

**Gold King Mine Release  
Sampling and Analysis Plan/Quality Assurance Project Plan**

To: Donn Zuroski  
From: Jonathan Colomb  
CC: Mike Boykin, Bret Moxley, Randy Nattis  
TDD#:  
Date: 8/27/2015  
DCN:  
Re: Addendum 1 to Gold King Mine Release SAP/QAPP – Surface and Sediment  
Sampling

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Comments: This is Addendum 1 to the Gold King Mine Release SAP/QAPP, dated 8/18/15. This Addendum provides the following:

1. Written protocol for collecting surface water and sediment samples from within the area affected by the Gold King Mine
2. List of analytes and corresponding method detection limits by laboratory.
3. ERT Standard Operating Procedure for Sediment Sampling.

**Purpose and Scope**

START will collect surface water and sediment/sludge samples to characterize potential impacts from the Gold King Mine release. Samples will be collected from within the area of potential impact from the release on the Navajo Reservation.

Known sample locations will be current surface water sample locations and include:

| <b>Location</b> | <b>Latitude</b> | <b>Longitude</b> | <b>Description</b>                           |
|-----------------|-----------------|------------------|--|
| SJLP            | 36.735887       | -108.253987      | The San Juan river and the La Plata Highway. |
| SJSR            | 36.781624       | -108.692784      | The San Juan river in Shiprock.              |
| SJ4C            | 36.996216       | -109.004684      | The San Juan river at Four Corners.          |
| SJMC            | 37.258226       | -109.310604      | The San Juan river at Montezuma Creek.       |
| SJMH            | 37.149993       | -109.866284      | The San Juan at Mexican Hat.                 |

These 5 sample locations were selected from 11 locations which had previously been sampled on a daily basis during the early phase of the response. These 5 locations represent sampling points which provide a snapshot of the river beginning upstream at the eastern border of the Navajo reservation (See attached figure). These sampling points were chosen in a biased fashion based on depth of the river, deposition of sediment, and physical ease of access. If sampling locations become inaccessible, alternate sampling locations which provide similarly adequate or sufficient data as the original will be identified and sampled based upon the best judgment of the inspector/sampler, if necessary.

**Sampling and Field OC Procedures**

Sampling will include collection of surface water and sediment/sludge samples.

Surface water samples will be collected to characterize water quality and flow impacts from the Gold King Mine release. Surface water will be monitored for pH and turbidity. Other water quality parameters such as conductivity, temperature, oxygen-reduction potential and dissolved oxygen will be measured as long as the additional information is helpful in evaluation site conditions.

A direct method of water collection will be utilized, collecting water samples from the surface

directly into sample containers. At shallow stream locations the sample will be collected under the surface water while pointing the sample container upstream of the collector. While collecting the sample, caution will be used to avoid disturbing the substrate. Sample collection procedures will follow those in ERT SOP 2001. Samples will be analyzed for total and dissolved metals including mercury using methods 200.7, 200.8, and 245.1, total dissolved solids using SM 2540C, total suspended solids using SM2540D, and pH with SM4500H+B. Requirements for the sample container, volume, preservation, and QC samples are presented on Worksheet 19 & 30 (Sample Containers, Preservation and Hold Times) and Worksheet 20 (Field Quality Control Sample Summary) of the QAPP.

The following table lists surface water criteria which will be used to evaluate the analytical results of the sludge sample material and corresponding method detection limits by a laboratory. Test America has been identified as the laboratory.

| Analyte                            | CAS.NO    | Units | PCL  | Drinking Water MCL | RBC.20150816 | Aquatic Acute | Aquatic Chronic | Irrigation | Livestock |
|------------------------------------|-----------|-------|------|--------------------|--------------|---------------|-----------------|------------|-----------|
| <b>Metals, Total and Dissolved</b> |           |       |      |                    |              |               |                 |            |           |
| Aluminum                           | 7429-90-5 | ug/L  | 3348 | ---                | 170000       | 8358          | 3348            | 5000       | ---       |
| Antimony                           | 7440-36-0 | ug/L  | 6    | 6                  | 67           | ---           | ---             | ---        | ---       |
| Arsenic                            | 7440-38-2 | ug/L  | 10   | 10                 | 50           | ---           | ---             | 100        | 200       |
| Barium                             | 7440-39-3 | ug/L  | 2000 | 2000               | 33000        | ---           | ---             | ---        | ---       |
| Beryllium                          | 7440-41-7 | ug/L  | 4    | 4                  | 330          | 340           | 150             | 100        | 100       |
| Cadmium                            | 7440-43-9 | ug/L  | 0.72 | 5                  | 83           | 2.88          | 0.72            | 10         | 50        |
| Calcium                            | 7440-70-2 | ug/L  | ---  | ---                | ---          | ---           | ---             | ---        | ---       |
| Chromium                           | 7440-47-3 | ug/L  | 100  | 100                | 220000       | 972           | 126             | 100        | 1000      |
| Cobalt                             | 7440-48-4 | ug/L  | 50   | ---                | 50           | ---           | ---             | 50         | 1000      |
| Copper                             | 7440-50-8 | ug/L  | 16   | 1300               | 6700         | 25            | 16              | 200        | 500       |

