.1.3.8 Check all fittings, and ensure that the corer is assembled properly.

6.1.3.9 Fill the coring box with lake water or dry ice to keep the cores cool.

6.1.3.10 With the corer fins at the water surface, set the zero on the E-Reel.

6.1.3.11 Slowly, lower the corer to approximately 10 to 20 feet from the bottom by slightly relieving the brake pressure on the E-Reel. The E-Reel can be used to adjust the depth if the corer is closer than 10 feet from the bottom.

6.1.3.12 Attempt to release the brake tension completely at approximately 10 to 20 feet from the bottom (gaged using the E-Reel depth gage) to allow the corer to free fall into the bottom.

6.1.3.13 If the corer is released from a depth of less than 10 feet, check to see if a complete core is obtained (i.e. a full core barrel of sediment). If a complete core is not obtained, discard the sample and repeat the process starting at Step 6.1.3.4, and lengthen the free-fall depth. Note the problem on the CSDF, no other QA documentation of this problem is required.

6.1.3.14 **AS SOON AS** the tension on the cable decreases, stop the reel to avoid laying excess cable on the deck.

6.1.3.15 Tighten the cable by hand until tension is observed, and read the depth on the E-Reel. This is the depth to the bottom, record it on the CSDF. This depth can be used for subsequent coring to indicate when to stop the reel.

6.1.3.16 Raise the corer to the deck with the E-reel. Keep the core in a vertical position at all times.

6.1.3.17 Use a piece of teflon to line the Caplug. Cap the bottom of the core liner with a plastic cap (Caplug) under the water surface **AS SOON AS** the corer comes to the surface.

6.1.3.18 Keeping the core in a near vertical attitude, one person holds the valve assembly to keep the core sample in the corer while another person disassembles the bottom of the corer.

CAUTION
When completing 6.1.3.19 do not let the lake water enter the top of the core liner.

6.1.3.19 Carefully remove the core liner and core sample from the corer by sliding the liner out of the corer (down into the water).

6.1.3.20 Remove the valve assembly, and cap the top of the core using the appropriate cap with a small slit cut in the top.

6.1.3.21 Dry the core liner with a towel or paper towels.

6.1.3.22 Tape the cap edges with electrical tape to seal the core.

6.1.3.23 Press the top cap gently to remove any head space between the cap and the water surface, and tape the top of the cap with duct tape.

6.1.3.24 Procedure 5-21000-OPS-FO.13, Containerization, Preservings, Handling and Shipping of Soil and Water Samples requires the following labels. Label the duct tape with the following information:

1. Sampling Location,
2. Sequence number of core (i.e. first, second, etc. core sampled at that location, time, and date),and
3. EG&G.
4. activity name and/or number.
5. analyses required.
6. samplers initials.

NOTE
The core box must be kept in a vertical attitude at all times.

6.1.3.25 Decontaminate the exterior of each sample container as required by 5-21000-OPS-FO.03, Section 6.2: General Equipment Decontamination, subsequent to sampling.

6.1.3.26 Place the core in the core box for storage and subsequent processing on shore.

6.1.3.27 Clean the corer with lake water to remove any gross quantities of debris/sediment before installing another core liner or before hoisting the corer onto the deck.

6.1.3.28 Install another core liner, as described in Appendix 2 Steps 6 to 16, if additional cores are to be taken.

6.1.3.29 When coring at a particular sight is completed, hoist the corer onto the deck, and secure the corer to the deck by tightening the cable and tying the corer to the deck with rope.

6.1.3.30 If additional cores are to be taken at another location, raise the anchor, and proceed to the next coring location then repeat Step 6.1.3.2 thru 6.1.3.28.

6.1.3.31 If core sampling is complete raise the anchor, and proceed to shore.

6.1.3.32 After reaching the shore, disassemble the corer by loosening the collars and disconnecting the cable from the corer. Reel up the cable and store the E-Reel in its case.

6.1.3.33 Properly store the battery by capping the terminals.

6.1.3.34 Initiate the chain of custody form per 5-21000-OPS-FO.24. The information on the sample label can be used to complete the sample data on this form. The CSDF(s) should be completed immediately after sampling.

6.1.3.35 Document any off-normal concerns in the comment section co the CSDF (s).Indicate if the core(s) is to be sectioned in the field on the CSDF and then sign and date the field collection portion of the CSDF, after 'Prepared by:'.

6.1.3.36 If the core is to be sectioned in the field go to Section 6.1.4 and otherwise arrange for transportation to the laboratory and transfer as necessary. Update the Chain-of-Custody form per 5-21000-OPS-FO.24 upon transfer of custody. Transmit data to EG&G Rocky Flats Environmental Data System (RFEDS) personnel as per 3-21000-OPS-FO.14, Field Data Management. The core must be sectioned within 2 hours of collection.

6.1.4 Core Extrusion and Sample Preparation

6.1.4.1 Set aside one core from each location for use in obtaining the physical description of the core. This core will be handled per Section 6.1.5, rather than sections 6.1.4.2 through 6.1.4.18.

6.1.4.2 Determine the intervals into which the core is to be sectioned by reviewing the task work plans.

NOTE

This task may be performed on site (on shore) or in a laboratory, but the sectioning shall be done within two hours of taking the core samples. The extrusion task (steps 6.1.4.3 to 6.1.4.18) requires two people.

6.1.4.3 The tools required for this task include a piece of flexible plastic tubing, the extrusion stick, stainless-steel or plastic core slicers, spatulas, sample containers and core sample measurement rings. The core-sample measurement rings are pre-cut and decontaminated pieces of core liner cut to the desired length of the sampling interval.

6.1.4.4 Remove a core from the core box; keeping the core vertical at all times.

CAUTION

Take care not to disturb the sediment/water interface.

6.1.4.5 Remove the top cap and siphon the overlying water off of the core using either tygon or teflon tubing; being careful not to disturb the sediment/water interface. Leave approximately 1.0 to 1.5 centimeters of water on top of the core.

6.1.4.6 Remove the tape from the bottom cap of the core and position the top of the extrusion stick (Figure B) near the bottom cap of the core. The extrusion stick consists of a handle as long as the core liner with a rubber stopper/plunger on the top end. The outside diameter of the stopper should equal the inside diameter of the liner.

6.1.4.7 The person who will be holding the core liner should stand on a platform approximately as high as the core liner is long.

6.1.4.8 Quickly remove the bottom cap, and simultaneously slide the plunger of the extrusion stick into the core liner. This procedure requires one person to hold the extrusion stick, and one person to hold the core liner.

6.1.4.9 Slowly extrude the core to the top of the liner by pushing the liner down on the extrusion stick until the core is approximately 1.0 centimeter from the top.

6.1.4.10 Hold a core-sample measurement ring flush with the top of the liner, and extrude the core out of the liner and into the measurement ring until the top of the core is approximately flush with the top of the measurement ring.

6.1.4.11 Slide a core slicer between the top of the core liner and the measurement ring; slicing the core in the process.

6.1.4.12 Slide the core slicer off the top of the core liner to cleanly section off the top sample.

NOTE

Use a plastic spatula for inorganic constituent samples. Use a stainless-steel spatula for organic constituent samples. The containers should be plastic for inorganic constituent samples and amber glass for organic constituents.

6.1.4.13 Transfer the core section to a pre-labeled container using a spatula.

CAUTION

Special care must be taken to ensure that no head space is left in the sample jar in containerization of the organic constituent samples (Richard Fox, USEPA, oral communication, 1992).

6.1.4.14 Gently push the sample into the sample jar so that the jar is slightly overfilled.

6.1.4.15 Cap the sample jar; being careful to keep the threads of the jar free of sample to ensure that a tight seal is obtained. Label the sample with the depth of the core, starting from 0 depth at the sediment/water interface. For example: the top 5 cm section of a core is labelled "000-005 cm". Record all sample labels in the sectioning part of the CSDF.

NOTE
Additional sample containerization procedures are contained in SOP FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples.

6.1.4.16 Continue to divide the core into sections and containerize the samples using the Steps above (Steps 6.1.4.7 to 6.1.4.15) using clean, decontaminated core-sample measurement rings, spatulas, and core slicers for each sample.

6.1.4.17 After the core has been completely sectioned and containerized, decontaminate the core liners, liner valve assemblies, spatulas, core slicers, sample measurement rings, caps, and extrusion stick and store the equipment as per 5-21000-ADM-FO.03, General Equipment Decontamination.

6.1.4.18 The samplers shall complete the Core Sectioning portion of the CSDF and then sign and date this portion. Document any off-normal concerns in the comment section of the CSDF(s).

6.1.5 Core Description

NOTE
Normally a physical description of the core material shall be done on one core from each sampling location.

6.1.5.1 Obtain the core(s) set aside for preparation of core descriptions in Step 6.1.4.1.

6.1.5.2 Layout a white background such as white paper.

6.1.5.3 Extrude the core (as described in Steps 6.1.4.3 to 6.1.4.9) horizontally onto a white background (see Step 6.1.5.2).

6.1.5.4 Split the core in half longitudinally with a spatula, and open the core to reveal the middle of the core.

6.1.5.5 Align a measuring instrument such as a yard stick, or measuring tape along the side of the core with the zero mark at the top of the core.

CAUTION
Personnel using photographic equipment on RFP shall comply with the applicable security requirements for possession of such equipment.

6.1.5.6 Photograph and qualitatively describe the core material in terms of color, texture, and composition on a CSDF. The core description color shall be determined using original Munsell standards.

Note
"Munsell" is a registered trademark.

6.1.5.7 Measure the positions of distinctly colored and/or textured layers of the core with a ruler, tape, or meter stick by measuring from the top of the core, and record the positions on the CSDF.

6.1.5.8 After the core description is complete, dispose of the core materials as per procedures in SOP FO.09, Handling of Residual Samples.

6.1.5.9 Complete the balance of Core Description portion of the CSDF and then sign and date this portion. Document any off-normal concerns in the comment section of the CSDF(s).

6.1.5.10 If additional cores remain to be described repeat Steps 6.1.5.1 to 6.1.5.9.

6.2 Core Sampling: Hand-Held Corers

NOTE

A large gravity corer might not be appropriate for coring a small, shallow pond such as an RFP detention pond. In this case, hand-held, zero-contamination, drive corers or hand-held gravity corers are used (Figure C in Appendix 4).

6.2.1 Equipment

6.2.1.1 Obtain a hand-held, drive corer or gravity corer (see Appendix 4). The drive corer should be used if one or both of the following apply: (1) the desired core length is greater than 3-feet long; (2) the bottom material is too coarse to obtain a sample with the drive sampler, otherwise the hand-held gravity corer is recommended.

