CHAPTER 3 Collection of Whole Sediments

Most sediment collection devices are designed to isolate and consistently retrieve a specified volume and surface area of sediment, from a required depth below the sediment surface, with minimal disruption of the integrity of the sample and no contamination of the sample. ***Maintaining the integrity*** of the collected sediment, for the purposes of the measurements intended, is a primary concern in most studies because disruption of the sediment's structure could change its physicochemical and biological characteristics, thereby influencing the bioavailability of contaminants and the potential toxicity of the sediment. This chapter discusses the factors to be considered in selecting a sediment collection device. A variety of samplers are described (and pictured in Appendix E), and recommendations are made regarding their use in different situations.

The flowchart in Figure 3-1 shows recommended sampling gear based on monitoring objective or site-specific issues of concern. Figures 3-2 and 3-3 provide recommended grab and core samplers, respectively, based on site factors (such as depth and particle size), and sampling requirements (such as sample depth and volume of sample needed).

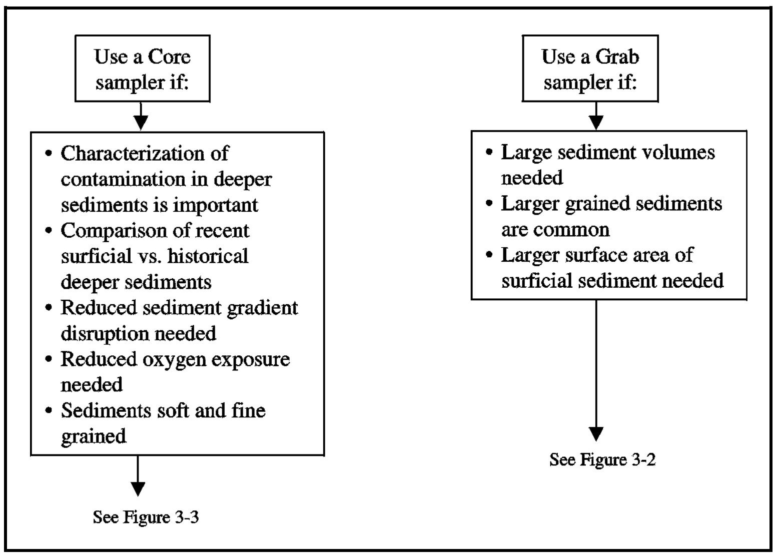


Figure 3-1. General types of considerations or objectives that are appropriate for grab or core sampling devices.

3.1 General Procedures

The planned mode of access to the sampling area (e.g., by water, over land or ice, or from the air) plays an important role in the selection of sampling gear. If the sampling gear needs to be transported to a remote area or shipped by air, its weight and volume might need to be taken into account. It is often the case that a specific vessel, having a fixed lifting capacity based on the configuration of its winch, crane, boom, A-frame, or other support equipment, is the only one available for use. This will affect the type of sampling equipment that can be safely operated from that vessel.

Many samplers are capable of recovering a relatively undisturbed sample in soft, fine-grained sediments, but fewer are suitable for sampling harder sediments containing significant quantities of sand, gravel, firm clay, or till (Mudroch and Azcue, 1995). One of the most important factors in determining the appropriate sampling device for the study are **Data Quality Objectives**. Many monitoring programs, such as EPA's Environmental Monitoring and Assessment Program (EMAP) and the NOAA National Status and Trends program, are primarily interested in characterizing recent environmental impacts in lakes, estuaries and coastal waters and therefore sample surface sediments