| Analyte    | CAS.NO    | Units | PCL    | Drinking Water MCL | RBC.20150816 | Aquatic Acute | Aquatic Chronic | Irrigation | Livestock |
|------------|-----------|-------|--------|--------------------|--------------|---------------|-----------------|------------|-----------|
| Iron       | 7439-89-6 | ug/L  | 120000 | ---                | 120000       | ---           | ---             | ---        | ---       |
| Lead       | 7439-92-1 | ug/L  | 5      | 15                 | 200          | 130           | 5               | 5000       | 100       |
| Magnesium  | 7439-95-4 | ug/L  | ---    | ---                | ---          | ---           | ---             | ---        | ---       |
| Manganese  | 7439-96-5 | ug/L  | 200    | ---                | 7800         | 3710          | 2050            | 200        | ---       |
| Mercury    | 7439-97-6 | ug/L  | 0.77   | 2                  | 50           | 104           | 0.77            | ---        | 10        |
| Molybdenum | 7439-98-7 | ug/L  | 830    | ---                | 830          | ---           | ---             | ---        | ---       |
| Nickel     | 7440-02-0 | ug/L  | 90     | ---                | 3300         | 813           | 90              | 200        | 1000      |
| Potassium  | 7440-09-7 | ug/L  | ---    | ---                | ---          | ---           | ---             | ---        | ---       |
| Potassium  | 9/7/7440  | ug/L  | ---    | ---                | ---          | ---           | ---             | ---        | ---       |
| Selenium   | 7782-49-2 | ug/L  | 5      | 50                 | 830          | 20            | 5               | 130        | 250       |
| Silver     | 7440-22-4 | ug/L  | 9.9    | ---                | ---          | 9.9           |                 |            |           |
| Sodium     | 7440-23-5 | ug/L  | ---    | ---                | ---          | ---           | ---             | ---        | ---       |
| Thallium   | 7440-28-0 | ug/L  | 1.7    | 2                  | 1.7          | ---           | ---             | ---        | ---       |
| Vanadium   | 7440-62-2 | ug/L  | 100    | ---                | 830          | ---           | ---             | 100        | 100       |
| Zinc       | 7440-66-6 | ug/L  | 219    | ---                | 50000        | 290           | 219             | 2000       | 25000     |

Sediment samples will be collected from a depth of 0-2 cm in areas of deposition and will be biased for sampling of sludge material. Sample collection procedures will follow those in ERT SOP 2016. Samples will be analyzed for total metals using methods 6010B, 6020A and 7471A. Requirements for the sample container, volume, preservation, and QC samples are presented on Worksheet 19 & 30 (Sample Containers, Preservation and Hold Times) and Worksheet 20 (Field Quality Control Sample Summary) of the QAPP. The following table

lists sediment screening criteria that will be used to evaluate the analytical results of the sludge sample material and corresponding method detection limits by laboratory. Test America has been setup as a laboratory.

| Metal    | Units | TEC <sup>1</sup> | PEC <sup>1</sup> | Test America MDLs |       |       | ESAT MDLs |       |      |
|----------|-------|------------------|------------------|-------------------|-------|-------|-----------|-------|------|
|          |       |                  |                  | 6010B             | 6020A | 7471A | 6010C     | 6020A | 7473 |
| Arsenic  | mg/kg | 9.79             | 33               | 0.8               | 0.1   | --    | 10        | 0.2   | --   |
| Cadmium  | mg/kg | 0.99             | 4.98             | 0.1               | 0.015 | --    | 0.5       | 0.02  | --   |
| Chromium | mg/kg | 43.4             | 111              | 0.21              | 0.11  | --    | 0.5       | 0.2   | --   |
| Copper   | mg/kg | 31.6             | 149              | 0.17              | 0.13  | --    | 0.2       | 0.1   | --   |
| Lead     | mg/kg | 35.8             | 128              | 0.34              | 0.05  | --    | 2.5       | 0.02  | --   |
| Mercury  | mg/kg | 0.18             | 1.06             | --                | --    | 0.008 | --        | --    | 0.01 |
| Nickel   | mg/kg | 22.7             | 48.6             | 0.38              | 0.26  | --    | 1.0       | 0.1   | --   |
| Zinc     | mg/kg | 121              | 459              | 0.7               | 1     | --    | 2.0       | 0.5   | --   |

<sup>1</sup> Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems, MacDonald (2000). TEC – threshold effect concentration. PEC – probable effect concentration.

START personnel will collect field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples and QA/QC samples as needed during the sampling activities. QA/QC samples will be collected as presented in Worksheet 20 of the QAPP.





# GENERAL FIELD SAMPLING GUIDELINES

SOP#: 2001  
DATE: 08/11/94  
REV. #: 0.0

## 1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide general field sampling guidelines that will assist REAC personnel in choosing sampling strategies, location, and frequency for proper assessment of site characteristics. This SOP is applicable to all field activities that involve sampling.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

Sampling is the selection of a representative portion of a larger population, universe, or body. Through examination of a sample, the characteristics of the larger body from which the sample was drawn can be inferred. In this manner, sampling can be a valuable tool for determining the presence, type, and extent of contamination by hazardous substances in the environment.

The primary objective of all sampling activities is to characterize a hazardous waste site accurately so that its impact on human health and the environment can be properly evaluated. It is only through sampling and analysis that site hazards can be measured and the job of cleanup and restoration can be accomplished effectively with minimal risk. The sampling itself must be conducted so that every sample collected retains its original physical form and chemical composition. In this way, sample integrity is insured, quality assurance standards are maintained, and the sample can accurately represent the larger body of

material under investigation.

The extent to which valid inferences can be drawn from a sample depends on the degree to which the sampling effort conforms to the project's objectives. For example, as few as one sample may produce adequate, technically valid data to address the project's objectives. Meeting the project's objectives requires thorough planning of sampling activities, and implementation of the most appropriate sampling and analytical procedures. These issues will be discussed in this procedure.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample to be collected, and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix being sampled and the parameter(s) of interest. Sample preservation, containers, handling, and storage for air and waste samples are discussed in the specific SOPs for air and waste sampling techniques.

