11.8 SEDIMENT COLLECTION

A variety of methods can be used to collect a sediment sample underlying a waterbody. Dredging (Peterson, Ekman, Ponar), coring, and scooping (BMH-60) are competent methods. Regardless of the method, precautions must be taken to insure that the sample collected is representative and sediment samples collected for chemical analysis are thoroughly mixed (except purgeable organic compounds analysis) before being placed in the appropriate sample containers.

These methods are discussed in the following paragraphs.

11.8.1 Lake Sediment (Ekman and Ponar Grab Samplers)

For routine analyses, the Peterson dredge can be used when the bottom is rocky, in very deep water, or when the stream velocity is high. The dredge must be lowered very slowly as it approaches bottom, because it can displace and miss lighter materials if allowed to drop freely.

The Ekman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when it is covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high velocities. It can not be used from a bridge more than a few feet above the water, because the spring mechanism that activates the sampler can be damaged by the messenger if dropped from too great a height.

The Ponar dredge is a modification of the Peterson dredge and is similar in size and weight. It has been modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave." The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

11.8.2 Wetland or Littoral Zone Sediment (Core Sampler)

Core samplers are used to sample vertical columns of sediment. They are particularly useful when a historical approach to sediment deposition is desired for they preserve the sequential layering of the deposit. Many types of coring devices have been developed depending on the depth of water from which the sample is to be obtained, the nature of the bottom material, and the length of core to be collected. They vary from hand-push tubes to weight or gravity driven devices.

Coring devices are particularly useful in pollutant monitoring because the "shock wave" created by descent is minimal, thus the fines of the sediment-water interface are only minimally disturbed.

The sample is withdrawn intact permitting the removal of only those layers of interest. Core liners manufactured of glass or Teflon can be purchased, thus reducing possible sample contamination. The samples are easily delivered to the lab for analysis in the tube in which they were collected.

The disadvantage of coring devices is that a relatively small surface area and sample size is obtained often requiring repetitive sampling to obtain the required amount for analysis. Since it is felt that this disadvantage is offset by the advantages, coring devices are recommended in sampling sediments for trace organic compounds or metals analyses.

In shallow, wadeable waters, the direct use of a core liner or tube manufactured of Teflon or glass is recommended for the collection of sediment samples. Their use can also be extended to deep waters when SCUBA equipment is available. Teflon is preferred to avoid glass breakage and possible sample loss. Stainless steel push tubes are also acceptable and provide a better cutting edge and higher strength than Teflon. The use of the glass or Teflon tube by itself eliminates any possible metal contamination from core barrels, cutting heads, and retainers. The tube should be about 30.5cm (12in) if only recently deposited sediments 20.3cm (8in) or less are to be sampled. Longer tubes shall be used when the depth of the substrate exceeds 20.3cm.

Soft or semiconsolidated sediments such as mud and clays have a greater adherence to the inside of the tube and thus should be sampled with larger diameter tubes. Because coarse or unconsolidated sediments such as sands and gravel tend to fall out of the tube, a small diameter tube is more appropriate. A tube about 5.1cm (2in) in diameter is usually the best size. The wall thickness of the tube should be about 0.83cm (0.33in) for either Teflon or glass. The inside wall may be filed down at the bottom of the tube to facilitate entry of the liner into the substrate.

Caution must be exercised to not disturb the area to be sampled when the sample is obtained by wading in shallow water. The core tube is pushed into the substrate until only 10.2cm (4.0in) or less of the tube is above the sediment-water interface. When sampling hard or coarse substrates, a gentle rotation of the tube while it is pushed will facilitate greater penetration and cut down on core compaction. The tube is then capped with a Teflon plug or a sheet of Teflon held in place by a rubber stopper or cork. After capping, the tube is slowly extracted, the negative pressure and adherence of the sediment keep the sample in the tube. Before pulling the bottom part of the core above the water surface, it too is capped.

11.8.3 Grab Samples (Scooping)

If the water is wadeable, the easiest way to collect a sediment sample is to scoop the sediment using a stainless steel spoon or scoop. This reduces the potential for cross-contamination. For streams, this can be accomplished by wading into the stream, and while facing upstream (into the current), scooping the sample along the stream bottom in the upstream direction. If the stream is too deep to wade but less than 2.4m (8ft) deep, a stainless steel scoop attached to a piece of conduit can be used either from the banks if the stream is narrow or from a boat.