NOTE

The drive corer consists of a stainless-steel core barrel and either plastic or stainless-steel, zero-contamination liners. A nose cone or a catcher is attached to the end of the corer to keep the core sample in the liner (Figure C in Appendix 4). A T-type handle with extension rods are attached to the core barrel. A slide hammer attachment is used to drive the corer into the bottom material if necessary. The hand-held gravity corer is analogous to the large garvity corer described in section 6.1 (Figure D in Appendix 4); only the hand-held version is much smaller. The core extrusion equipment used to extrude the sample from the corer is the same as the equipment used for the larger gravity corer (Steps 6.1.4.3 to 6.1.4.9).

6.2.1.2 Obtain the tools needed for extrusion. This includes core-sample measurement rings, core slicers, spatulas, and an extrusion stick.

NOTE

The core barrels for the hand-held corers are approximately 2.0 to 3.0 feet long; whereas the core barrel for the large gravity corer is approximately 5.0 to 6.0 feet long. Therefore, the extrusion stick for the smaller hand-held corer need only be about 3.0 to 4.0 feet long. See Step 6.1.4.3 for further details on core extrusion equipment. Specifications for the hand-held zero-contamination corers are listed in Appendix 4.

6.2.1.3 Assemble the hand-held drive corer as described by the manufacturer's instructions.

6.2.1.4 Verify the liner type on the Core Sample Data Form (CSDF) (Appendix 5):

i) If the sampling is for inorganic constituents verify that a plastic core liner was used.

ii) If the sampling is for organic constituents verify that a steel core liner was used.

6.2.1.5 Decontaminate all components that will come in contact with the sample per procedures in 5-21000-ADM-FO.03, General Equipment Decontamination prior to sampling.

6.2.1.6 Install the appropriate liner into the corer as described in the manufactures instructions. If a liner is already installed go to the next step.

CAUTION

At no time shall personnel touch or other sources introduce contaminants to the insides of the core liners and caps.

6.2.2 Sampling with the Hand-Held Drive Corer

6.2.2.1 **Don personal flotation devices**, and then launch the boat.

6.2.2.2 Proceed to the approximate sampling location and then drop anchor at the desired coring location.

6.2.2.3 Verify and reference the location by recording relative positions to the shore line, islands, or other landmarks on the CSDF. Surveying or telemetry equipment may also be used to reference the sampling location.

6.2.2.4 Attach extension rods to the corer, and lower the corer down into the water.

6.2.2.5 Add extension rods until the corer reaches the bottom.

6.2.2.6 Attach either the T-handle or the hammer attachment to the top extension rod and force the corer into the bottom sediments until the entire core barrel is embedded in the bottom material or until considerable force is required to drive the corer deeper. The T-handle may be used in loosely consolidated sediments, but the hammer will be needed for more compact sediments.

6.2.2.7 Retrieve the corer by pulling the core straight out of the bottom. Keep the corer vertical at all times.

6.2.2.8 Disassemble the extension rods as the corer is brought to the surface.

6.2.2.9 **AS SOON AS** the corer is brought aboard the boat, remove the catcher and cap the bottom of the core liner.

6.2.2.10 Remove the core liner from the core barrel and cap the top of the core.

6.2.2.11 Dry the core barrel with a towel or paper towels, and tape the caps to the core liner with electrical tape.

6.2.2.12 Place a piece of duct tape on the core liner as a label for the core. Label the duct tape with the following information using a permanent marker:

1. Sampling Location,
2. Sequence number of core (i.e. first, second, etc. core sampled at that location, time, and date),
3. EG&G
4. activity name and/or number
5. analyses required
6. sampler's initials

NOTE

The core box must be kept in a vertical attitude at all times.

6.2.2.13 Place the core in the core box for storage and subsequent processing on shore.

6.2.2.14 Clean the corer with lake water to remove any gross quantities of debris/sediment before installing another core liner or before lifting the corer onto the deck.

6.2.2.15 If additional cores are to be taken, raise the anchor and proceed to the next coring location, then repeat steps 6.2.2.4 thru 6.2.2.14.

6.2.2.16 If core sampling is complete raise the anchor, and proceed to shore.

6.2.2.17 Disassemble the corer, and store it in its case.

6.2.2.18 Go to section 6.1.4 for core sectioning and description procedures and sample preparation.

6.2.3 Sampling with the Hand-Held Gravity Corer

6.2.3.1 A hand-held gravity corer is used to obtain core samples in shallow water (less than 20 feet) where a core sample of the top 3-feet (or less) of bottom sediment is desired. See Appendix 4-Figure F for an illustration of the hand-held gravity corer.

6.2.3.2 Decontaminate the hand-held gravity corer components as described in steps 6.2.1.4 through 6.2.1.6.

6.2.3.3 Refer to Appendix 4 for assembly instructions for the hand-held gravity corer.

6.2.3.4 Prepare for sampling by following steps 6.2.2.1 through 6.2.2.3.

6.2.3.5 Cock the valve cap on top of the corer so that the spring-loaded catch mechanism is holding the notch on the valve shaft (Appendix 4-Figure G).

6.2.3.6 Secure the end of the corer retreiving rope to the boat. Suspend the corer over the side of the boat by the hoisting rope, and release the rope to allow the corer to free fall into the bottom sediment.

6.2.3.7 Hold the retreiving rope taught, and clip the brass-swivel messanger onto the rope. Release the messanger to trigger the spring-loaded catch mechanism; thereby sealing the top of the corer with the valve cap.

6.2.3.8 Hoist the corer by hand to the water surface and go to step 6.2.2.9 to continue core sample processing, decontamination, and documentation procedures.

6.3 Bottom-Sediment Grab Sampling

NOTE

The preferred equipment for obtaining pond and reservoir bottom sediment samples is the Eckman Grab (Dredge) and the USBM-60 bottom sediment sampler. The Eckman Grab is preferred because of its ease of operation and the large sample size it provides. The USBM-60 sampler is useful for obtaining samples with minimal fine particulate loss in retrieving the sample from the bottom, but the USBM-60 does not obtain the large quantity of sample that the Eckman Grab provides.

6.3.1 Initiation of Bottom-Sediment Grab Sampling Activity

6.3.1.1 Review the SSCF(s) to determine if the documentation is complete and the location is clear. The Sample Tracking Personnel will assign the sample sequence number(s) prior to sampling. If additional information is required contact your supervisor or designee for additional information and revise the SSCF(s) as needed to be consistent with the requirements of 3-21000-ADM-17.01, Quality Assurance Records Management.

6.3.1.2 If the SSCF(s) does not have a unique datasheet number record one on the datasheet. If no other instructions are provided this number can be generated as described in Appendix 8.

6.3.1.3 Record your name and the date on the SSCF(s), if not already present.

6.3.1.4 Record on the datasheet your knowledge of the sample required and any instruction from your supervisor, regarding whether the Eckman Grab or the USBM-60 sampler should be used.

NOTE
The Eckman Grab is described in Appendix 6. The USBM-60 sampler is described Appendix 7. The instructions/guidance for operation of these samplers are located in these Appendices. Both samplers require the use of a reel and boom (Figure A of Appendix 1) to lower the samplers to the bottom and retrieve the sampler once the sampling mechanisms are tripped with a sounding messenger.

6.3.1.5 Obtain either Eckman Grab or USBM-60 samplers (or if needed both samplers) per the instructions of your supervisor.

6.3.1.6 Obtain the reel and boom equipment described in Appendix 1 (the core equipment is not required). Typical equipment is shown and labeled in Appendix 1 Figures A and B.

6.3.1.7 Only major equipment components are listed in Appendix 1 Also obtain the required supporting supplies such as electrical tape, duct tape, chain wrenches, bolt drivers, screw drivers, spatulas, markers, sample jars, and other miscellaneous supplies.

NOTE
Similar equipment that meets the above specifications may be substituted.

CAUTION
The equipment should be assembled before launching the boat for convenience and safety.

6.3.1.8 Assemble the reel and boom equipment and attach the sampler (Steps 1 to 4 and 17 of Appendix 2). Guidance for assembly can be found in Appendix 2. Figure C in Appendix 1 is an illustration of typical boom and reel equipment.

6.3.1.9 Decontaminate the sampler as per 5-21000-OPS-FO.03, General Equipment Decontamination. Decontaminate the boat and anchor prior to sampling as required by 5-21000-OPS-SW.06, Field Sampling at Rocky Flats Plantsite. No decontamination of the boat is required for offsite sampling.

CAUTION
At no time shall personnel touch or otherwise introduce contaminants to the insides of the sampler following decontamination.

6.3.1.10 Verify that the sampling equipment is secured to the boat.

6.3.1.11 **Don personal flotation devices**, and then launch the boat.

6.3.1.12 Proceed to the approximate sampling location and then drop anchor at the desired coring location.

6.3.1.13 Verify and reference the location by recording relative positions to landmarks on the shore line, islands, or other landmarks on the SSCF. Surveying or telemetry equipment may also be used to reference the sampling location.

6.3.1.14 Take the sample by slowly lowering the sampler to the bottom with the reel and boom and tripping the sampling mechanism as described in Appendices 6 and 7.

CAUTION
Care should be taken to process samples for organic constituents as quickly as possible.

6.3.1.15 Upon hoisting the bottom sediment samplers to the surface, the sediments should be processed and containerized for analysis according to Section 5.4.2 of 5-21000-ADM-SW.06, Sediment Sampling.

6.3.1.16 When containerizing the sample verify that:

a. no head space exists in the sample container, and

b. the threads on the container are free of debris to ensure that the sample container seals tightly.

c. the sample container will be labelled in accordance with 5-21000-OPS-FO.13.

6.3.1.17 Decontaminate the sampler between samples and prior to storing the sampler after use according to 5-21000-ADM-FO.03, General Equipment Decontamination.

6.3.1.18 If additional samples are to be taken raise the anchor, and proceed to the next location and repeat steps 6.3.1.9 thru 6.3.17.

6.3.1.19 If sampling is complete raise the anchor, and proceed to shore.

6.3.1.20 Disassemble the corer by loosening the collars and disconnecting the cable from the corer. Reel up the cable and store the E-Reel in its case.

6.3.1.21 Properly store the battery by capping the terminals.

6.3.1.22 Initiate the chain of custody form per 5-21000-OPS-FO.24. The information on the sample label can be used to complete the sample data on this form.

6.3.1.23 Document any off-normal conditions in the comment section of the CSDF(s). Complete the SSCF(s) for the samples. Then sign and date the SSCF (s) after 'Prepared by:'.