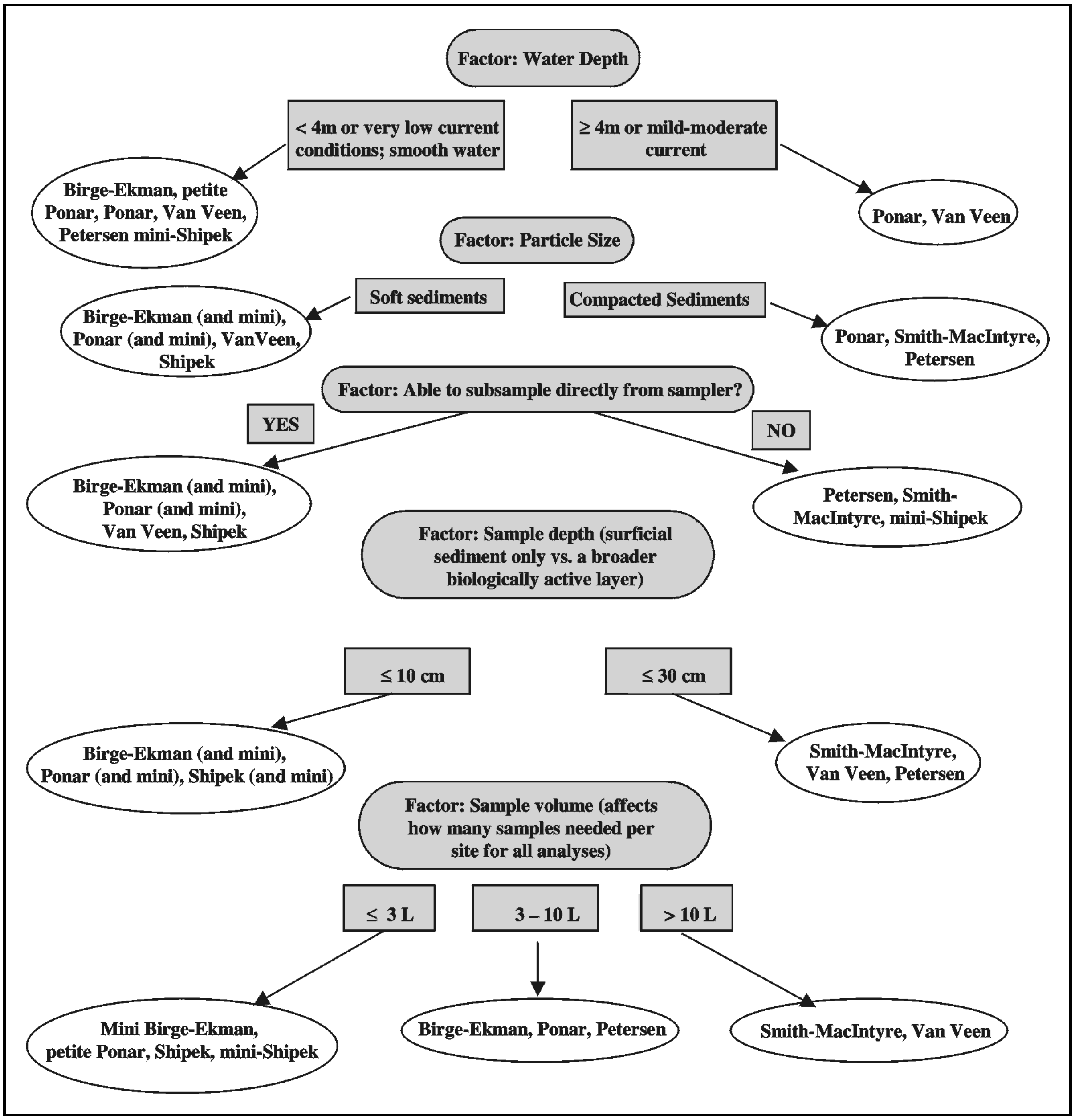


Figure 3-2. Flowchart for selecting appropriate grab samplers based on site-specific or design factors

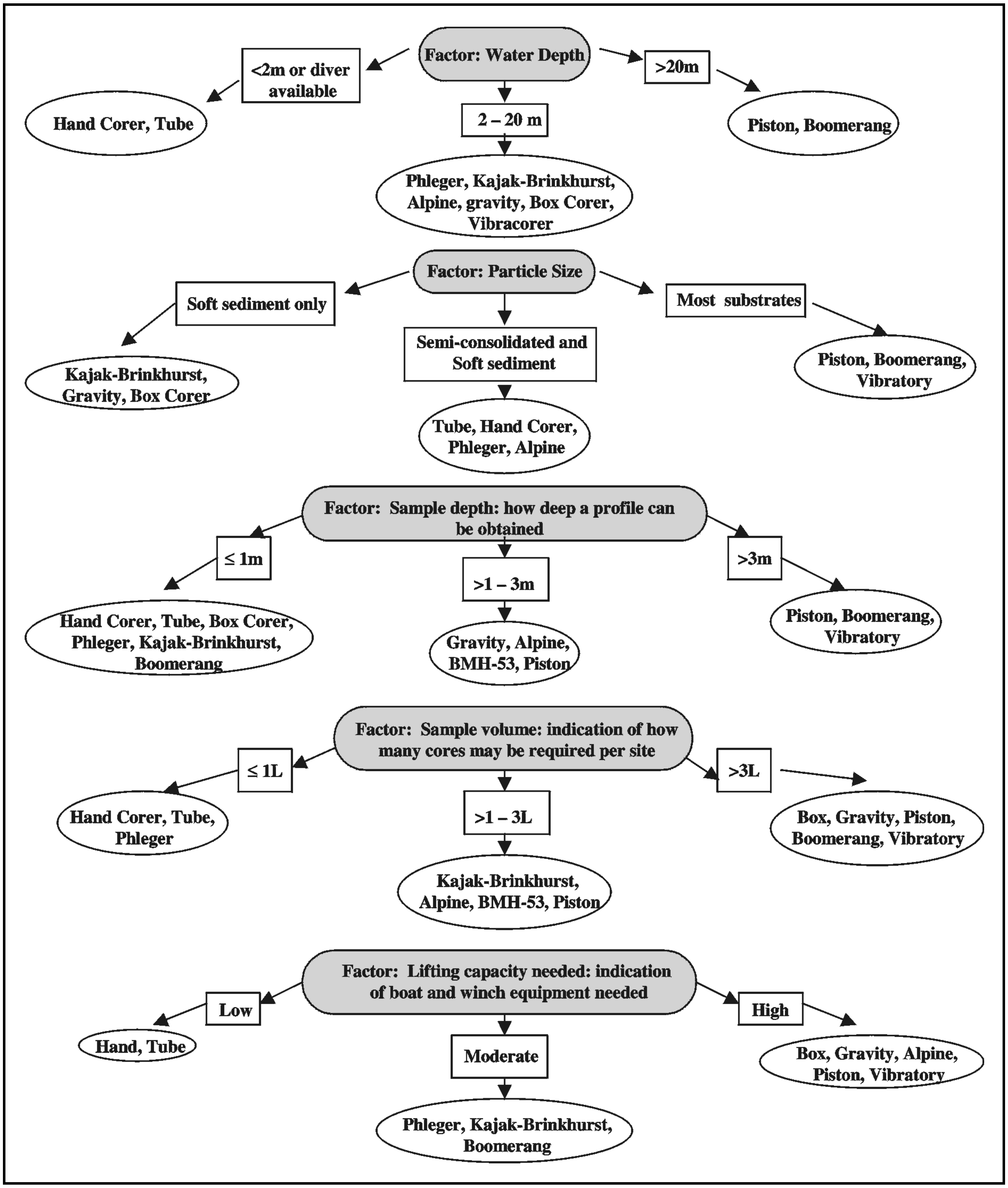


Figure 3-3. Flowchart for selecting appropriate core samplers based on site-specific factors

Considerations

Although there is no one sampler that satisfies all possible considerations, the ideal sampler...