## 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The nature of the object or materials being sampled may be a potential problem to the sampler. If a material is homogeneous, it will generally have a uniform composition throughout. In this case, any sample increment can be considered representative of the material. On the other hand, heterogeneous samples present problems to the sampler because of changes in the material over distance, both laterally and vertically.

Samples of hazardous materials may pose a safety threat to both field and laboratory personnel. Proper health and safety precautions should be implemented when handling this type of sample.

Environmental conditions, weather conditions, or non-target chemicals may cause problems and/or interferences when performing sampling activities or when sampling for a specific parameter. Refer to the specific SOPs for sampling techniques.

## **5.0 EQUIPMENT/APPARATUS**

The equipment/apparatus required to collect samples must be determined on a site specific basis. Due to the wide variety of sampling equipment available, refer to the specific SOPs for sampling techniques which include lists of the equipment/apparatus required for sampling.

## **6.0 REAGENTS**

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

## **7.0 PROCEDURE**

### **7.1 Types of Samples**

In relation to the media to be sampled, two basic types of samples can be considered: the environmental sample and the hazardous sample.

Environmental samples are those collected from streams, ponds, lakes, wells, and are off-site samples that are not expected to be contaminated with hazardous materials. They usually do not require the special handling procedures typically used for concentrated wastes. However, in certain instances, environmental samples can contain elevated concentrations of pollutants and in such cases would have to be handled as hazardous samples.

Hazardous or concentrated samples are those collected from drums, tanks, lagoons, pits, waste piles, fresh spills, or areas previously identified as contaminated, and require special handling procedures because of their potential toxicity or hazard. These samples can be further subdivided based on their degree of hazard; however, care should be taken when handling and shipping any wastes believed to be concentrated regardless of the degree.

The importance of making the distinction between environmental and hazardous samples is two-fold:

- (1) Personnel safety requirements: Any sample thought to contain enough hazardous materials to pose a safety threat should be designated as hazardous and handled in a manner which ensures the safety of both field and laboratory personnel.
- (2) Transportation requirements: Hazardous samples must be packaged, labeled, and shipped according to the International Air Transport Association (IATA) Dangerous Goods Regulations or Department of Transportation (DOT) regulations and U.S. EPA guidelines.

### **7.2 Sample Collection Techniques**

In general, two basic types of sample collection techniques are recognized, both of which can be used for either environmental or hazardous samples.

#### Grab Samples

A grab sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected all at once at one particular point in the sample medium. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease.

#### Composite Samples

Composites are nondiscrete samples composed of more than one specific aliquot collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can in certain instances be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask problems by diluting isolated concentrations of some hazardous compounds below detection limits.

Compositing is often used for environmental samples and may be used for hazardous samples under certain conditions. For example, compositing of hazardous waste is often performed after compatibility tests have



been completed to determine an average value over a number of different locations (group of drums). This procedure generates data that can be useful by providing an average concentration within a number of units, can serve to keep analytical costs down, and can provide information useful to transporters and waste disposal operations.

For sampling situations involving hazardous wastes, grab sampling techniques are generally preferred because grab sampling minimizes the amount of time sampling personnel must be in contact with the wastes, reduces risks associated with compositing unknowns, and eliminates chemical changes that might occur due to compositing.

### 7.3 Types of Sampling Strategies

The number of samples that should be collected and analyzed depends on the objective of the investigation. There are three basic sampling strategies: random, systematic, and judgmental sampling.

Random sampling involves collection of samples in a nonsystematic fashion from the entire site or a specific portion of a site. Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established. When judgmental sampling is performed, samples are collected only from the portion(s) of the site most likely to be contaminated. Often, a combination of these strategies is the best approach depending on the type of the suspected/known contamination, the uniformity and size of the site, the level/type of information desired, etc.

### 7.4 QA Work Plans (QAWP)

A QAWP is required when it becomes evident that a field investigation is necessary. It should be initiated in conjunction with, or immediately following, notification of the field investigation. This plan should be clear and concise and should detail the following basic components, with regard to sampling activities:

- C Objective and purpose of the investigation.
- C Basis upon which data will be evaluated.
- C Information known about the site including location, type and size of the facility, and length of operations/abandonment.
- C Type and volume of contaminated material, contaminants of concern (including

concentration), and basis of the information/data.

- C Technical approach including media/matrix to be sampled, sampling equipment to be used, sample equipment decontamination (if necessary), sampling design and rationale, and SOPs or description of the procedure to be implemented.
- C Project management and reporting, schedule, project organization and responsibilities, manpower and cost projections, and required deliverables.
- C QA objectives and protocols including tables summarizing field sampling and QA/QC analysis and objectives.

Note that this list of QAWP components is not all-inclusive and that additional elements may be added or altered depending on the specific requirements of the field investigation. It should also be recognized that although a detailed QAWP is quite important, it may be impractical in some instances. Emergency responses and accidental spills are prime examples of such instances where time might prohibit the development of site-specific QAWPs prior to field activities. In such cases, investigators would have to rely on general guidelines and personal judgment, and the sampling or response plans might simply be a strategy based on preliminary information and finalized on site. In any event, a plan of action should be developed, no matter how concise or informal, to aid investigators in maintaining a logical and consistent order to the implementation of their task.

### 7.5 Legal Implications

The data derived from sampling activities are often introduced as critical evidence during litigation of a hazardous waste site cleanup. Legal issues in which sampling data are important may include cleanup cost recovery, identification of pollution sources and responsible parties, and technical validation of remedial design methodologies. Because of the potential for involvement in legal actions, strict adherence to technical and administrative SOPs is essential during both the development and implementation of sampling activities.