6.3.1.24 Arrange for transportation to the storage or laboratory per the directions on the SSCF(s) or from your supervisor. Update the Chain-of-Custody form per 5-21000-OPS-FO.24 upon transfer of custody. Transmit data to RFEDS per 3-21000-OPS-FO.14, Field Data Management.

6.4 Waste Management

Wastes such as personal protective equipment, excess sample materials, paper towels, decontamination water, and so forth shall be handled according to procedures outlined in the following procedures:

- 5-21000-ADM-FO.03, General Equipment Decontamination
- 5-21000-ADM-FO.04, Heavy Equipment Decontamination
- 5-21000-ADM-FO.06, Handling of Personal Protective Equipment
- 5-210000-ADM-FO.07, Handling of Decontamination Water and Wash Water
- 5-21000-ADM-FO.09, Handling of Residual Samples

7. RECORDS

The CSDF and SSCF will be QA records when completed, but they are not complete at the conclusion of this procedure. Completion of these records requires verification per 5-21000-ADM-FO.14, Field Data Management.

Initiate the chain of custody form per 5-21000-OPS-FO.24, Chain of Custody. Then transmit data to RFEDS per 3-21000-OPS-FO.14, Field Data Management.

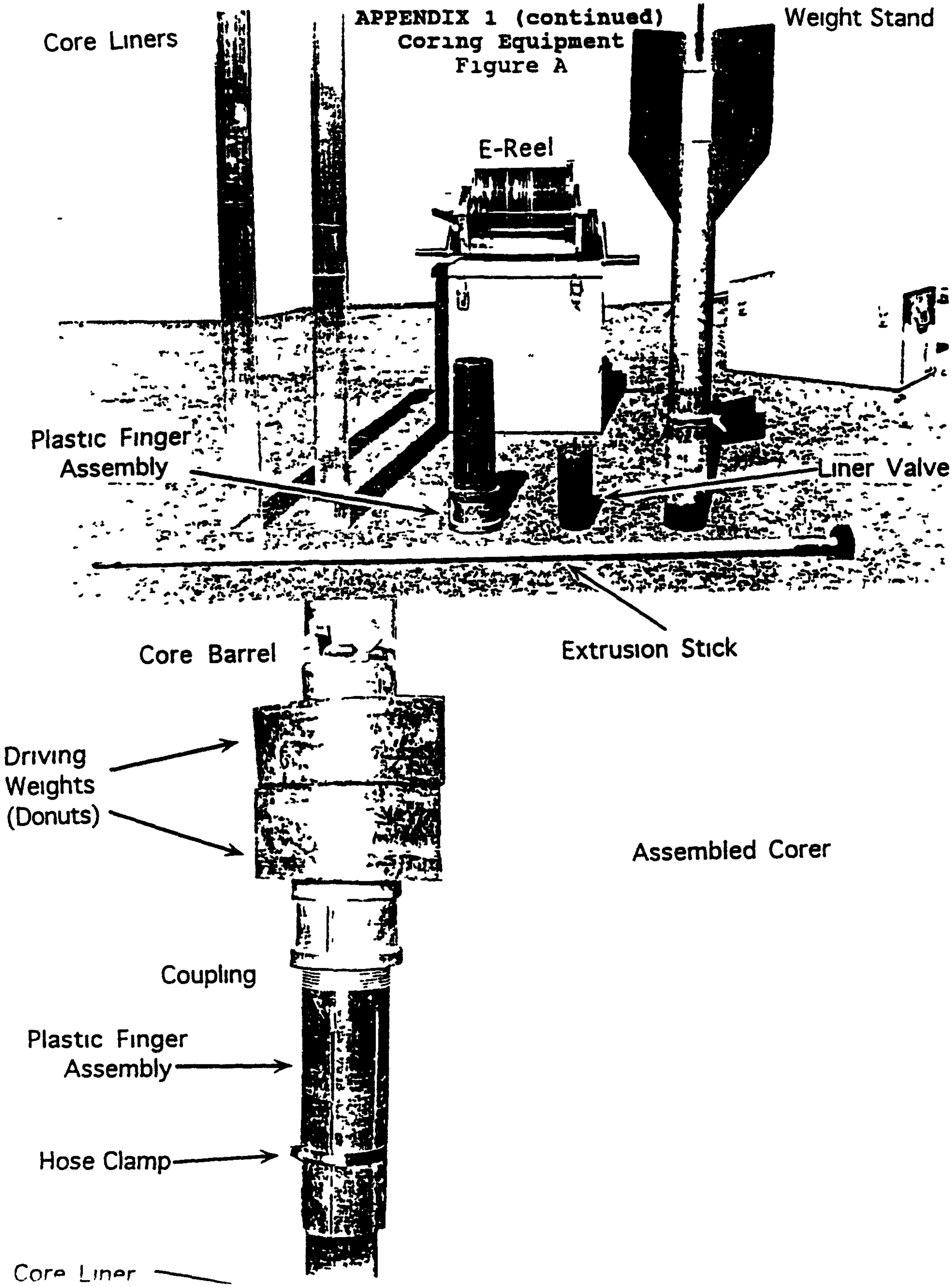
APPENDIX 1
Coring Equipment

Part	Material	Approximate Dimensions	Figure(s)
Weight Stand	Galvanized Steel	4'-long 16"-Dia.	A
Driving Weights	Lead	50 kilograms/EA	A
Couplings	Galvanized Steel	2.9" I.D., threaded	A
Core Barrel	Galvanized Steel	Must fit Couplings 2.9" I.D.	A
Core Liner	Clear Plastic or Stainless Steel	2.9" O.D. 2.6" I.D.	A&B
Nose Cone	Brass	Must fit end of core barrel	not shown
Benthos Liner Valve Assembly	PVC and Steel	Must fit end of core liner	A&B
Liner Caps	#45 "Caplugs"	2.9" I.D.	B
Plastic Fingers	PVC attached to galvanized coupling	Must fit core barrel end	A&B
Hose Clamps	Steel	To fit Core Barrel	A&B

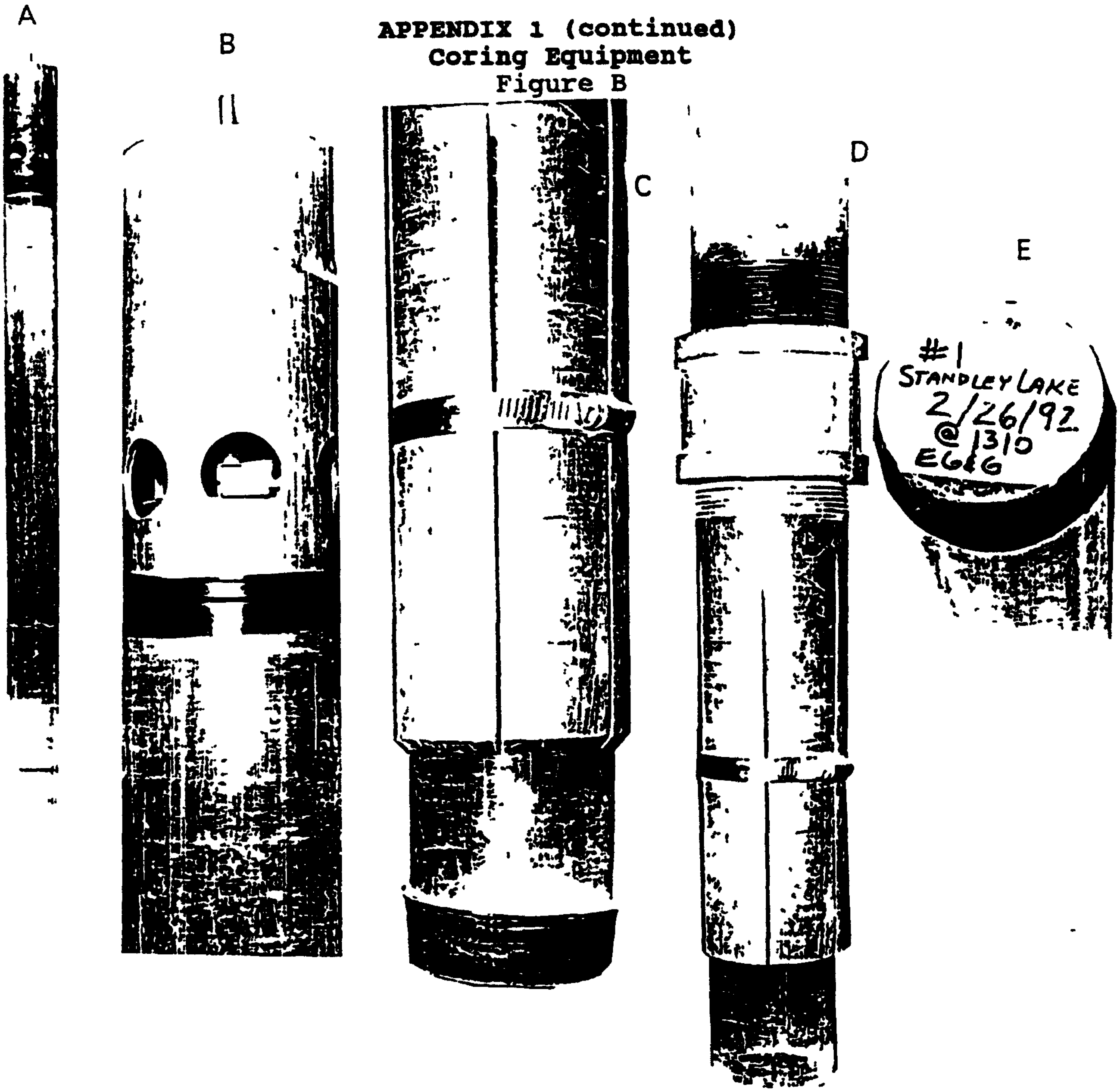
APPENDIX 1 (continued)
Coring Equipment

Part	Materials	Dimensions	Figure(s)
Carabiner	Steel	3/8" O.D.	D
USGS E-Reel with Steel Cable	Steel	Cable must be at least 125 feet long	C
Marine 12-Volt Battery		Used to power E-Reel	Not shown
Boat with 6-8' Boom		At least 30' long	Not shown
Core Storage Box	Wood or Plastic	Should contain cores in cool, dark environment	Not shown