! avoids a pressure wave

! penetrates cleanly to minimize disturbance

! closes tightly

! allows for subsampling

! can accommodate weighting

! collects sufficient sediment volume

! retrieves sediment from a wide range of water and sediment depths

! does not contaminate the sample

! is easy and safe to operate

! is easily transported/assembled at the site

(e.g., Long et al., 1996). Other programs (e.g., dredged material characterization studies conducted for EPA and the US Army Corps of Engineers), are concerned with the vertical distribution of contaminants in sediment to be dredged and therefore seek to characterize a sediment column (USEPA/ACOE, 1991,1998). Each program would employ different sampling devices.

Related to study objectives, another important factor in selecting a sampler is desired depth of sediment penetration. For monitoring and assessment studies where historical contamination is not the focus, the upper 10 to 15 cm is typically the horizon of interest. Generally, the most recently deposited sediments and most epifaunal and infaunal organisms are found in this horizon. To ensure minimum disturbance of the upper layer during sampling, a minimum penetration depth of 6 to 8 cm is recommended, with a penetration depth of 10 to 15 cm being preferred. However, if sediment contamination is being related to organism exposures (e.g., benthic macroinvertebrates and/or fish) then more precise sampling of sediment depths might be needed, such as with a core sampler. The life history and feeding habits of the organisms (receptors) of concern should be considered. For example, some organisms (e.g., shrimp, rotifers) might be epibenthic and are only exposed to surficial sediments (e.g., 0 to 1 cm) while others (e.g., amphipods, polychaetes) that are infaunal irrigators might receive their primary exposure from sediments that are several centimeters in depth. Relating contaminant levels that occur in sediment layers other than where resident organisms are exposed, might produce incorrect conclusions.

Sampling of the surface layer provides information on the horizontal distribution of parameters or properties of interest for the most recently deposited material. Information obtained from analysis of surface sediments can be used, for example, to map the distribution of a chemical contaminant in sediments across a specific body of water (e.g., lake, embayment, estuary). A sediment column, including both the surface sediment layer and the sediment underneath this layer, is collected to study historical changes in parameters of interest (as revealed through changes in their vertical distribution) and to characterize sediment quality with depth.

Once study objectives and the general type of sampler have been identified, a specific sampler is selected based on knowledge of the bathymetry and areal distribution of physically different sediment types at the sampling site. Therefore, it is strongly recommended that this information be gathered during the initial planning stage of all sample collection efforts (see Section 2.5.1).

The quantity of sediment to be collected at each sampling site may also be an important consideration in the selection of a sampling device (see also Section 2.4.1). The required quantity of sediment typically depends on the number and type of physicochemical and biological tests to be carried out (See Table 2-3 for typical sediment volumes needed for different analyses).

Regardless of the type of sampler used, it is important to follow the standard operating procedures specific to each device. Before retrieving the sample, the outside of the sampling device should be carefully rinsed with water from the sampling station. Between each sampling event, the sampling device should be cleaned, inside and out, by dipping the sampler into and out of the water rapidly or by washing with water from the location being sampled. More rigorous between-sample cleaning of the sampler (e.g., chemical decontamination or washing with soap) might be required, depending on the nature of the investigation and specific program guidance (see Section 3.5).

To minimize cross-contamination of samples and to reduce the amount of equipment decontamination required, it might be prudent to sample **reference sites** (i.e., relatively clean sites) first, followed by test stations. If certain stations are known to be heavily contaminated, it might be prudent to sample those stations last when sampling many locations at one time.

3.2 Types of Sediment Samplers

There are three main types of sediment sampling devices: **grab samplers**, **core samplers**, and **dredge samplers**. Grab samplers (see Appendix E) are typically used to collect surficial sediments for the assessment of the horizontal distribution of sediment characteristics. Core samplers (see Appendix E) are typically used to sample thick sediment deposits, or to collect sediment profiles for the determination of the vertical distribution of sediment characteristics or to characterize the entire sediment column. Dredge samplers are used primarily to collect benthos. Dredges cause disruption of sediment and pore water integrity, as well as loss of fine-grained sediments. For these reasons, only grab and core samplers are recommended for sediment physicochemistry or toxicity evaluations. Since many grab samplers are appropriate for collecting benthos as well (Klemm et al., 1990; ASTM, 2000c), grab samplers are likely to be more useful than dredges in sediment quality assessments. Therefore, dredges are not considered further in this document.

Advantages and disadvantages of various grab and core samplers are summarized in Appendix Tables E-1 and E-2, respectively, and are discussed briefly in the following sections. Figure 3-1 provides recommendations regarding the type of sampler that would be appropriate given different study objectives. For many study objectives either cores or grab samplers can be used, however, in practice, one will often be preferred over the other depending on other constraints such as amount of sample required for analyses and equipment availability.

3.2.1 Grab Samplers

Grab samplers consist either of a set of jaws that shut when lowered into the surface of the bottom sediment or a bucket that rotates into the sediment when it reaches the bottom (see Appendix E). Grab samplers have the advantages of being relatively easy to handle and operate, readily available, moderately priced, and versatile in terms of the range of substrate types they can effectively sample.