11.8.4 Total Suspended Sediment (TSS)

A. EQUIPMENT (Depth-integrated sampling)

1. US DH-48 Suspended Sediment Hand Sampler with 0.64cm (0.25in) nozzle

2. One glass pint TSS sample bottle with 0.64cm (0.25in) clean nozzle

3. One liter polyethylene sample bottle

4. One plastic funnel

B. COLLECTION

1. Determine the appropriate sampling interval width, based on the length and depth of the cross section and flow velocity. Visually inspect the cross section from bank to bank, observing the velocity and depth distribution, and apparent distribution of sediment in cross section. Determine the size of the interval that represents approximately 10% of the flow at that part of the cross section where the "unit width discharge" is the largest or has greatest concentration of sediment is moving. This interval size must then be used for the entire cross section. The number of sections is generally not less than 10 nor more than 20.

2. Begin sampling where there is sufficient depth and velocity. In shallow water, there is the chance of disturbing the sampling bedload, which is not material in true suspension. In very sluggish water, the sample bottle shall not readily fill.

3. Take samples at the predetermined interval. The sampler containing the sample bottle is lowered from the surface of the water to the streambed and immediately raised back to the surface, at a constant rate with the nozzle pointed directly into the flow.

4. Using the same bottle, sample intervals until the bottle is filled to within about 6.4 to 7.6cm (2.5 to 3in) from the top (about 400ml). Do not overfill, as secondary circulation and enrichment of heavy particles may occur.

5. Rinse the funnel in the stream, and use it when pouring the sample from the sample bottle into the l liter polyethylene bottle. After most of the sample has been transferred, swirl the remaining sample to resuspend any remaining sediment before transferring the remaining water.

6. Fill the 1 liter polyethylene bottle no more than

75% full, leaving sufficient room for agitation and complete mixing. The more suspended solids, less sample must be collected. Collect at least 500ml for laboratory analysis.

7. Determine a vertical transit rate that will yield about 800ml (approximately two bottlesful) of sample in one traverse of the cross section.

C. FILTRATION None

D. PRESERVATION Chill to < 4 ^{o}C

E. PRECAUTIONS

1. Do not disturb the streambed by bumping the sampler onto it, or dislodged material from the bed may enter the nozzle, giving incorrect results. Each bottle must be inspected. If coarse material is present, the bottle is emptied and rinsed, and the section is resampled using the same sampling intervals.

2. If a bottle is overfilled, the bottle is emptied, rinsed, and the section is resampled using the same sampling intervals.

F. QUALITY CONTROL

When duplicate TSS samples are collected, use the same sampling intervals and vertical transit rate.

G. GRAB SAMPLES - SPECIAL INSTRUCTIONS

There are occasions when grab sampling for TSS shall be desirable. Some of these are:

1. Stream velocity is too fast to safely wade the cross section.

2. Large floating and/or submerged debris is present.

3. Stream depth is very shallow.

4. Stream velocity is very slow.

5. Stream width and depth are too great to depth integrate.

When grab sampling a stream too shallow to depth integrate, immerse a hand-held bottle in the centroid of flow with the mouth of the bottle directed toward the current. Care must be taken to avoid getting the mouth of the bottle too close to the streambed. When grab sampling a stream too large or too deep to depth integrate, grab sample in a location where velocity is representative and at a depth approximately one half the distance from the water surface to the streambed.

H. REFERENCES

Field Guidelines for Collection, Treatment, and Analysis of Water Samples, Montana District US Geological Survey. Open File Report 85-409.

"A Study of Methods Used in Measurement and Analysis of Sediment Loads in Streams. Report J., Operating Instructions for US DH-48 Suspended Sediment Hand Sampler: Intra-Agency Committee on Water Resources, Subcommittee on Sedimentation, 1965.

I. PROJECT

Clark Fork Basin Study, Intensive Surveys

11.8.5 Sediment Collection for Trace Metal Analysis

Contamination of a waterbody with trace metals is not always detectable in the water column. Therefore, other measurements are needed to determine if a waterbody has been impacted by trace metals. These measurements may include collecting biological samples or sampling the sediments deposited from the water column.

Trace metals entering a waterbody may not be detectable in the water column because they may have precipitated, or adsorbed to organic particulates or fine sediments. Also, contamination from an intermittent source may have been moved past the sample site (i.e., flushed out).

A. GRAB SAMPLE ANALYSIS

Sediment samples collected using methods in Sections 10.1 may be analyzed for trace metals to identify potential sources of water column pollutants. The laborator processes the sample by oven drying at 40 °C and pulverizing with a pestle and mortar.