APPENDIX 1 (continued)
Coring Equipment
Figure A



APPENDIX 1 (continued)
Coring Equipment
Figure B



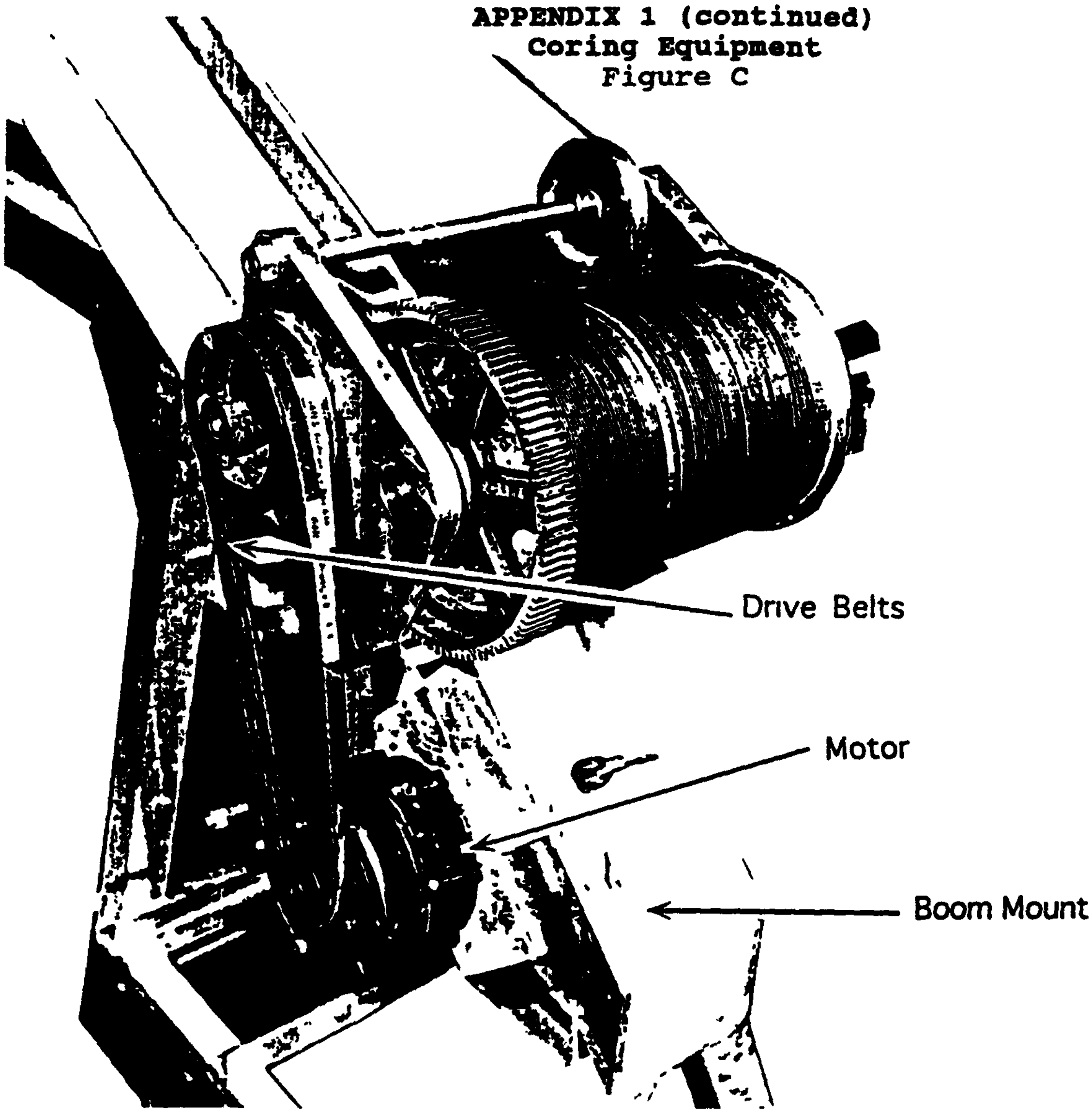
A&B -- Assembled Core Liner with Liner Valve Assembly

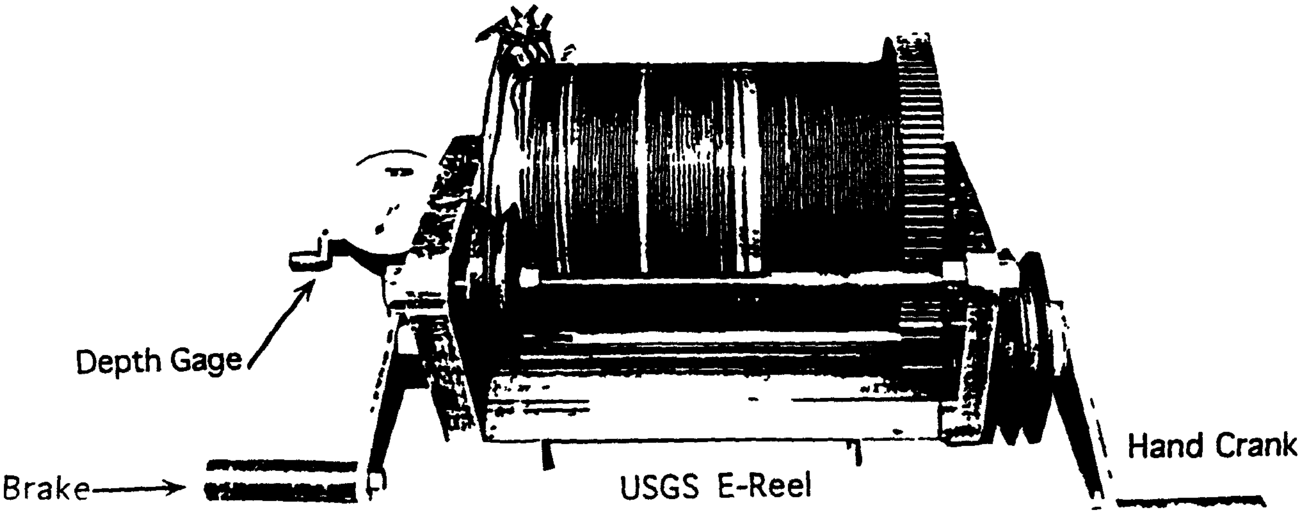
C -- Core Liner Installed in Weight Stand and Finger Assembly

D -- Capped Core Liner After Core Sample is Collected

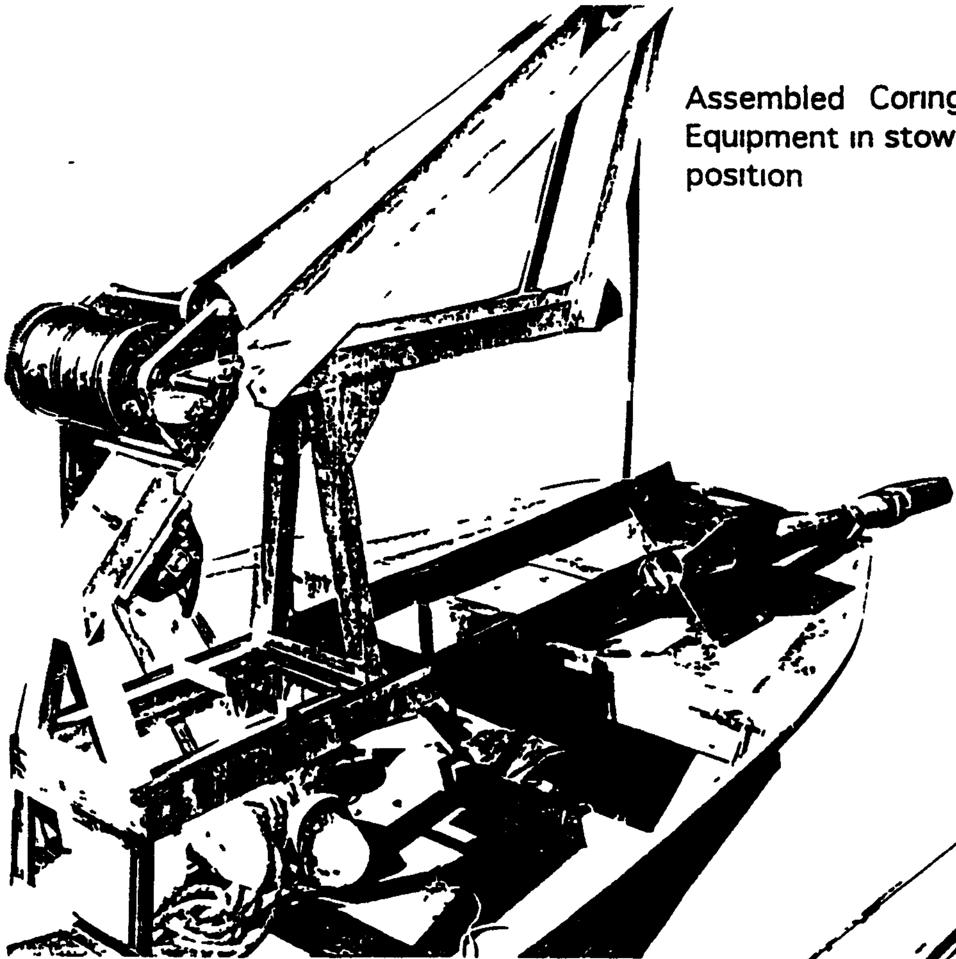
E -- Capped and Labeled Core Sample

APPENDIX 1 (continued)
Coring Equipment
Figure C

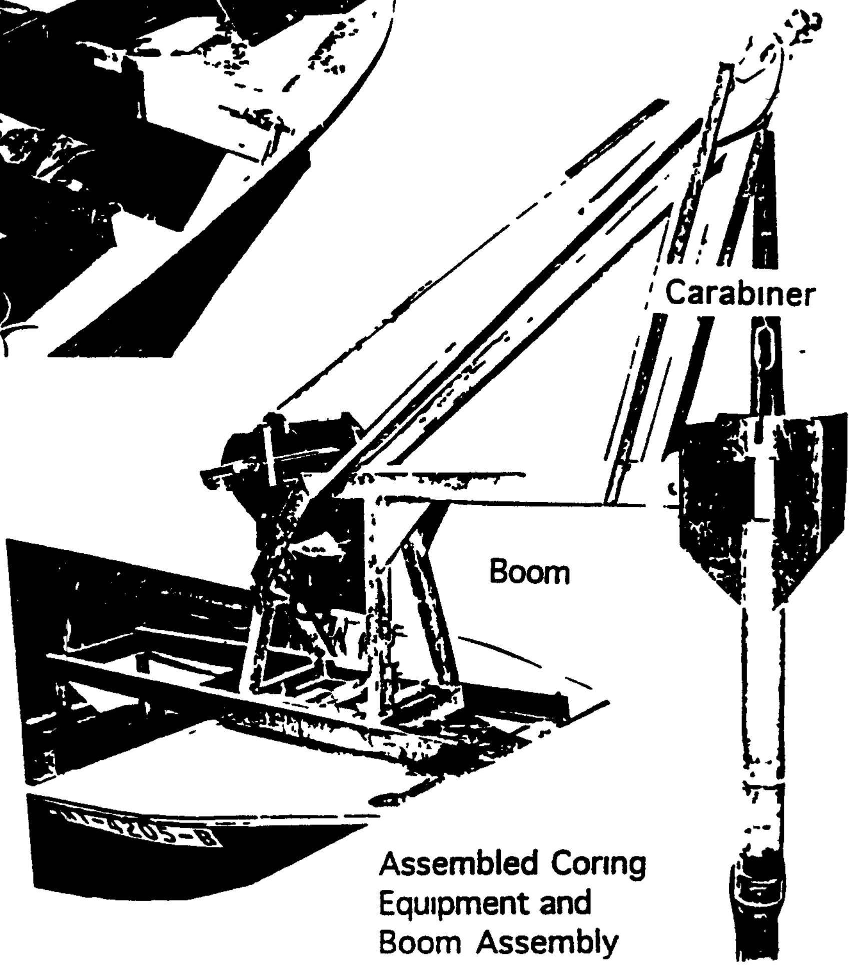




APPENDIX 1 (continued)
Coring Equipment
Figure D



Assembled Coring Equipment in stowed position



Assembled Coring Equipment in sampling position

Assembled Coring Equipment and Boom Assembly

APPENDIX 2

Coring Equipment Assembly Instructions

1. Assemble the tools required for assembly of the gravity coring equipment (e.g., screwdriver, boltdriver, chain wrench, and pliers).