Technically valid sampling begins with thorough planning and continues through the sample collection and analytical procedures. Administrative requirements involve thorough, accurate

documentation of all sampling activities. Documentation requirements include maintenance of a chain of custody, as well as accurate records of field activities and analytical instructions. Failure to observe these procedures fully and consistently may result in data that are questionable, invalid and non-defensible in court, and the consequent loss of enforcement proceedings.

## **8.0 CALCULATIONS**

Refer to the specific SOPs for any calculations which are associated with sampling techniques.

## **9.0 QUALITY ASSURANCE/ QUALITY CONTROL**

Refer to the specific SOPs for the type and frequency of QA/QC samples to be analyzed, the acceptance criteria for the QA/QC samples, and any other QA/QC activities which are associated with sampling techniques.

## **10.0 DATA VALIDATION**

Refer to the specific SOPs for data validation activities that are associated with sampling techniques.

## **11.0 HEALTH AND SAFETY**

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures.



# SEDIMENT SAMPLING

SOP#: 2016  
DATE: 11/17/94  
REV. #: 0.0

## 1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) is applicable to the collection of representative sediment samples. Analysis of sediment may be biological, chemical, or physical in nature and may be used to determine the following:

- C toxicity;
- C biological availability and effects of contaminants;
- C benthic biota;
- C extent and magnitude of contamination;
- C contaminant migration pathways and source;
- C fate of contaminants;
- C grain size distribution.

The methodologies discussed in this SOP are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. However, if modifications occur, they should be documented in a site or personal logbook and discussed in reports summarizing field activities and analytical results.

For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, and impoundments; or flowing, as in rivers and streams.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

Sediment samples may be collected using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile

required (surface vs. subsurface), the type of sample required (disturbed vs. undisturbed), contaminants present, and sediment type.

Sediment is collected from beneath an aqueous layer either directly, using a hand held device such as a shovel, trowel, or auger; or indirectly, using a remotely activated device such as an Ekman or Ponar dredge. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size and construction for the analyses requested. If composite sampling techniques are employed, multiple grabs are placed into a container constructed of inert material, homogenized, and transferred to sample containers appropriate for the analyses requested. The homogenization procedure should not be used if sample analysis includes volatile organics; in this case, sediment, or multiple grabs of sediment, should be transferred directly from the sample collection device or homogenization container to the sample container.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

1. Chemical preservation of solids is generally not recommended. Cooling to 4°C is usually the best approach, supplemented by the appropriate holding time for the analyses requested.
2. Wide mouth glass containers with Teflon lined caps are utilized for sediment samples. The sample volume is a function of the analytical requirements and will be specified in the Work Plan.
3. If analysis of sediment from a discrete depth or location is desired, sediment is transferred directly from the sampling device to a labeled sample container(s) of appropriate size and construction for the analyses

requested. Transfer is accomplished with a stainless steel or plastic lab spoon or equivalent.

4. If composite sampling techniques or multiple grabs are employed, equal portions of sediment from each location are deposited into a stainless steel, plastic, or other appropriate composition (e.g., Teflon) containers. The sediment is homogenized thoroughly to obtain a composite representative of the area sampled. The composite sediment sample is transferred to a labeled container(s) of appropriate size and construction for the analyses requested. Transfer of sediment is accomplished with a stainless steel or plastic lab spoon or equivalent. Samples for volatile organic analysis must be transferred directly from the sample collection device or pooled from multiple areas in the homogenization container prior to mixing. This is done to minimize loss of contaminant due to volatilization during homogenization.
5. All sampling devices should be decontaminated, then wrapped in aluminum foil. The sampling device should remain in this wrapping until it is needed. Each sampling device should be used for only one sample. Disposable sampling devices for sediment are generally impractical due to cost and the large number of sediment samples which may be required. Sampling devices should be cleaned in the field using the decontamination procedure described in the Sampling Equipment Decontamination SOP.

#### **4.0 INTERFERENCES AND POTENTIAL PROBLEMS**

Substrate particle size and organic matter content are a direct consequence of the flow characteristics of a waterbody. Contaminants are more likely to be concentrated in sediments typified by fine particle size and a high organic matter content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic matter content do not typically concentrate pollutants and are generally found in erosional zones. The selection of a sampling location

can, therefore, greatly influence the analytical results and should be justified and specified in the Work Plan.

#### **5.0 EQUIPMENT/APPARATUS**

Equipment needed for collection of sediment samples may include:

- C Maps/plot plan
- C Safety equipment
- C Compass
- C Tape measure
- C Survey stakes, flags, or buoys and anchors
- C Camera and film
- C Stainless steel, plastic, or other appropriate composition bucket
- C 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- C Ziploc plastic bags
- C Logbook
- C Sample jar labels
- C Chain of Custody records, field data sheets
- C Cooler(s)
- C Ice
- C Decontamination supplies/equipment
- C Spade or shovel
- C Spatula
- C Scoop
- C Trowel
- C Bucket auger
- C Tube auger
- C Extension rods
- C "T" handle
- C Sediment coring device (tube, drive head, eggshell check valve, nosecone, acetate tube, extension rods, "T" handle)
- C Ponar dredge
- C Ekman dredge
- C Nylon rope or steel cable
- C Messenger device

#### **6.0 REAGENTS**

Reagents are not used for preservation of sediment samples. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP.