A subsample is then digested with nitric acid, diluted, analyzed for total recoverable metals and reported in ug/kg (ppm) as dry weight (oven dry).

If there is a desire for temporal or spatial comparability of total recoverable metal results it may be important to have information regarding particle size and total organic carbon (TOC) content of the sediment. This information assists in determining the variations in the sample physical features that may influence attenuation of trace metals by the sediment. A sediment sample containing large amounts of silts, clays, or TOC is more likely to adsorb trace metals.

B. Separating Sands from Fines by Sieving

One method developed to collect samples that are comparable is by sieving the sediment fines. Saturated sediment is collected and sieved in the field via gravity or a hand vacuum pump through a 0.062mm nonmetallic mesh inserted onto a large diameter plastic funnel. The 0.062mm mesh size separates fines from sands. Site water is used to wet sieve 100 grams of fines into a 1 liter container. The sample is kept chilled at 4 °C and delivered to the laboratory.

At the laboratory the excess water is decanted, and evaporated from the fines by oven drying at 40 °C. A subsample can then be analyzed for total recoverable trace metals and TOC.

C. SEDIMENT SAMPLING METHODS

Equipment:

--1 1000mL or 2000mL sample bottle
--Two-piece plastic Buchner funnel
--2 pieces of spectra nylon mesh filter paper (60 micrometer pores)
--Plastic spoon
--1 250mL periphyton bottle
--1 used 1000mL sample bottle
--1 large nitric acid ampule
--1 1000mL wash bottle filled with DI water

Method:

First identify at least 5 wadeable, depositional zones at the site being assessed. These zones must be made up of VERY fine bed sediment, since uniform size sediment is being filtered through a mesh with pores of 60 microns in diameter. Depositional zones will be found on the inside bends of the stream, shallow waters near the shore, or areas just downstream from obstacles such as boulders, islands, sand bars, etc. These zones must represent the entire stream reach as best as possible, so it is important to identify as many zones as is necessary to accomplish this. A composite sample of sediment will be taken from the zones that have been identified. At each zone, subsamples will be taken. The number of subsamples will be determined by the areal size of the zone (the larger the areal size, the greater the number of subsamples that should be collected). This is done in order to get a complete representation of each zone. Sediment should not be scooped from one spot in the zone, but from the entire zone.

Before taking any samples, the equipment must be cleaned. Take the nitric acid ampule and pour it in the 1000mL wash bottle filled with DI water. Wash off all of the equipment by spraying the dilute nitric acid over the used 1000mL sample bottle which will be used to collect the nitric acid. Place the tephlon 60 micron sieve between the two pieces of the buchner funnel.

At the first zone, scoop sediment from the stream bed and place it on the sieve in the funnel. Scoop sediment from various places in the zone to represent the zone (as discussed above with areal size). Fill the funnel about an inch and a half deep with the very fine sediment. Too little an amount of sediment will not give enough filtered particles and too much will do damage to the mesh. One inch to 1 ½ inch is sufficient. Make sure the sediment completely covers the mesh filter and add ambient stream water using the periphyton bottle as a scoop. Once the water is added, stir the water and sediment being very gentle not to damage the filter mesh. If the composite sample is to be made up of 6 different zones, for example, make sure that you fill the jar no more than 1/6 full. This will help get a more representative sample of the stream reach. The less water the better, but you must get at least 1cm of filtered

sediment in order for analysis. Once the first zone is completed pour the excess sediment out and move to the next zone.

At the second zone, rinse the equipment with stream water and then repeat the steps from the first zone. Do the same for the remaining zones until the jar is filled. As was stated above, you do not need to completely fill the 2L bottle. The least amount of water, the easier it will be for the lab to analyze the sample. There must be at least 1 cm of filtered sediment for analysis.

Once done, close the jar and rinse off the equipment. Place a removable label on the jar with the name of the site, date, recorders' names, the number of zones making up the composite sample, and any other pertinent information. The jar should be stored in a cooler and kept cool until delivered to the lab. DO NOT preserve the sample. Allow the filter mesh to dry separate from the funnel so it is not damaged. Only one sample is necessary for each site. Deliver the sample to the lab for ICP scan of metals present. Make sure bottles are acid soaked and returned after analysis.

D. REFERENCES

Methods of Soil Analysis. Part 1 - Physical and Mineralogical Properties, Including Statistics of Measurement and Sampling. 1965. Chapter 43 - Particle Fractionation and Particle-Size Analysis.