2. Attach the E-Reel to the boom as per the manufacturer's instructions, and thread the cable through the boom.

3. Attach the cable to the top of the weight stand with the carabiner.

4. Attach the battery to the E-Reel using cables supplied with E-Reel.

5. Slide the driving weights onto the weight stand. Vary the number of driving weights according to the degree of consolidation of the bottom sediments.

6. Push the liner valve assembly onto the top of a decontaminated core liner.

NOTE

The core liners should be decontaminated as per SOP FO.03, General Equipment Decontamination.

7. Seal the joint between the liner and the valve assembly with one or two turns of electrical tape.

8. Ensure that the core liner contacts only clean, decontaminated materials during all steps prior to sampling.

9. Plastic core liners are to be used only for inorganic constituent sampling. If sampling for organic constituents go to step 14.

10. Screw the plastic fingers assembly onto the end of the core barrel and tighten the assembly with a chain wrench until secure.

11. Insert the plastic core liner into the core barrel with the liner valve assembly up.

APPENDIX 2 (continued)
Coring Equipment Assembly Instructions

12. Finally, secure the liner in the corer by tightening two hose clamps around the fingers using either a screwdriver or a bolt driver until secure.

13. Go to step 17

14. Stainless steel liners are used for organic constituent sampling.

15. Add additional sections of the corer into the core barrel until the barrel is full.

16. Attach the brass nose cone to the end of the core barrel to secure the liner in the barrel.

17. Secure the assembled corer to the deck of the boat by taking up any slack on the cable and tying the corer to the deck with rope.

APPENDIX 3
Core Sample Data Form (CSDF)

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT Page 1/2
Core Sample Data Form (CSDF)
Form SW.17A

SAMPLE ID:______________________ Site ID:__________________________

LOCATION____

CORE NUMBER__________ Laser Decontaminated. Yes / NO

REQUEST FOR ANALYSIS NUMBER__________________CHAIN OF CUSTODY NUMBER__________SHIP DATE__________

CORE LINER. Organics-Stainless Steel / Non-Organics-Polybutyrate NORTH OR Y ______________________ EAST OR X.__________

COLLECTION DATE__________________ QUARTER. 1 2 3 4

COLLECTION TIME_______ PURPOSE/PROJECT________________PROJECT CHARGE NUMBER__________________

COMPOSITE. YES / NO COMPOSITE DESCRIPTION ______________________________________

QC TYPE: REAL MS MSD LR DUP RNS QC PARTNER______________________________________

COLLECTION METHOD· GRAVITY CORER HAND-HELD CORER

TYPE OF SAMPLE. METALS RADIONUCLIDES VOLATILES SEMI-VOLATILES DESCRIPTION

OTHER____

DEPTH OF WATER__________(FEET) TOTAL LENGTH OF CORE________(FEET)

SECTIONED CORE. YES / NO· IF YES COMPLETE CORE SECTIONING PORTION ON PAGE 2/2.

WEATHER____

COMMENTS____

CORE DESCRIPTION

DEPTH FROM TOP (cm or inches)	COLOR	TEXTURE	OTHER FEATURES / OBSERVATIONS (ie. Vegetation, Roots, Organisms, Objects)

Sampler____

Prepared By:____
Print Name Signature Date

Transmitted to RFEDS By:____
Print Name Signature Date

RFEDS Data Verified By:____
Print Name Signature Date

APPENDIX 3 (Continued)

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT Page 2/2
Core Sample Data Form (CSDF)
Form SW.17A

SAMPLE ID: ______________________ **Site ID:** ____________
LOCATION: ______________________
CORE NUMBER: ____________ **REQUEST FOR ANALYSIS NUMBER:** ____________
CHAIN OF CUSTODY NUMBER: ______________________

Core Sectioning Information

Core Section Number	Sample Number	Analysis Types	Chain of Custody Number

Sampler: ______________________

Prepared By ______________________
Print Name Signature Date

Transmitted to RFEDS By: ______________________
Print Name Signature Date

RFEDS Data Verified By· ______________________
Print Name Signature Date

APPENDIX 4

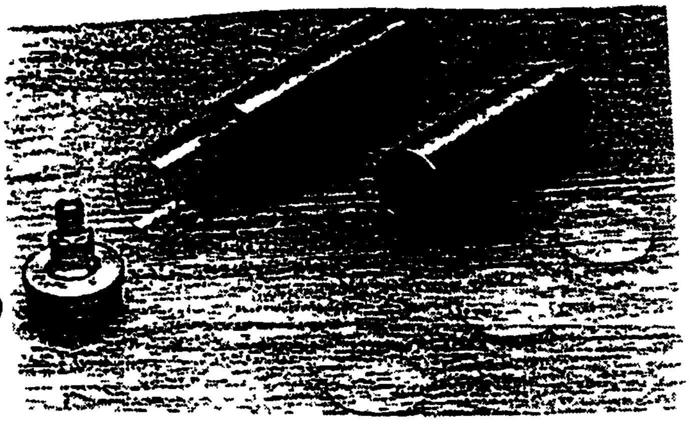
Hand-held, Drive Coring Equipment Specifications.

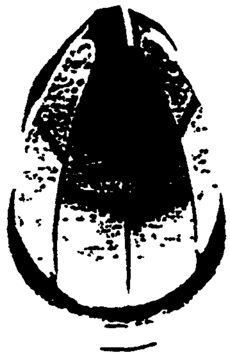
Part	Material	Approximate Dimensions
Core Barrel with Cap	Stainless-Steel	3 ft. long x 2 in. I.D.
Core Liner	Butyrate or Stainless-Steel	To Fit Core Barrel
Core Liner Caps	Butyrate	To Fit Liners
Hammer Attachment	Steel	20 in. long-11 pounds
Cross Handle and Extensions	Chrome-Molybdenum	16 in.-long Handle 5-ft Extensions
Core Catcher	Stainless-Steel	To Fit Core Barrel

APPENDIX 4 (Continued)

Hand-held, Drive Coring Equipment Specifications.
Figure E

Core Sampler

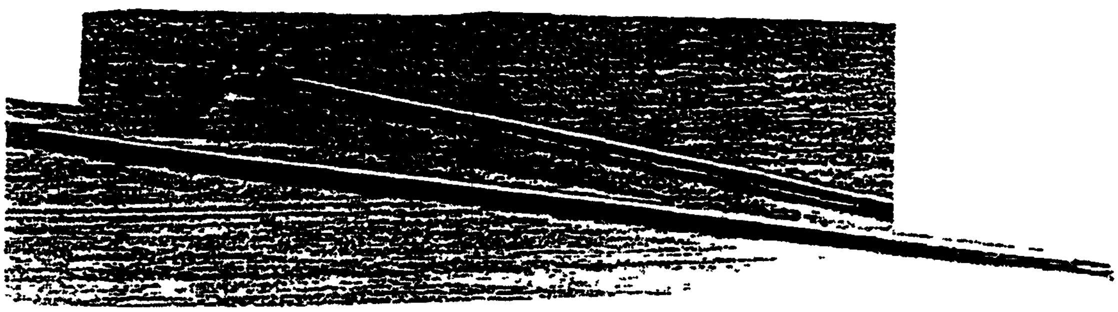




CORE CATCHER

HAMMER ATTACHMENT

Cross Handle and Extensions



APPENDIX 4 (Continued)

Assembly Instructions for the Hand-held Gravity Corer

NOTE
No tools are required to assemble the hand-held gravity corer.

1. Thread the core barrel into the fin assembly and hand tighten.

2. Thread 1/4-inch nylon rope into the top of the fin assembly. The rope should thread through a small hole in the top of the fin assembly. Tie at least two overhand knots in the end of the rope to secure the corer onto the rope.

NOTE
The rope should be at least ten feet longer than the depth of the water.

3. Test the knots in the rope to be certain that the corer will not slide off of the end of the rope.

4. Insert a decontaminated core liner into the core barrel.

NOTE
The core liners should be decontaminated as per SOP FO.03, General Equipment Decontamination

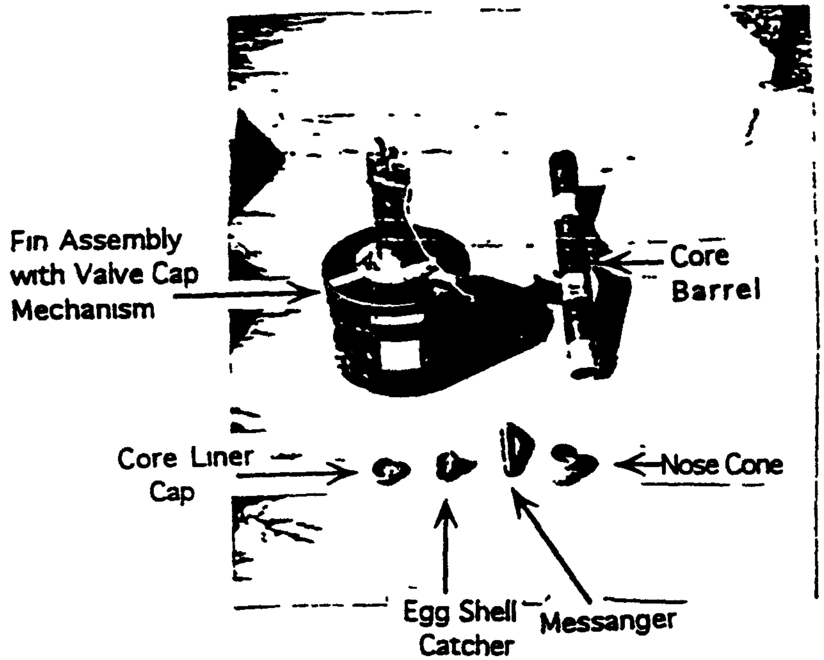
NOTE
Step 5 is optional and should be used only if the core sample is lost from the corer liner or if coarse material is being cored.