Of the grab samplers, the **Van Veen**, **Ponar** (see photograph on page 3-6), and **Petersen** are the most commonly used. These samplers are effective in most types of surface sediments and in a variety of environments (e.g., lakes, rivers, estuaries, and marine waters). In shallow, quiescent water, the Birge-Ekman sampler also provides acceptable samples and allows for relatively nondisruptive sampling. However, this sampler is typically limited to soft sediments. The Van Veen sampler, or the modified Van-Veen (Ted Young), is used in several national and regional estuarine monitoring programs, including the NOAA National Status and Trends Program, the EPA Environmental Monitoring and Assessment Program (EMAP), and the EPA National Estuary Program because it can sample most types of sediment, is less subject to blockage and loss of sample than the Peterson or

Examples of grab samplers

Photo courtesy of Allen Burton

Ponar

Photo courtesy of Allen Burton

Eckman grab

Photo courtesy of Ed Long

Double VanVeen grab

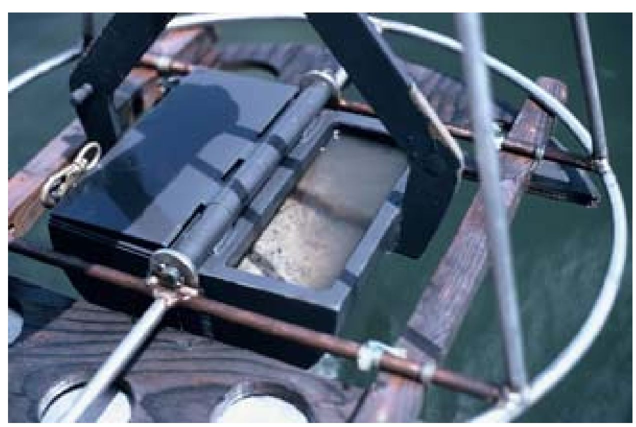
Photo courtesy of Scott Carr

Birge-Eckman grab

Taking subsamples from a Ted Young modified VanVeen sampler

Photos on this page, courtesy of Ed Long

Sampling using a Ted-Young modified VanVeen. Large grab samplers such as these require winches and sufficient boat size for efficient operation.



Ted-Young VanVeen sampler in supporting frame. Illustrating movable cover flap to enable direct sampling from the grab sampler. Note the overlying water in the sampler and adequate volume, indicating an acceptable grab sample.

Ponar samplers, is less susceptible to forming a bow wave during descent, and provides generally high sample integrity (Klemm et al., 1990). The support frame further enhances the versatility of the VanVeen sampler by allowing the addition of either weights (to increase penetration in compact sediments) or pads (to provide added bearing support in extremely soft sediments). However, this sampler is relatively heavy and requires a power winch to operate safely (GLNPO, 1994).

As shown in Appendix Table E-1, grab sampler capacities range from approximately 0.5 L to 75 L. If a sampler does not have sufficient capacity to meet the study plan requirements, additional samples can be collected and composited to obtain the requisite sample size (see Section 5.3). Grab samplers penetrate to different depths depending on their size, weight, and the bottom substrate. Heavy, large volume samplers such as the Smith-McIntyre, large Birge-Ekman, Van Veen, and Petersen devices can effectively sample to a depth of 30 cm. These samplers might actually sample sediments that are too deep for certain study objectives (i.e., not reflective of recently deposited sediments). Smaller samplers such as the small Birge-Ekman, standard and petite Ponar, and standard Shipek devices can effectively collect sediments to a maximum depth of 10 cm. The mini-Shipek can sample to a depth of 3 cm.

Another consideration in choosing a grab sampler is how well it protects the sample from disturbance and washout. Grab samples are prone to washout which results in the loss of surficial, fine grained sediments that are often important from a biological and contaminant standpoint. The Ponar, Ted-Young modified grab, and Van Veen samplers are equipped with mesh screens and rubber flaps to cover the jaws. This design allows water to pass through the samplers during descent, reducing disturbance from bow waves at the sediment-water interface. The rubber flaps also serve to protect the sediment sample from washout during ascent.

The use of small or lightweight samplers, such as the small Birge-Ekman (see page 3-6), petite Ponar, and mini-Shipek, can be advantageous because of easy handling, particularly from a small vessel and/or using only a hand line. However, these samplers are not recommended for use in strong currents or high waves. This is particularly true for the Birge-Ekman sampler, which requires relatively calm conditions for proper performance. Lightweight samplers generally have the disadvantage of being less stable during sediment penetration. They tend to fall to one side due to inadequate or incomplete penetration, resulting in unacceptable samples.

In certain very shallow water applications, such as a stream assessment at a superfund site, it might be difficult to use even a lightweight sampler to collect a sample. In these cases, it might be acceptable to collect sediment from depositional areas, using a shovel or other hand implement. However, such sampling procedures are discouraged as a general rule and the use of a hand corer or similar device is preferred (see Section 3.2.2).

Figure 3-2 summarizes appropriate grab samplers based on two important site factors, depth and sediment particle size. This figure also indicates appropriate grab samplers depending on certain common study constraints such as sample depth and volume desired, and the ability to subsample directly from the sampler (see also Section 4.3; ASTM, 2000c). Based on all of these factors, the Ponar or Van Veen samplers are perhaps the most versatile of the grab samplers, hence their common usage in sediment studies.