## **7.0 PROCEDURES**

### **7.1 Preparation**

1. Determine the objective(s) and extent of the sampling effort. The sampling methods to be employed, and the types and amounts of equipment and supplies required will be a function of site characteristics and objectives of the study.
2. Obtain the necessary sampling and monitoring equipment.
3. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
4. Decontaminate or preclean equipment, and ensure that it is in working order.
5. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
6. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors including flow regime, basin morphometry, sediment characteristics, depth of overlying aqueous layer, contaminant source, and extent and nature of contamination should be considered when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

### **7.2 Sample Collection**

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sampling location, and (2) the physical characteristics of the sediment to be sampled. The following procedures may be utilized:

#### **7.2.1 Sampling Surface Sediment with a Trowel or Scoop from Beneath a Shallow Aqueous Layer**

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth and

a shallow aqueous layer is considered to range from 0 to 12 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with tools such as spades, shovels, trowels, and scoops. Although this method can be used to collect both unconsolidated/consolidated sediment, it is limited somewhat by the depth and movement of the aqueous layer. Deep and rapidly flowing water render this method less accurate than others discussed below. However, representative samples can be collected with this procedure in shallow sluggish water provided care is demonstrated by the sample team member. A stainless steel or plastic sampling implement will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials; plating is particularly common with garden trowels.

The following procedure will be used to collect sediment with a scoop, shovel, or trowel:

1. Using a decontaminated sampling implement, remove the desired thickness and volume of sediment from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.
3. Surface water should be decanted from the sample or homogenization container prior to sealing or transfer; care should be taken to retain the fine sediment fraction during this procedure.

#### **7.2.2 Sampling Surface Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer**

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of bucket auger or tube auger, a series of extensions, and a "T" handle (Figure 1, Appendix A). The use of additional extensions in conjunction with a bucket auger can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. However, sample handling and manipulation increases

in difficulty with increasing depth of water. The bucket auger or tube auger is driven into the sediment and used to extract a core. The various depths represented by the core are homogenized or a subsample of the core is taken from the appropriate depth.

The following procedure will be used to collect sediment samples with a bucket auger or tube auger:

1. An acetate core may be inserted into the bucket auger or tube auger prior to sampling if characteristics of the sediments or waterbody warrant. By using this technique, an intact core can be extracted.
2. Attach the auger head to the required length of extensions, then attach the "T" handle to the upper extension.
3. Clear the area to be sampled of any surface debris.
4. Insert the bucket auger or tube auger into the sediment at a 0° to 20° angle from vertical. This orientation minimizes spillage of the sample from the sampler upon extraction from the sediment and water.
5. Rotate the auger to cut a core of sediment.
6. Slowly withdraw the auger; if using a tube auger, make sure that the slot is facing upward.
7. Transfer the sample or a specified aliquot of sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.

### 7.2.3 Sampling Deep Sediment with a Bucket Auger or Tube Auger from Beneath a Shallow Aqueous Layer

For the purpose of this method, deep sediment is considered to range from six to greater than 18 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches. Collection of deep sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a bucket auger, a tube auger, a series of extensions and a

"T" handle. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to five feet or more. However, water clarity must be high enough to permit the sampler to directly observe the sampling operation. In addition, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger is used to bore a hole to the upper range of the desired sampling depth and then withdrawn. The tube auger is then lowered down the borehole, and driven into the sediment to the lower range of the desired sampling depth. The tube is then withdrawn and the sample recovered from the tube. This method can be used to collect firmly consolidated sediments, but is somewhat limited by the depth of the aqueous layer, and the integrity of the initial borehole.

The following procedure will be used to collect deep sediment samples with a bucket auger and a tube auger:

1. Attach the bucket auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
2. Clear the area to be sampled of any surface debris.
3. Begin augering, periodically removing any accumulated sediment (i.e., cuttings) from the auger bucket. Cuttings should be disposed of far enough from the sampling area to minimize cross contamination of various depths.
4. After reaching the upper range of the desired depth, slowly and carefully remove bucket auger from the boring.
5. Attach the tube auger bit to the required lengths of extensions, then attach the "T" handle to the upper extension.
6. Carefully lower tube auger down borehole using care to avoid making contact with the borehole sides and, thus, cross contaminating the sample. Gradually force tube auger into sediment to the lower range of the desired sampling depth. Hammering of the tube auger to facilitate coring should be avoided as the vibrations may cause the boring walls

to collapse.

7. Remove tube auger from the borehole, again taking care to avoid making contact with the borehole sides and, thus, cross contaminating the sample.
8. Discard the top of core (approximately 1 inch); as this represents material collected by the tube auger before penetration to the layer of concern.
9. Transfer sample into an appropriate sample or homogenization container. Ensure that non-dedicated containers have been adequately decontaminated.

#### 7.2.4 Sampling Surface Sediment with an Ekman or Ponar Dredge from Beneath a Shallow or Deep Aqueous Layer

For the purpose of this method, surface sediment is considered to range from 0 to six inches in depth. Collection of surface sediment can be accomplished with a system consisting of a remotely activated device (dredge) and a deployment system. This technique consists of lowering a sampling device (dredge) to the surface of the sediment by use of a rope, cable, or extended handle. The mechanism is activated, and the device entraps sediment in spring loaded or lever operated jaws.

An Ekman dredge is a lightweight sediment sampling device with spring activated jaws. It is used to collect moderately consolidated, fine textured sediment. The following procedure will be used for collecting sediment with an Ekman dredge (Figure 2, Appendix A):

1. Attach a sturdy nylon rope or stainless steel cable through the hole on the top of the bracket, or secure the extension handle to the bracket with machine bolts.
2. Attach springs to both sides of the jaws. Fix the jaws so that they are in open position by placing trip cables over the release studs. Ensure that the hinged doors on the dredge top are free to open.
3. Lower the sampler to a point 4 to 6 inches

above the sediment surface.