5. Insert the egg-shell catcher into the end of the core liner. The point of the catcher should be pointed toward the fin assembly (up).

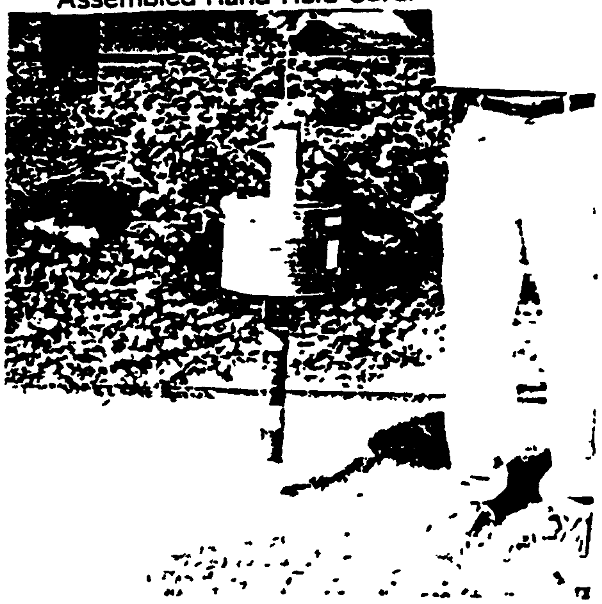
6. Screw the nose cone onto the end of the core barrel and hand tighten.

APPENDIX 4 (Continued)

Hand-held, Gravity Coring Equipment
Figure F

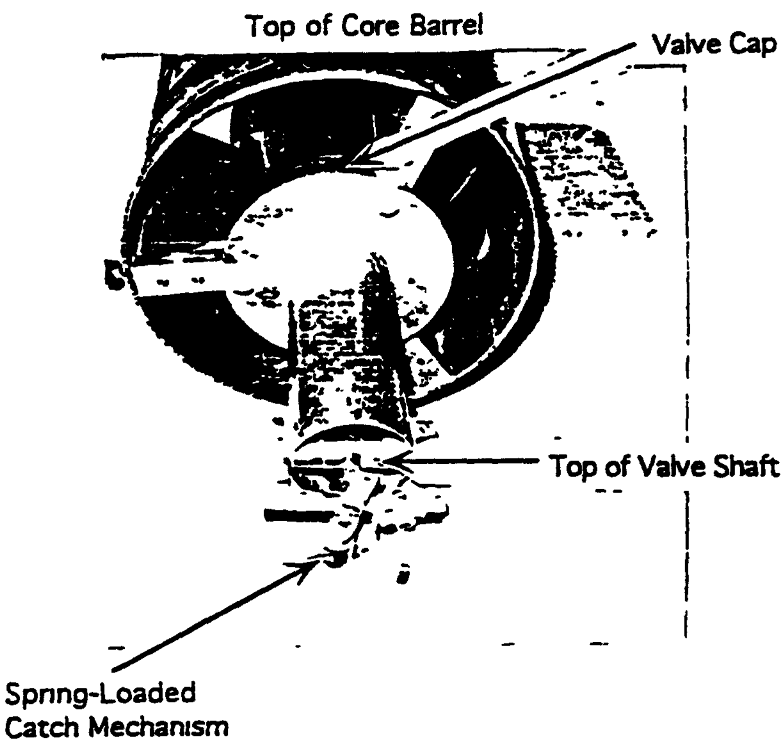


Assembled Hand-Held Corer



APPENDIX 4 (Continued)

Hand-held, Gravity Coring Equipment
Figure G



APPENDIX 5

Sediment Sample Collection Form (SSCF)

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM SW.6A

SEDIMENT SAMPLE COLLECTION FORM

SAMPLE ID: ____________ SITE ID: ____________ LOCATION: ____________

NORTH OR Y: ____________ EAST OR X: ____________

COLLECTION DATE: ____________ QUARTER: 1 2 3 4 DKS: Y / N

COLLECTION TIME: ____________ PURPOSE: ____________

COMPOSITE: Y / N

COMPOSITE DESCRIPTION: ____________

QC TYPE: REAL MS MSD LR DUP RNS QC PARTNER: ____________

COLLECTION METHOD: Scoop ______ Dredge ______ Core ______ Other ____________

SIEVED: Y / N SIEVE SIZE NO: 10

SIEVE MATERIAL: FRAME ____________ SCREEN ____________

TEAM LEADER ____________ TECH ____________ TECH ____________ TECH ______

VOLUME COLLECTED: ____________ UNITS ____________

DEPTH OF WATER: ____________ Feet

DEPTH OF TAKE: ____________ Inches

COMMENTS: ____________

SAMPLED FROM:

Shore Stream Boat Bridge Cross-Section Dry Area Other ____________

SAMPLING CONDITIONS:

Stream Pond Dry Other ____________

WEATHER:

Clear Calm Hot Sunny P/C Lt. Breeze Warm Fog Cloudy Windy Cool Rain

Gusty Cold Sleet V Cold Snow Other ____________

MATRIX: ____________

REQUEST FOR ANALYSIS NO: ____________

CHAIN OF CUSTODY NO: ____________

SHIP DATE: ____________

Sampler: ____________

Prepared by: ____________

Print Name Signature

Company: ____________

(4011-040-0101-040)(SW6REV.2)(02/26/92)

APPENDIX 6

Eckman Grab Sampler
(From Welch, 1948)

EKMAN DREDGE

Of all the various bottom samplers, the Ekman dredge is so preeminently successful and so widely used for soft bottoms that it has become the standard instrument. In its present form (Fig 50) it is modified from the original Ekman design by being adapted to the use of a messenger for closing. It is commonly built in two sizes, one having a cross section of 6 × 6 in. (15.2 × 15.2 cm.) and the other 9 × 9 in. (22.8 × 22.8 cm.) The body of the dredge consists of a square or rectangular box of sheet brass. The lower opening of this box is closed by a pair of strong brass jaws so made and installed that they oppose each other and, when shut, close tightly; when fully pulled apart, they leave the whole bottom of the box open. Two strong external springs, when released by the messenger,

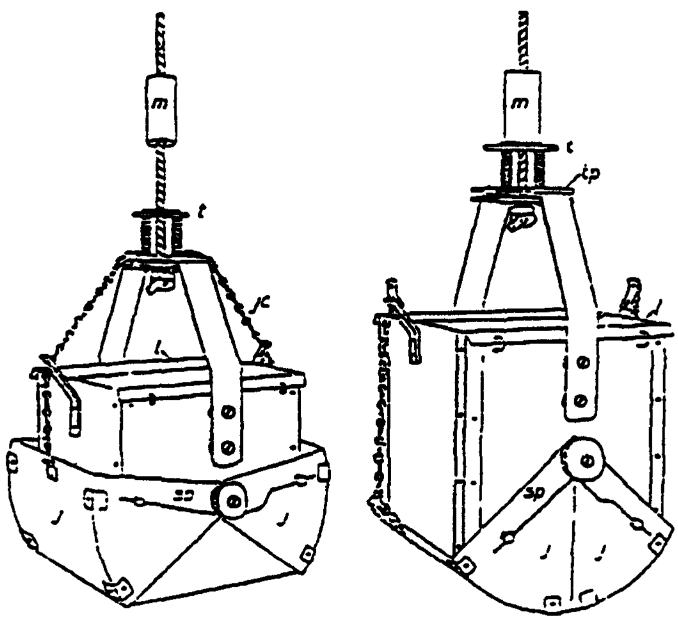


FIG. 50 Ekman dredge of usual type. (*Left*) In open form and ready to be lowered into water. (*Right*) In closed form after messenger has released trip mechanism and jaws have closed. (*j*) Jaw (*jc*) Jaw chain. (*l*) Top lid. (*m*) Messenger (*sp*) Spring which operates jaws. (*t*) Trip mechanism. (*tp*) Trip pin.

APPENDIX 6 (continued)
Eckman Grab Sampler
(From Welch, 1948)

snap the jaws shut. The top of the box is closed by two thin, hinged, overlapping lids which open easily when the dredge is descending through the water but which close and are held tightly shut by the water pressure while the dredge is lifted to the surface. A spring mechanism at the top of the sampler provides a means of releasing the jaws by a messenger when the sampler is at the proper place. Two short chains extend from the upper edges of the jaws to two pins in the spring mechanism when the jaws are set at the open position. Other details of construction appear in Fig 50

In operation, the sampler is attached to a strong rope by passing the latter through the trip mechanism and knotting it securely below the underlying plate. The sampler is then lowered into the water until it rests on the bottom. Its own weight is usually sufficient to sink it in the mud for much or all of its height. After a short time to allow for settling, the messenger is sent down on the rope causing the jaws to close and bite out a sample. If the sampler is in good condition this sample can be drawn to the surface without loss and without any contact with overlying water. On arrival at the top the sample is delivered into screens, containers or elsewhere by merely pulling up the jaw chains.

This sampler is especially adapted for use in soft, finely divided mud, muck, ooze, submerged marl and fine peaty materials. It will not function on sand bottoms since the springs are not strong enough to force the jaws closed, also fine grains of sand get between the sides of the box and the closely opposed sides of the jaws, preventing the latter from closing. This difficulty may appear even in muds having some intermixture of fine sand. The presence of hard objects (sticks, partly decayed leaves, clams, stones) may cause difficulty by getting between the jaws. Ordinarily the instrument is useless on hard bottoms.