Careful use of grab samplers is required to avoid problems such as loss of fine-grained surface sediments from the bow wave during descent, mixing of sediment layers upon impact, lack of sediment penetration, and loss of sediment from tilting or washout upon ascent (ASTM, 2000a; Environment Canada, 1994; Baudo, 1990; Golterman et al., 1983; Plumb,1981). When deploying a grab sampler, the speed of descent should be controlled, with no “free fall” allowed. In deep waters, use of a winching system is recommended to control both the rate of descent and ascent. A ball-bearing swivel should be used to attach the grab sampler to the cable to minimize twisting during descent. After the sample is collected, the sampling device should be lifted slowly off the bottom, then steadily raised to the surface at a speed of about 30 cm/s (Environment Canada, 1994).

Recommendation Box #1
What are appropriate sampling devices given different study objectives?

➡ Grab or core samplers are preferred over dredges for collecting surficial sediments for physicochemical or toxicity analyses. Dredges might be acceptable for collecting macroinvertebrates.

➡ Grab samplers are recommended for surficial sediment analyses where accurate resolution of surficial sediment depths is not necessary. Core samplers are recommended for: (a) assessments requiring accurate surficial sediment depth resolution, (b) historical sediment analyses, (c) detailed sediment quality studies of vertical sediment profiles, to characterize sediment quality at depth, (d) when characterizing thick sediment deposits (such as shoals to be excavated), and/or (e) where it is important to maintain an oxygen-free environment.

➡ In sand, gravel, firm clay, or till sediments, grab samplers might be preferred over core samplers (when only surface material needs to be collected and samples at depth are not necessary) because the latter are often less efficient in these sediment types.

➡ Ponar, VanVeen, or Ekman samplers are commonly used and generally preferred for grab sampling. Ekman samplers, however, are less efficient in deep waters.

➡ The Kajak-Brinkhurst corer is a common core sampler for soft, fine grained sediments where large volumes or deep cores are not needed. The Phleger corer is commonly used for a variety of sediments including peat and plant roots but is not appropriate where large volumes or deep cores are needed.

➡ Box corers are especially recommended for: (a) studies of the sediment-water interface; (b) collecting larger volumes of sediment from a given depth (generally less than one meter depth, however); (c) for *in-situ* studies involving interstitial water characterization; and (d) collecting subsamples for different analyses from the same station.

➡ Vibracorers are recommended for studies requiring deep cores (> 1 m), or where sediment consists of very compacted or large grained material (e.g., gravel).

3.2.2 Core Samplers

Core samplers (corers) are used: (1) to obtain sediment samples for geological characterizations and dating, (2) to investigate the historical input of contaminants to aquatic systems and, (3) to characterize the depth of contamination at a site. Corers are an essential tool in sediments in which 3-dimensional maps of sediment contamination are necessary. Appendix Table E-2 discusses some of the advantages and disadvantages of common corers.

Vibracorer in use showing extrusion of the core sample for inspection and Subsampling.

Photos on this page, courtesy of Allen Burton

Core devices are recommended for projects in which it is critical to maintain the integrity of the sediment profile, because they are considered to be less disruptive than dredge or grab samplers. Core samplers should also be used where it is important to maintain an oxygen-free environment because they limit oxygen exchange with the air more effectively than grab samplers. Cores should also be used where thick sediment deposits must be representatively sampled (e.g., for dredging projects).

One limitation of core samplers is that the volume of any given depth horizon within the profile sample is relatively small. Thus, depending on the number and type of analyses needed, repetitive sampling at a site might be required to obtain the desired quantity of material from a given depth. Some core samplers are prone to "plugging" or "rodding" where the friction of the sediment within the core tube prevents it from passing freely and the core sample is compressed or does not sample to the depth required. This limitation is more likely with smaller diameter core tubes and heavy clay sediments. Except for piston corers and vibracorers, there are few core devices that function efficiently in substrates with significant proportions of sand, gravel, clay, or till.

Coring devices are available in various designs, lengths, and diameters (see Appendix E). With the obvious exception of hand corers, there are only a few corers that can be operated without a mechanical winch. The more common of these include the standard **Kajak-Brinkhurst corer**, suitable for sampling soft, fine-grained sediments, and the **Phleger corer**, suitable for a wider variety of sediment types ranging from soft to sandy, semi-compacted material, as well as peat and plant roots in shallow lakes or marshes (Mudroch and Azcue, 1995). The Kajak-Brinkhurst corer uses a larger core tube, and therefore recovers a greater quantity of sediment, than the Phleger corer. Both corers can be used with different liner materials including stainless steel and PVC. Stainless steel liners should not be used if trace metal contamination is an issue.

Gravity corers are appropriate for recovering up to 3 m long cores from soft, fine-grained sediments. Recent models include stabilizing fins on the upper part of the corer to promote vertical penetration into the sediment, and weights that can be mounted externally to enhance penetration (Mudroch and Azcue, 1995). A variety of liner materials are available including stainless steel; Lexan®, and PVC. For studies in which metals are a concern, stainless steel liners should not be used.

Vibracorers are perhaps the most commonly used coring device in sampling programs in the U.S. because they collect deep cores in most types of sediments, yielding excellent sample integrity. Vibracorers are one of the only sampling devices that can reliably collect

Checklist

Corers may consist of the following components (from Mudroch and Azcue, 1995)

✓ A hollow metal (or plastic) pipe that serves as the core barrel

✓ Easily removed plastic liners or core tubes that fit into the core barrel and retain the sediment sample

✓ A valve or piston mounted on top of the core barrel that is open and allows water to flow through the barrel during descent, but shuts upon penetration of the corer into the sediment to prevent the sediment from sliding through the corer during the ascent

✓ A core catcher to retain the sediment sample

✓ A core cutter for penetration of the sediment

✓ Removable metal weights (usually lead coated with plastic) or piston-driven impact or vibration to increase penetration of the corer into the sediment

✓ Stabilizing fins to ensure vertical descent of the corer thick sediment samples (up to 10 meters or more). Some programs that rely on vibracorers include the Puget Sound Estuary Program, the Great Lakes ARCS Program, and the Dredged Materials Management Program.