4. Drop the sampler to the sediment.
5. Trigger the jaw release mechanism by lowering a messenger down the line, or by depressing the button on the upper end of the extension handle.
6. Raise the sampler and slowly decant any free liquid through the top of the sampler. Care should be taken to retain the fine sediment fraction during this procedure.
7. Open the dredge jaws and transfer the sample into a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment grabs until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

A Ponar dredge is a heavyweight sediment sampling device with weighted jaws that are lever or spring activated. It is used to collect consolidated fine to coarse textured sediment. The following procedure will be used for collecting sediment with a Ponar dredge (Figure 3, Appendix A):

1. Attach a sturdy nylon rope or steel cable to the ring provided on top of the dredge.
2. Arrange the Ponar dredge with the jaws in the open position, setting the trip bar so the sampler remains open when lifted from the top. If the dredge is so equipped, place the spring loaded pin into the aligned holes in the trip bar.
3. Slowly lower the sampler to a point approximately two inches above the sediment.
4. Drop the sampler to the sediment. Slack on

the line will release the trip bar or spring loaded pin; pull up sharply on the line closing the dredge.

5. Raise the dredge to the surface and slowly decant any free liquid through the screens on top of the dredge. Care should be taken to retain the fine sediment fraction during this operation.
6. Open the dredge and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenized and then transfer sediment to sample containers appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

### 7.2.5 Sampling Subsurface Sediment with a Coring Device from Beneath a Shallow Aqueous Layer

For purposes of this method, subsurface sediment is considered to range from 6 to 24 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of subsurface sediment from beneath a shallow aqueous layer can be accomplished with a system consisting of a tube sampler, acetate tube, eggshell check valve, nosecone, extensions, and "T" handle, or drivehead. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. This sampler may be used with either a drive hammer for firm sediment, or a "T" handle for soft sediment. However, sample handling and manipulation increases in difficulty with increasing depth of water.

The following procedure describes the use of a sample coring device (Figure 4, Appendix A) used to collect subsurface sediments.

1. Assemble the coring device by inserting the acetate core into the sampling tube.

2. Insert the "egg shell" check valve into the lower end of the sampling tube with the convex surface positioned inside the acetate core.
3. Screw the nosecone onto the lower end of the sampling tube, securing the acetate tube and eggshell check valve.
4. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.
5. Place the sampler in a perpendicular position on the sediment to be sampled.
6. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. After the desired depth is reached, rotate the sampler to shear off the core at the bottom. Slowly withdraw the sampler from the sediment and proceed to Step 15.
7. If the drive hammer is selected, insert the tapered handle (drive head) of the drive hammer through the drive head.
8. Drive the sampler into the sediment to the desired depth.
9. Record the length of the tube that penetrated the sample material, and the number of blows required to obtain this depth.
10. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.
11. Rotate the sampler to shear off the core at the bottom.
12. Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head, and rotate about 90°.
13. Slowly withdraw the sampler from the sediment. If the drivehead was used, pull the hammer upwards and dislodge the sampler from the sediment.



14. Carefully remove the coring device from the water.
15. Unscrew the nosecone and remove the eggshell check valve.
16. Slide the acetate core out of the sample r tube. Decant surface water, using care to retain the fine sediment fraction. If head space is present in the upper end, a hacksaw may be used to shear the acetate tube off at the sediment surface. The acetate core may then be capped at both ends. Indicate on the acetate tube the appropriate orientation of the sediment core using a waterproof marker . The sample may be used in this fashion, or the contents transferred to a sample or homogenization container.
17. Open the acetate tube and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated. If necessary, continue to collect additional sediment until sufficient material has been secured to fulfill analytical requirements. Thoroughly homogenize and then transfer sediment to sample container s appropriate for the analyses requested. Samples for volatile organic analysis must be collected directly from the bucket before homogenization to minimize volatilization of contaminants.

## **8.0 CALCULATIONS**

This section is not applicable to this SOP.

## **9.0 QUALITY ASSURANCE/ QUALITY CONTROL**

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

## **10.0 DATA VALIDATION**

This section is not applicable to this SOP.

## **11.0 HEALTH AND SAFETY**

When working with potentially hazardous materials , follow U.S. EPA/OSHA and Corporate health and safety procedures.

More specifically, when sampling sediment from waterbodies, physical hazards must be identified and adequate precautions must be taken to ensure the safety of the sampling team. The team member collecting the sample should not get too close to the edge of the waterbody, where bank failure may cause loss of balance. To prevent this, the person performing the sampling should be on a lifeline, and be wearing adequate protective equipment. If sampling from a vessel is determined to be necessary, appropriate protective measures must be implemented.

## **12.0 REFERENCES**

Mason, B.J., Preparation of Soil Sampling Protocol : Technique and Strategies. 1983 EPA-600/4-83-020.

Barth, D.S. and B.J. Mason, Soil Sampling Quality Assurance User's Guide. 1984 EPA-600/4-84-043.