This sampler has been modified in various ways to suit special purposes. For example, it may be made in a tall form in order to provide a better chance of securing the uppermost, fine, bottom materials. Such a tall form is sometimes equipped with a series of regularly spaced, horizontal slits through which thin metal sheets resembling the shutters on a camera plate holder can be inserted thus dividing the sample into horizontal strata which can be delivered one at a time, thus making possible a study of stratification of materials and vertical distribution of organisms. Both the standard and the tall forms are sometimes equipped with a brass screen of selected mesh which covers the upper end of the instrument just below the lids. Such a screen is looked upon by some workers as a means of preventing the overspill loss of organisms and coarser materials by the sampler sinking into the mud deeper than its own height. However, when a sampler is so screened, it must be used with care since if lowered too speedily into a bottom the passage of watery mud through the screen may not equal the speed of lowering and then there is a danger of underspill

APPENDIX 6 (continued
Eckman Grab Sampler
(From Welch, 1948)

at the bottom opening The size of mesh of such a screen must be selected with care and preliminary tests of a sampler so equipped should be conducted in the laboratory before it is used in the field.

General Considerations

a. All nuts must be sealed into place with solder to prevent loss in the field.

b. In attaching the rope to the sampler, care must be taken to make a close, secure knot below the supporting plate with the rope end worked into the knot, otherwise the loose end may interfere with the closure of the upper lids.

c. When lowering the sampler into the water, it should be started down in a vertical position and then not dropped too rapidly, otherwise the open sampler will tend to descend in some diagonal direction. When lowered properly, the sampler will meet bottom in the correct position.

d. Ekman samplers of larger sizes (9 × 9 in. or larger) when loaded are heavy and ordinarily should be used with the aid of a hoist (Fig 51)

e. While this sampler, as usually built, is sturdy and will function indefinitely, damage in the form of bent or dented sides, jaws, and lids is likely to result in leaks, seriously impairing its usefulness. Hence in use, impacts with the boat and other objects should be avoided.

f. An Ekman dredge may be used at any depths in inland waters.

g The Ekman dredge is suitable both for qualitative and quantitative work.

PETERSEN DREDGE

The Petersen dredge is now widely used for taking samples on hard bottoms, such as sand, gravel, marl, clay, and similar materials. This sturdy dredge is usually built of iron and so constructed that both by its own weight and by the leverage exerted by its closing mechanism it bites its way into hard bottoms deep enough to secure satisfactory samples. The principal features of construction appear in Fig 52 It may be made in any desired size and weight. For ordinary uses one which weighs 35 lb empty and which may be loaded with weights bolted to the outer surface of the jaws to a total weight of 70 lb. is recommended Since the total weight is markedly increased when the instrument acquires a sample it is usually necessary to operate it with a hoist (Fig. 51). A dredge of the size just mentioned will enclose an area, when open, of about 0.06 sq m The weight of its load depends upon how nearly it fills and upon the character of the bottom materials. One of its virtues is simplicity of construction and operation. Barring accidents, such a dredge will last indefinitely The tripping device consists only of a horizontal locking bar which holds the

APPENDIX 6 (continued)
Eckman Grab Sampler
(From Edmondson and Winberg, 1971)

2. *Ekman type samplers*
These samplers are metal boxes closed by jaws at the bottom. Because of simplicity and availability, the Ekman grab or variations of it have been very widely used

The Ekman grab
The body of the Ekman grab consists of a square or rectangular box of sheet brass usually 25 cm on each side (Fig. 1.3.10, Ekman 1911; Shadin 1960, Schwoerbel 1966). The lower opening is closed by a pair of strong brass jaws that oppose each other and are closed tightly by springs. When fully pulled apart, they leave the whole bottom of the box open. Two strong external springs, when released by messenger, snap the jaws shut. The top of the box is covered by two thin, hinged, overlapping lids which are pushed open when the grab is descending through the water but which close and are held shut by water pressure while the dredge is lifted to the surface. A spring mechanism at the top of the sampler provides a means of releasing the jaws by a messenger when the sampler is on the bottom.

In operation, the sampler is cocked and lowered to the bottom. Its own weight should be sufficient to sink it in the mud for much of its height. The messenger is then sent down on the rope causing the jaws to close. If the sampler has worked properly, it can be drawn to the surface without loss of material or disturbance within. On arrival at the surface, the sample is delivered into containers by merely pulling up the jaw chains (description from Welch 1948).

This grab is specially adapted for use in medium soft deposits. The most important

s

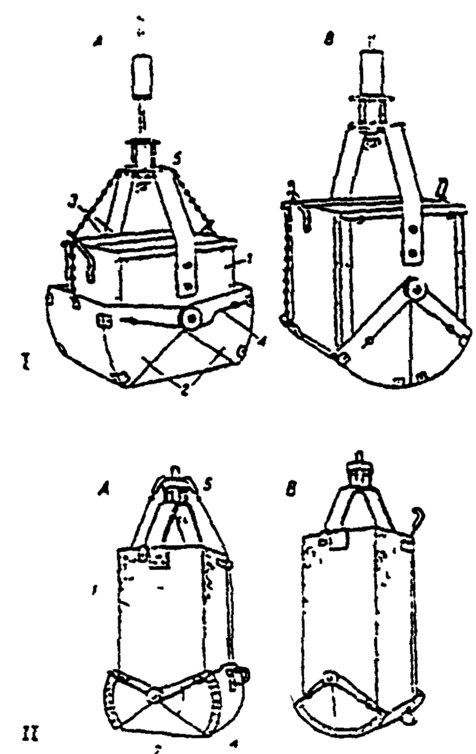


Figure 1.3 10. Ekman-Birge grab I Initial form II. Tall form as used by Borutzky A. open B closed. It is advantageous to use flexible cable rather than chains to hold the jaws open and to have the guides open rather than to have the cable pass through a hole. 1, box 2, jaws 3 .oo lids 4 spring which operates jaws 5, jaw chain fastened on trip mechanism. (From Pavlovski & Zadin 1956.)

APPENDIX 6 (continued)
Eckman Grab Sampler
(From Edmondson and Winberg, 1971)

requirements for proper functioning are: the top lids opening easily and strong springs which should tightly close the apparatus when the sample is taken, sufficient weight and height. Too rapid lowering of the grab must be avoided as this causes displacement of ooze even when the lids function properly

In very soft mud there is a danger of the grab sinking too far into the bottom and losing part of the contents through the top of the apparatus. It is better therefore to use a tall modification (Fig. 1.3.10, II, Lenz 1931, Borutsky 1935, Shadin 1960, 1966). Each sample should be checked to see if there is water above the surface of the deposit in the apparatus.

Screens covering the top opening of the apparatus should not be used because even when the apparatus is lowered very slowly, they cause disturbance of deposits. For the same reason the top lids should move up swiftly under the pressure of flow during lowering the grab and drop down when the instrument is on the bottom.

The Ekman grab on a pole is used in shallower environments with harder sediments (Hrbacek *et al.* 1962, see Section 1.3.1) The apparatus is pushed to the proper depth with the pole. The operation of the apparatus in such environments where gravel, shells, etc., do not prevent the jaws from closing can be successful. Less troublesome and more reliable in this type of environment is a sampler of the Zabolocki type (Fig. 1.3.11) in which the jaws are closed by hand with a lever.

Deevey & Bishop (1942) used a sampler something like an Ekman grab on a pole, but with long levers extending from the jaws. The jaws were closed by pulling ropes attached to the levers.

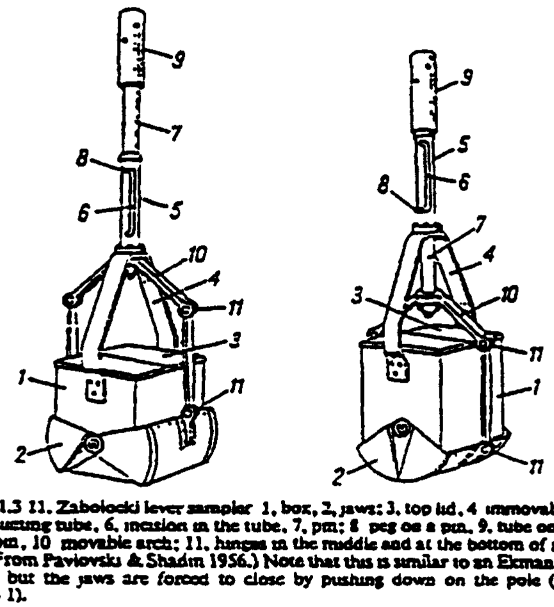


Figure 1.3 11. Zabolocki lever sampler 1, box, 2, jaws; 3, top lid, 4 immovable arch, 5 conducting tube, 6, incision in the tube, 7, pin; 8 peg on a pin, 9, tube on the top of the pin, 10 movable arch; 11, hinges in the middle and at the bottom of movable arch. (From Pavlovski & Shadin 1956.) Note that this is similar to an Ekman grab on a pole, but the jaws are forced to close by pushing down on the pole (see also Fig. 1 4 1).

APPENDIX 6 (continued)
Eckman Grab Sampler
(From Edmondson and Winberg, 1971)

Allan's grab (Southwood 1966) works on a similar principle, but should not be advised because of the closed top.

The addition of very strong springs fixed in a suitable way (Hrbacek *et al.* 1962; Wiktor, unpublished) makes the use of the Ekman grab possible even on mud bottom covered with shells (easily crushed by jaws) and on substrates covered with soft vegetation.

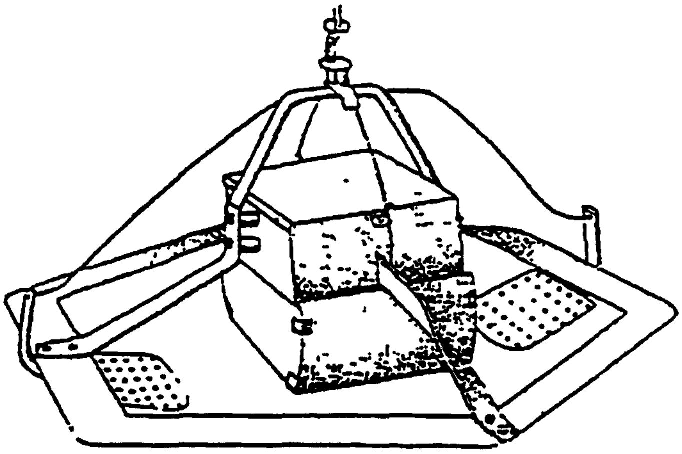


Figure 1.3.12. Rawson modification of Ekman grab for use in deep waters. The flat ring stabilizes the grab and keeps it from falling on its side. The two paddles are pushed up and trip the closing mechanism. Even with messenger activation, the stabilizing ring is useful in deep water.

On bottoms covered with shells only the Ekman grab on a rod can be applied because even very heavy weights cannot make the grab bite into the substratum Wiktor (unpublished data) used the Ekman grab on a rod even in depths of 8 m, hanging the stick on the mast of the boat and using a block. Samples taken by the Ekman grab from sand, gravel or stony bottom should not be accepted as reliable.