Vibracorers have an electric-powered, mechanical vibrator located at the head end of the corer which applies thousands of vertical vibrations per minute to help penetrate the sediment. A core tube and rigid liner (preferably of relatively inert material such as cellulose acetate butyrate) of varying diameter depending on the specific vibrator head used, is inserted into the head and the entire assembly is lowered in the water. Depending on the horsepower of the vibrating head and its weight, a vibracorer can penetrate very compact sediments and collect cores up to 6 m long. For example, the ARCS program in the Great Lakes uses a Rossfelder® Model P-4 Vibracorer (Rossfelder Corporation, La Jolla, CA) that produces a force of 7,000 lbs and a mono-directional frequency of 3,400 vibrations per minute (GLNPO, 1994). Cores up to 6 m in length have been routinely collected using this vibracorer. However, this particular model is relatively heavy (113 kg as compared to 8.1 kg for the more portable Wacker® Model M3000 vibracorers [GLNPO, 1994]). Therefore, use of a heavy vibracorer requires a large vessel to maintain balance and provide adequate lift to break the corer out of the sediment and retrieve it (GLNPO, 1994; PSEP, 1997a).

When deployed properly, **box corers** can obtain undisturbed sediment samples of excellent quality. The basic box corer consists of a stainless steel box equipped with a frame to add stability and facilitate vertical penetration on low slopes. Box corers are recommended particularly for studies of the sediment-water interface or when there is a need to collect larger volumes of sediment from the depth profile. Because of the heavy weight and large size of almost all box corers, they can be operated only from a vessel with a large lifting capacity and sufficient deck space. Sediment inside a box corer can be subsampled by inserting narrow core tubes into the sediment. Thus, they are an ideal sampler for obtaining acceptable subsamples for different analyses at a given station. Carlton and Wetzel (1985) describe a box corer that permits the sediment and overlying water to be held intact as a laboratory microcosm under either the original *in situ* conditions or other laboratory controlled conditions. A box corer was developed that enables horizontal subsampling of the entire sediment volume recovered by the device (Mudroch and Azcue, 1995).

Figure 3-3 summarizes the core samplers that are appropriate given site factors such as depth and particle size and other study constraints such as sample depth and volume required, and lifting capacity needed to use the sampling device. Given the factors examined for general monitoring studies, the Phleger, Alpine, and Kajak-Brinkhurst corers might be most versatile. For dredged materials evaluations, and projects requiring sediment profile characterizations > 3 m in sediment depth, the vibracorer or piston corer are the samplers of choice.

Collection of core samples with hand-coring devices should be executed with care to minimize disturbance and/or compression of sediment during collection. To minimize disruption of the sediment, core samples should be kept as stationary and vibration-free as possible during transport. These cautions are particularly applicable to cores collected by divers.

The speed of descent of coring devices should be controlled, especially during the initial penetration of the sediment, to avoid disturbance of the surface and to minimize compression due to frictional drag from the sides of the core liner (ASTM, 2000d). In deep waters, winches should be used where necessary to minimize twisting and tilting and to control the rate of both descent and ascent. With the exception of piston corers or vibracorers, that are equipped with their own mechanical impact features, for other corers, only the weight or piston mechanism of the sampler should be used to force it into the sediment. The sampler should be raised to the surface at a steady rate, similar to that described for grab samplers. Where core caps are required, it is essential to quickly and securely cap the core samples when the samples are retrieved. The liner from the core sampler should be carefully removed and kept in a stable position until the samples are processed (see Chapter 4). If there is little to no overlying water in the tube and the sediments are relatively consolidated, it is not necessary to keep the core sample tubes vertical. Core sample tubes should be quickly capped and taped to secure the sample. If sediment oxidation is a concern (e.g., due to potential changes in metal bioavailability or volatile substances), then the head space of the core tube should be purged with an inert gas such as nitrogen or argon.

Recommendation Box #2
How should sampling devices be used?

- ➡ The recommended depth of sediment sampling is dependent on the study objectives. Issues that determine the appropriate depth of sampling include: regulatory objectives (e.g., depth of dredging for sediment remediation), need to characterize sediments at depth (e.g., materials to be dredged versus shallow depositional areas in some superfund sites), historical comparisons, sediment deposition rates, and/or time period of contamination.
- ➡ Appropriate winching systems are required to control the rate of ascent and descent of the samplers.
- ➡ The sampler should be rinsed thoroughly with water at the sampling station between and within-station samples, and rinsed with water from the next sapling station before collecting a sample. Equipment used in the handling of sediment should also be washed thoroughly between samples.
- ➡ More rigorous equipment decontamination might be necessary if highly contaminated sites are sampled or if low level contaminants are a concern.
- ➡ To reduce the probability of cross-contamination of samples, it is useful to sample reference or relatively clean sites first and then suspected contaminated sites.

3.3 Sample Acceptability

Only sediments that are correctly collected with grab or core sampling devices should be used for subsequent physicochemical, biological or toxicity testing. Acceptability of grabs can be ascertained by noting that the samplers were closed when retrieved, are relatively full of sediment (but not over-filled), and do not appear to have lost surficial fines. Core samples are acceptable if the core was inserted vertically in the sediment and an adequate depth was sampled.