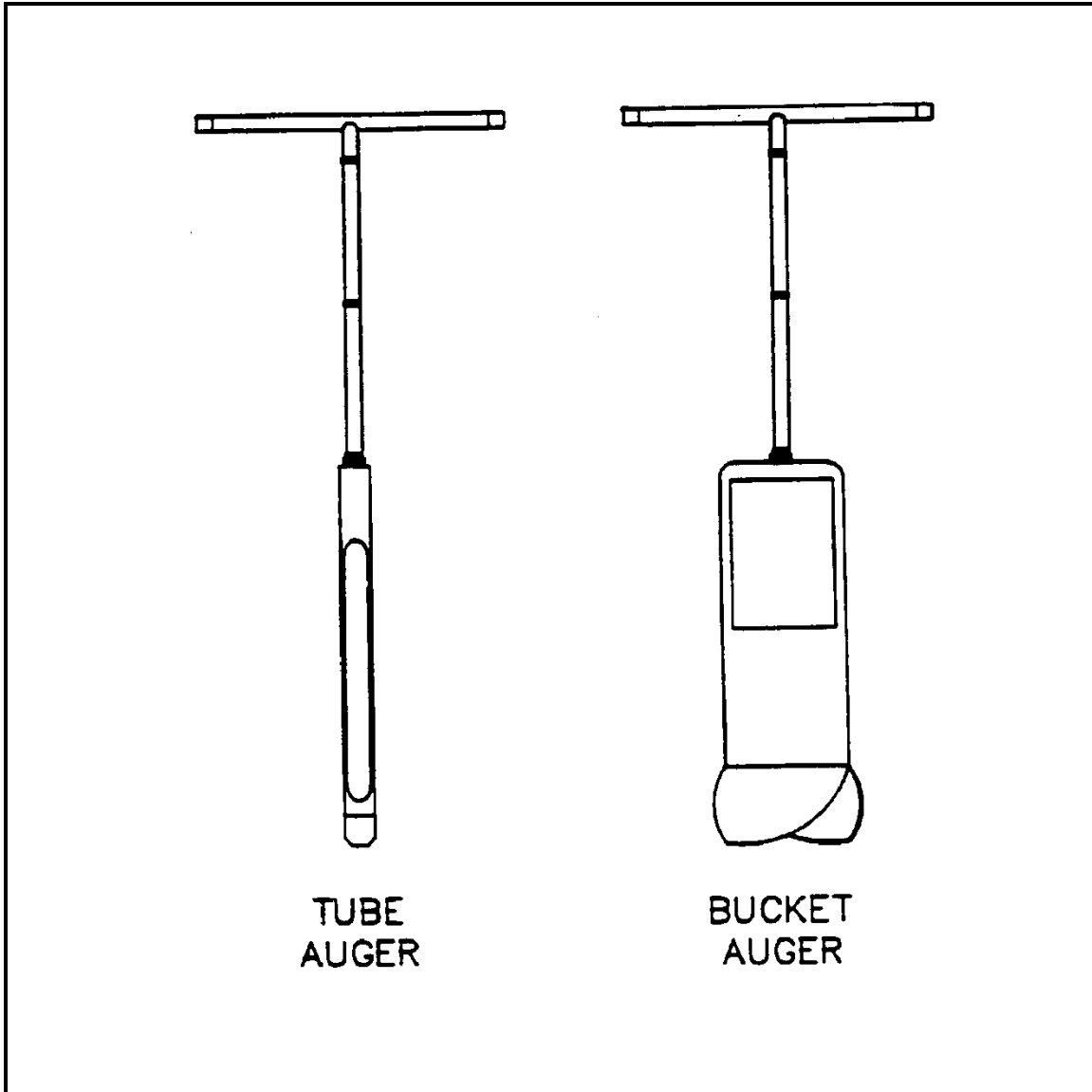
U.S. EPA. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. 1984 EPA - 600/4-84-076.