Among other versions of the Ekman grab, Rawson's modification (Fig. 1.3.12, Rawson 1947) should be mentioned. This apparatus can be automatically closed by triggered plates, without the use of a messenger, this saves much time in deep waters and enables the grab to close even when it descends obliquely. Even without the automatic closing feature, the supporting ring is valuable because it prevents the sampler from settling too deeply into the sediment and keep it from tipping over when it is used in deep water (see also Fig. 1.3.13)

APPENDIX 6 (continued)
Eckman Grab Sampler
(From Edmondson and Winberg, 1971)

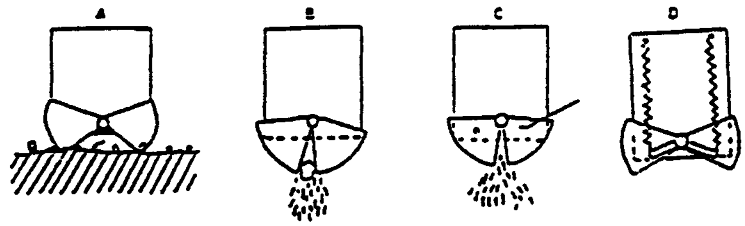


Figure 1.3.13. Possible failures of Ekman grab on coarse bottom materials. a, jaws slide on surface and only superficial material; b, jaws fail to close completely because of stone between them; c, incomplete closure caused by sand stuck between the side pieces of the jaws and the side of the grab; d, modification of springs with pulling on levers to make jaws close with much more force.

Very often additional weights, to assure adequate penetration are used. Auerbach's grab (Auerbach 1953) can be mentioned as an example. As in the Rawson's modification, it closes automatically, which permits sampling in great depths.

Szczepanski's sampler is similar in principle to the Ekman grab but differs in having only one jaw and a smaller sampling surface (10–20 cm²) (Szczepanski 1953, Shadin 1960, 1966). It can be used on a rope in deep water or on a pole in shallow. It can be used for sampling on much harder bottoms than the Ekman grab.

This and other tall form samplers, when working in deep places, can be supplied with stands or frames to keep them upright as they enter the bottom. This can be very important to successful sampling.

3. *Petersen type samplers*
Some samplers are designed to scrape bottom material into a container during the sampling process.

The Petersen grab consists of two hinged buckets, each forming a sector of a cylinder (Fig. 1.3.14; Welch 1948; Holme 1966; Petersen 1908). It is lowered to the bottom in the open position. When the lowering rope slackens, a release is actuated so that when the grab is hauled two scoops close together and take a bite of sediment semicircular in cross section. This type of grab has been modified in various ways. For example, to increase the closing force, the scoops of the van Veen grab (Holme 1964; Schwoerbel 1966; Wigley 1967) are closed by the pincerlike action of two long arms to which the bridles are attached.

This type of grab operates in such a way that there is uncertainty about the area and the depth sampled. Also, the jaws may be kept partly open by stones or sticks, and part of the sample may be lost. Further, the closed or screened construction of the modified sampler often used creates a pressure wave that can displace the loose surface deposit.

APPENDIX 7
USBM-60 Sampler
(From Guy and Norman, 1982)

finer than about 30 or 40 mm in diameter As noted in the description of individual samplers, there may also be limitations with respect to some very fine sediments for some of the samplers The collection and analysis of material larger than coarse gravel logically becomes more difficult and costly because other techniques are required to avoid handling heavy samples with larger and more expensive equipment Because of the difficulty in measuring large sizes little information regarding size distribution is available on streams having gravel cobble and boulder beds. Therefore much of the equipment for measurement of large bed material is of an experimental nature and standard equipment is not available for routine use Several references are available however on direct and indirect methods of sampling and analysis of coarse bed materials (Lane and Carlson 1953, Kellerhals 1967 and Wolman 1954)

Hand-held samplers—US BMH-53 and US BMH-60

The Federal Inter-Agency Project has developed three types of instruments for sampling the bed material of streams where most of the material is finer than medium gravel The smallest of the three designated as the US BMH-53 (see fig 8) is designed to sample the bed of wadable streams. The instrument is 46 inches in total length and usually is made of corrosion resistant materials The collecting end of the sampler is a stainless steel thin-walled cylinder 2 inches in diameter and 8 inches long with a tight-fitting brass piston The piston is held in position by a rod which passes through the handle to the opposite end The piston creates a partial vacuum above the material being sampled and thereby compensates in a reverse direction for some of the frictional resistance required to push the sampler into the bed This partial vacuum also retains the sample in the cylinder while the sampler is being removed from the bed The piston also serves to force the sample from the cylinder in a manner that results in a sample column with a minimum of distortion from which material at different depths from the surface may be visualized and subsamples obtained (See F I A S P (1963b, 1966) for more detailed information)

The bed material of deeper streams or lakes can be sampled with the US BMH-60 (see fig 9) This is a hand-line sampler about 22 inches (56 cm) long made of cast aluminum has tail vanes and is available in weights of 30, 35 or 40 pounds (13.6, 15.9 or 18.2 kg) Because of its light weight its use should be restricted to streams of slower to deep - and velocities and whose bed material is also moderately firm and yet does not contain much gravel

The sampler mechanism of the US BMH-60 consists of a scoop or bucket driven by a cross-curved constant-torque motor-type spring that rotates the bucket from front to back The scoop when activated by release of tension on the hanger rod can penetrate into the bed about 1.7 inches (4.3 cm) and can hold approximately 175 cc of material The scoop is aided in penetration of the bed by extra weight in the sampler nose To cock the bucket into an open position for sampling (that is, retracted into the body the sampler must first be supported by the hand line then the bucket can be rotated (back to front) with an allen wrench to an open position

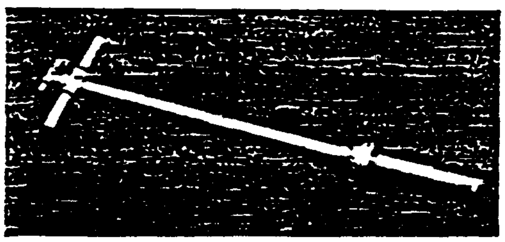


Figure 8 —Hand-held piston-type bed-material sampler US BMH-53

Figure 9 —Hand-line spring driven rotary-bucket 30-pound bed material sampler US BMH-60 Adapted from F I A S P (1963 p 103)

APPENDIX 7 (Continued)
USBM-60 Sampler
(From Guy and Norman, 1982)

The hanger rod to which the hand line is attached is grooved so that a safety yoke can be placed in position to maintain tension on the hanger rod assembly. **Caution At no time should the hand or fingers be placed in the bucket opening as the bucket may accidentally close with sufficient force to cause permanent injury!** A piece of wood or a brush can be used to remove any material adhering inside the sample bucket. (See F.I.A.S.P. (1963b, 1966) for more detailed information.)

The bucket closes when the safety yoke is removed and tension on the hand line is released as will occur when the sampler comes to rest on the streambed. A gasket on the closure plate prevents trapped material from contamination or being washed from the bucket.

Cable-and-reel sampler—US BM-54

Except for streams with extremely high velocities, the 100-pound cable-and-reel suspended BM-54 sampler (fig. 10) can be used for sampling bed material of streams and lakes of any reasonable depth. The body of the BM-54 is of cast steel. Its physical configuration is nearly identical with the cast aluminum BMH-60, 22 inches (56 cm) long and with tail vanes. Its operation is also similar to the BMH-60 in that it takes a sample when tension on the cable is released as the sampler touches the bed. The sampling mechanism externally looks similar to that of the BMH-60, but its operation is somewhat different.

After 1956 the BM-54 units were equipped with a safety bar which can be rotated over the front or cutting edge of the bucket when cocked into the open position. The bar then keeps the bucket in the open position even though the catch mechanism operated by tension on the cable is not engaged. These safety bars should be obtained from the F.I.A.S.P. for use on units issued before 1956. Again **please note that even though a safety bar is used it is necessary to keep one's hands away from the bucket cavity.** The power of the bucket is demonstrated by the fact that upon release it has been observed to lift the 100-pound (45 kg) sampler from a hard surface.

The driving force of the bucket comes not from a constant-torque spring but rather from a conventional coil-type spring. The tension on the spring is adjusted by the nut-and-bolt assembly protruding from the front of the sampler to obtain a bite powerful enough to obtain a sample from the bed of very compacted sand. It is suggested that the tension on the spring be released during extended periods of idleness even though the bucket is closed. Maximum tension need be used only when the streambed is very firm. Unlike the BMH-60, the spring and cable assembly rotates the bucket from the back to the front of the sampler. Again, the trapped sample is kept from washing out by a rubber gasket. (See F.I.A.S.P. (1963b, 1964, and 1966) for more complete description and details.)

In the event that core samples are needed in deep flowing water, a sampler has been developed and extensively used in studies of the Columbia River Estuary by Prych and Hubbell (1966). This cable-suspended sampler collects a 1¾-inch-diameter by 1-foot-long core by a combination of vibration and an axial force derived by cables from a 250-pound streamlined stabilizing weight.

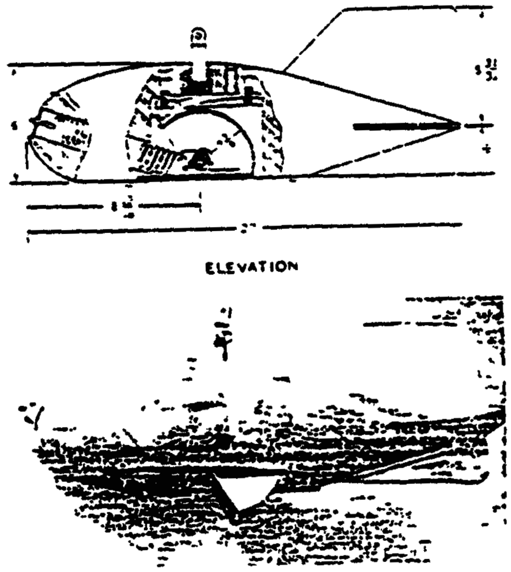


Figure 10.—Elevation sketch (top) and photograph (bottom) of a cable-and reel spring-driven rotary-bucket 100 pound bed-material sampler, US BM-54. Dimensions on sketch are in inches. Adapted from F.I.A.S.P. (1959, p. 29 and 30)

APPENDIX 8
Generation of Unique Sample Numbers

A datasheet or data form number can be generated by assigning it the number CSDF-XXXXX-III-MMDDYY-KK where,

1. XXXXX is the location number if available (if unavailable or unclear this may be left out),

2. III is your initials,

3. MMDDYY is the date in the indicated format, and

4. KK is a unique number assigned by you, typically the depth of the core section interval in units used in sectioning portion of the CSDF.