A sediment sample should be inspected as soon as it is secured. If a collected sample fails to meet any of the acceptability conditions listed below for the respective sampling device, then the sample might need to be rejected and another sample collected at the site. The location of consecutive attempts should be as close to the original attempt as possible and located in the “upstream” direction of any existing current. Rejected sediment samples should be discarded in a manner that will not affect subsequent samples at that station or other possible sampling stations. Illustrations of acceptable and unacceptable grab samples are provided in Figure 3-4.

Checklist
Sample acceptability for grab and core samples

Grab samples *should be visually inspected to ensure that the following acceptability conditions are satisfied (USEPA, 1986b; Environment Canada, 1994):*

- ✓ The sampler is not overfilled so that the sediment surface is touching the top of the sampler;
- ✓ Overlying water is present (indicates minimal leakage). This overlying water should be removed prior to processing and storage by siphoning, not decanting (see Chapter 6);
- ✓ The overlying water is clear or not excessively turbid;
- ✓ The sediment-water interface is intact and relatively flat, with no sign of channeling or sample washout;
- ✓ The desired depth of penetration has been achieved; and
- ✓ There is no evidence of sediment loss (incomplete closure of the sampler, penetration at an angle, or tilting upon retrieval).

Core samples *should meet the following acceptability conditions:*

- ✓ The core sampler was not inserted at an angle or tilted upon retrieval
- ✓ The core collected the required depth to meet the study objectives, with no loss of sediment.

3.4 Equipment Decontamination

For most sampling applications, site water rinse of equipment in between stations is normally sufficient (PSEP, 1997a). However, if one is sampling many stations, including some that could be heavily contaminated, a site water rinse might not be sufficient to minimize cross-contamination of samples among stations. In these cases, it might be necessary to decontaminate all sampling materials in between stations. This would include the sampling device, scoop, spatula, mixing bowls, and any other utensils that come in contact with sediment samples. An approach recommended by ASTM (2000a) for field samples of unknown composition includes: (1) soap and water wash, (2) distilled water rinse, (3) acetone or ethanol rinse, and (4) site water rinse. In general, organic solvents such as methylene chloride should not be used due to the associated health and safety risks. Waste solvents should be collected in labeled hazardous waste containers. If sediment can be collected from the interior of the sampling device, and away from potentially contaminated surfaces of the sampler, it might be adequate to rinse with site water between stations.

If metals or other inorganic compounds are specifically of concern, sampling and handling equipment should be suspended over a tub and rinsed from the top down with 10 percent nitric acid using a pump or squirt bottle (USEPA, 1993; ASTM, 2000a). If organic compounds are a specific concern, sampling equipment can be decontaminated using acetone followed by a site water rinse. Wash water from decontamination should be collected and disposed of properly.

Some specific programs (like Superfund) have their own decontamination procedures, which are legally required.

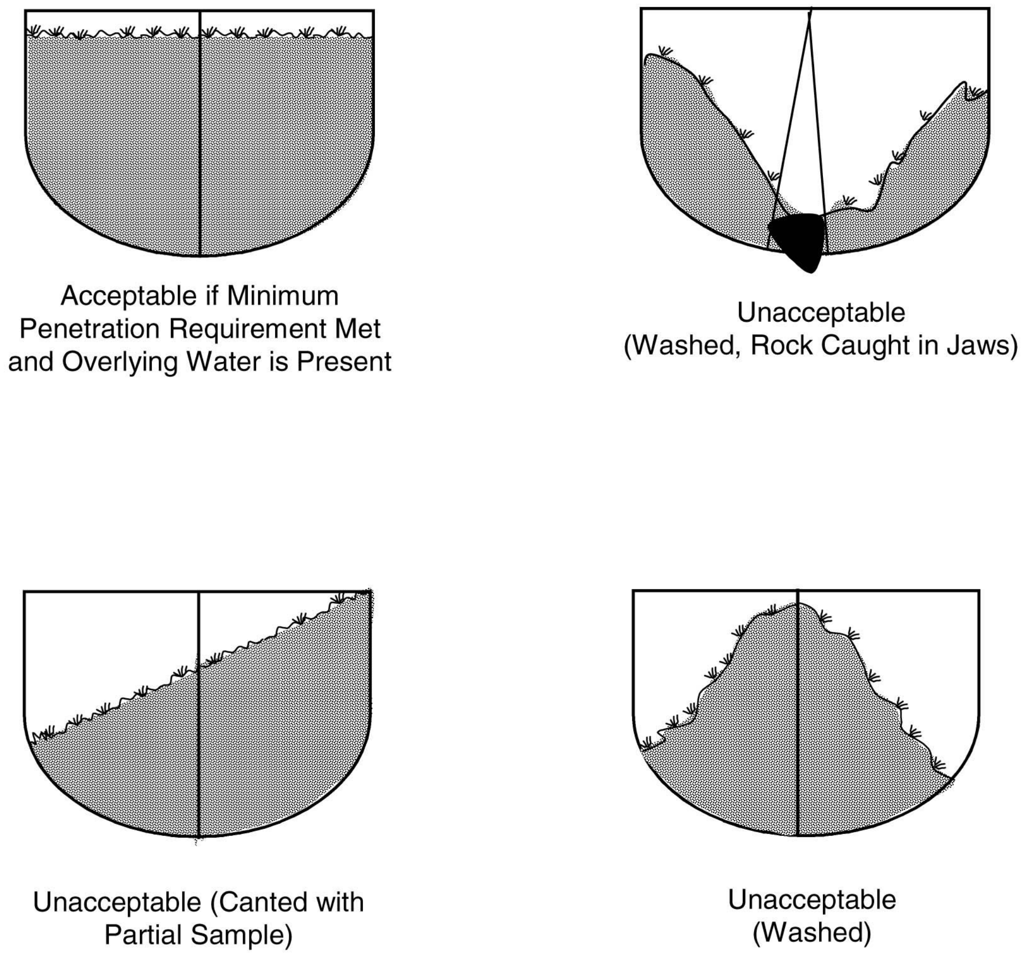


Figure 3-4. Illustrations of acceptable and unacceptable grab samples.