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**APPENDIX A**

Figures

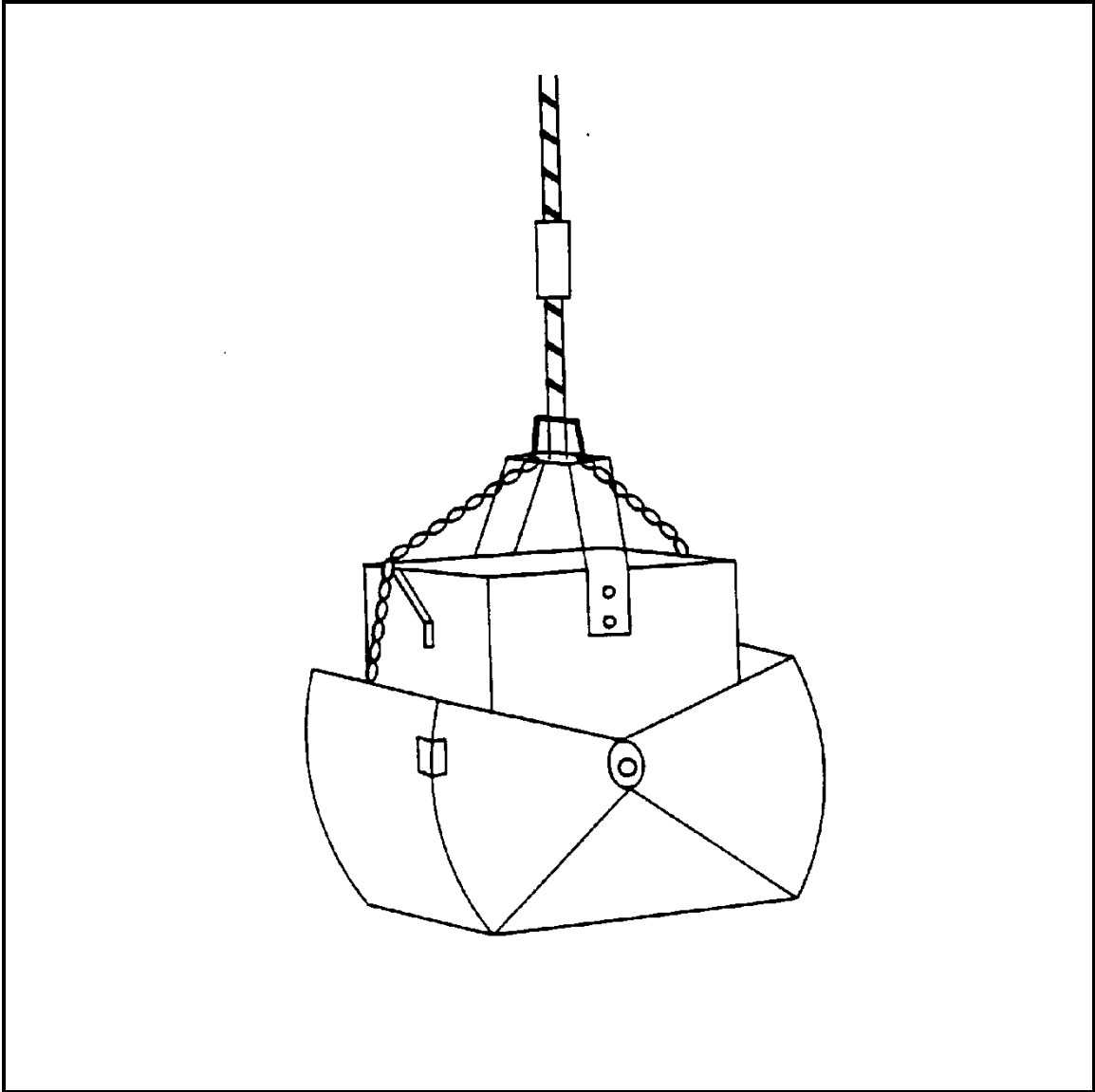
FIGURE 1. Sampling Auger



**APPENDIX A (Cont'd)**

Figures

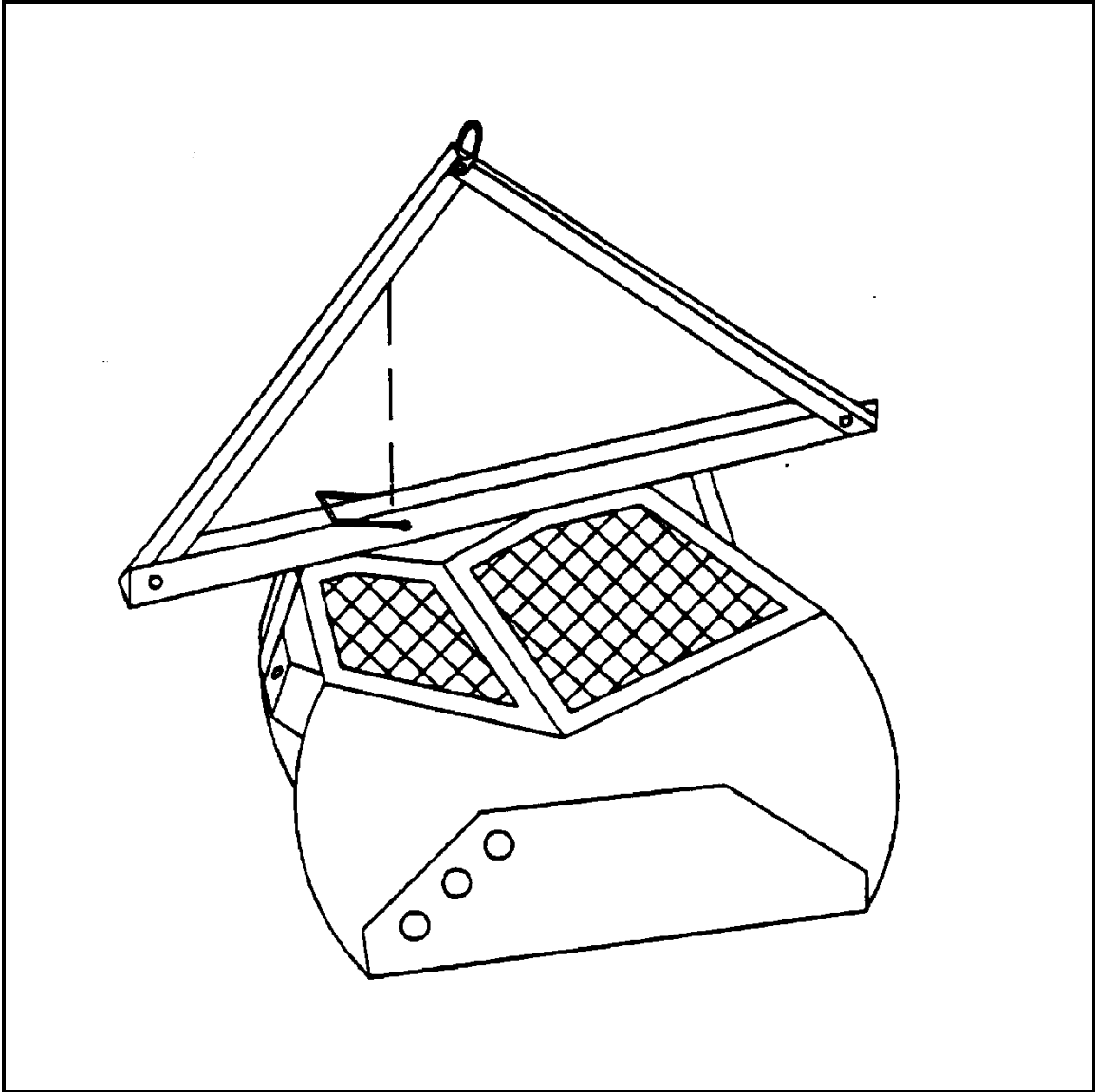
FIGURE 2. Ekman Dredge



**APPENDIX A (Cont'd)**

Figures

FIGURE 3. Ponar Dredge



**APPENDIX A (Cont'd)**

**Figures**

**FIGURE 4. Sample Coring Device**