Methods of Soil Analysis. Part 2 - Chemical and Microbiological Properties. 1965. Chapter 90 - Organic Carbon.

National Handbook of Recommended Methods For Water-Data Acquisition. 1977. Office of Water Data Coordination, Geological Survey, U.S. Department of the Interior, Reston, Virginia. Chapter 3 - Sediment.

11.8.6 Percent Fines Calculation

Methods for Determining Percent Fine Sediments in Stream Beds

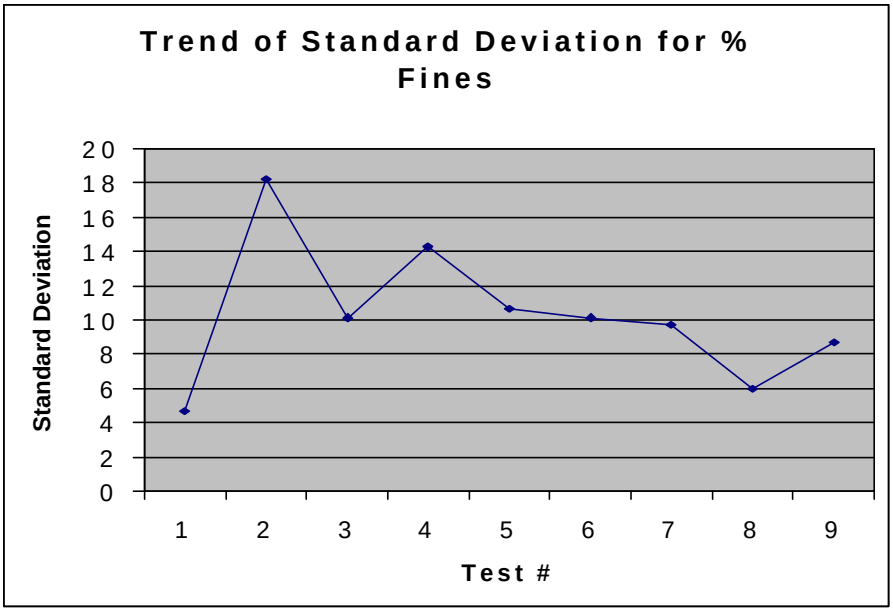
Sediments that are smaller than six millimeters in diameter are classified as fine, and the concentration of these sediments in a streambed is given as a percent of the total sediment. DEQ procedures for classifying percent fines are a modification of the procedure used by the U.S. Forest Service. The method used by the DEQ facilitates easier viewing of the substrate, as well as a simplified sampling procedure.

Site Selection

The samples are t aken in pool tails and riffles, depending on the relative abundance of each in the stream reach being assessed. For example, if the reach contains 70% riffles and 30% pools, then 70% of the sediment samples should come from riffles and 30% from pool tails. Samples within the pools and riffles are taken at random.

Sampling Parameters

The DEQ has determined that at least six samples need to be taken to achieve a stable level of variability. A series of test samplings was run ; the first involving only one sample, the last involving ten samples. The standard deviation for the percent fine sediments of each set was calculated, and the difference between the deviation of each



set began to level out at six samples. More than six samples do not significantly affect the accuracy of the assessment, but fewer than six and the accuracy is noticeably affected, as seen in the graph below.

Equipment

Equipment for this procedure consists of a five-gallon bucket with a clear grid in the bottom. The grid is made of lines intersecting every inch to form 49 intersections (the 4 corners are cut off to make 45). Each intersection is left empty to form a space 6 mm long on each line to aid in determining sediment size. The grid material itself is a clear acrylic (plexi-glass). A square just large enough to view 45 of the intersections is cut in the bottom of the bucket, and the grid is glued on. Four legs, approximately 1 inch long, are glued to the bottom to hold the bucket up off of the sediment. A brightly painted rock, about the size of a baseball, is also used.

Procedure

To take samples, toss the rock out into the stream as randomly as possible. Place the center of the grid over where the rock settled, and count the number of intersections where sediment smaller than 6mm is present. Repeat this procedure until 6 samples have been collected.

Calculations

The percent of the sediments in the stream that are fine is calculated by dividing the number of fine sediments in each sample by the total number of intersections. The average of the six samples is calculated, and this number represents the percent of the sediments in this section of stream that are classified as fine.

References

R1/R4 Fish and Fish Habitat Standard Inventory Procedures Handbook. USDA, Forrest Service. May, 1997
pp. 30