3.5 Field Measurements and Observations

Field measurements and observations are critical to any sediment collection study, and specific details concerning sample documentation should be included in the study plan. Section 2.7 summarizes the types of information commonly recorded in the field during sampling. Several programs, referenced in this Manual, provide specific guidance on field measurements and observations necessary (e.g., see the Sampling and Analyses Plan Guidance development by the Washington Department of Ecology in Appendix B [WDE, 1995 or PSEP, 1997a]). Measurements and observations should be documented clearly in a bound field logbook (or on pre-printed sample forms). Preferably, a logbook should be dedicated to an individual project. The investigator's name, project name, project number, and book number (if more than one is required) should be entered on the inside of the front cover of the logbook. All entries should be written in indelible ink, and the date and time of entry recorded. Additionally, each page should be initialed and dated by the investigator. At the end of each day's activity, or entry of a particular event if appropriate, the investigator should enter his or her initials. All aspects of sample collection and handling as well as visual observations and field conditions should be documented in the field logbooks at the time of sample collection. Logbook entries should also include any circumstances that potentially affected sampling procedures and/or any field preparation of samples. Data entries should be thorough enough to allow station relocation and sample tracking. Since field records are the basis for later written reports, language should be objective, factual, and free of personal opinions or other terminology which might appear inappropriate. In describing characteristics of samples collected (see below), some cautions should be noted. First, polarized glasses are often worn in the field to reduce glare, however, they can also alter color vision. Therefore, visual examination or

Checklist

Depending on program objectives, field measurements might include the following:

- ✓ temperature and perhaps pH of the sediment at the sediment-water interface;
- ✓ concentration of dissolved oxygen in the water overlying the sediment in the system being sampled.
- ✓ salinity or conductivity of the overlying water.

Recommendation Box #3

What information should be documented for each sample collected? (PSEP, 1997a; ASTM, 2000a)

- ➡ project title, time and date of collection, sample number, replicate number, site identification (e.g., name); station number and location (e.g., positioning information);
- ➡ water depth and the sampling penetration depth;
- ➡ details pertaining to unusual events which might have occurred during the operation of the sampler (e.g., possible sample contamination, equipment failure, unusual appearance of sediment integrity, control of vertical descent of the sampler, etc.), preservation and storage method, analysis or test to be preformed;
- ➡ estimate of quantity of sediment recovered by a grab sampler, or length and appearance of recovered cores;
- ➡ description of the sediment including texture and consistency, color, presence of biota or debris, presence of oily sheen, changes in sediment characteristics with depth, and presence/location/thickness of the redox potential discontinuity (RPD) layer (a visual indication of black is often adequate for documenting anoxia);
- ➡ photograph of the sample is desirable, especially longitudinally-sectioned cores, to document stratification;
- ➡ deviations from approved work plans or SOPs.

NOTE: Some geological characterization methods might include an odor evaluation of the sediment as this can provide useful information on physicochemical conditions. However, sediment odor evaluation is potentially dangerous depending on the chemicals present in the sediment (ASTM 2000a) and should therefore be done cautiously, if at all.

characterization of samples should be performed without sunglasses (GLNPO, 1994). Second, descriptions of sediment texture and composition should rely on a texture-by-feel or "ribbon" test in addition to visual determinations (GLNPO, 1994). In this test, a small piece of suspected clay is rolled between the fingers while wearing protective gloves. If the piece easily rolls into a ribbon it is clay; if it breaks apart, it is silt (GLNPO, 1994).

3.6 Documentation of Sample Collection

Documentation of collection and analysis of sediment and porewater samples requires all the information necessary to: 1) trace a sample from the field to the final result of analysis; 2) describe the sampling and analytical methodology; and 3) describe the QA/QC program (Mudroch and Azcue 1995; Keith, 1993). Poor or incomplete documentation of sample collection can compromise the integrity of the sample(s) and thus, the study. In addition, stations that could not, or were not, sampled should be documented with an explanation. Samples should be accompanied by chain-of-custody forms that identify each sample collected and the analyses to be conducted on that sample. Specific guidance on quality assurance procedures regarding sample chain-of-custody is summarized in Chapter 7.

Checklist
Project documentation should include...

- ✓ type of vessel used (e.g., size, power, type of engine);
- ✓ notation of the system used to define the position of the sampling site;
- ✓ notation of the system used to identify and track samples;
- ✓ name of personnel collecting the samples;
- ✓ level of personal protective equipment worn;
- ✓ notation of any visitors to the site;
- ✓ sketch of sampling area with photographs, if possible;
- ✓ ambient weather conditions, including wind speed and direction, wave action, current, tide, vessel traffic, temperature of both the air and water, thickness of ice if present;
- ✓ type of sediment collection device and any modifications made during sampling;
- ✓ calibration data.