

## 8.0 BENTHIC MACROINVERTEBRATES

Benthic invertebrates inhabit the sediment or live on the bottom substrates of streams. The benthic macroinvertebrate assemblage in streams is an important component of measuring the overall biological condition of the aquatic community. Monitoring this assemblage is useful in assessing the status of the water body and detecting trends in ecological condition. Populations in the benthic assemblage respond to a wide array of stressors in different ways so that it is often possible to determine the type of stress that has affected a macroinvertebrate assemblage (e.g., Klemm et al., 1990). Because many macroinvertebrates have relatively long life cycles of a year or more and are relatively immobile, the structure and function of the macroinvertebrate assemblage is a response to exposure of present or past conditions.

The benthic macroinvertebrate protocol of WSA is intended to evaluate the biological condition of wadeable streams in the United States for the purpose of detecting stresses on structure and assessing the relative severity of these stresses. It is based on the updated Rapid Bioassessment Protocols (RBPs) published by the U.S. Environmental Protection Agency (Barbour et al., 1999) and adopted for use by many states. The main difference between the benthic macroinvertebrate collection methods from the original RBPs (1989) and the 2<sup>nd</sup> Edition (1999), is the use of a D-frame net (Figure 8-1). The D-frame net used by WSA still requires only one person. This technique is versatile for varying habitat type and is the preferred macroinvertebrate collecting method for streams with flowing water.

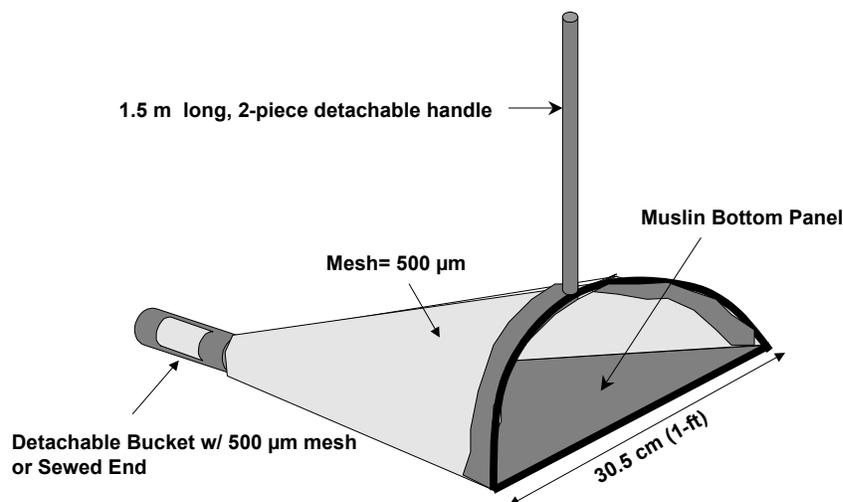


Figure 8-1. Modified D-frame kick net. (Not drawn to scale.)

## 8.1 SAMPLE COLLECTION

The transect sample design for collecting benthic macroinvertebrates is shown in Figure 8-2. This design was used in the EMAP-WP stream study in the western U.S. (refer to Section 1 for project descriptions), which provides continuity for a nationwide assessment.

A sample is collected from **1-m downstream** of each of the eleven cross-section transects (Transects “A” through “K”) at an assigned sampling point (Left, Center, or Right). These points may have been assigned when the sampling reach was laid out (Figure 8-2; refer also to Section 4; Table 4-3). If not, the sampling point at Transect “A” is assigned at random using a die or other suitable means (e.g., digital watch). Once the first sampling point is determined, points at successive transects are assigned in order (Left, Center, Right). At transects assigned a “Center” sampling point where the stream width is between one and two net widths wide, pick either the “Left” or “Right” sampling point instead. If the stream is only one net wide at a transect, place the net across the entire stream width and consider the sampling point to be “Center”. If a sampling point is located in water that is too deep or otherwise unsafe to wade, select an alternate sampling point on the transect at random.

The procedure for collecting a sample at each transect is described in Table 8-1. At each sampling point, determine if the habitat is a “riffle/run” or a “pool/glide”. Any area where there is not sufficient current to extend the net is operationally defined as a pool/glide habitat. Record the dominant substrate type (fine/sand, gravel, coarse substrate (coarse gravel or larger) or other (e.g., bedrock, hardpan, wood, aquatic vegetation, etc.) and the habitat type (pool, glide, riffle, or rapid) for each sample collected on the Sample Collection Form as shown in Figure 8-3. As you proceed upstream from transect to transect, combine all samples into a bucket or similar container.

If it is impossible to sample at the sampling point with the modified kick net following either procedure, spend about 30 seconds hand picking a sample from about 0.09 m<sup>2</sup> (1 ft<sup>2</sup>) of substrate at the sampling point. For vegetation-choked sampling points, sweep the net through the vegetation for 30 seconds. Place the contents of this hand-picked sample into the sampling container.

## 8.2 SAMPLE PROCESSING

Use a sieve bucket while sampling to carry the composite sample as you walk upstream. Alternatively, place each sample in a five-gallon bucket and use a soil sieve (500 µm) to cull-down the sample before it is packed and preserved in a Nalgene container(s) upon completion (Table 8-2). Record tracking information for each composite sample on the Sample Collection Form as shown in Figure 8-3. **Do not fill out the collection form until you have collected (or confirmed at the site that you will collect) samples.** If forms are filled out before you arrive at the site, and then no samples are collected, a lot of time is wasted by others later trying to find samples that do not exist.

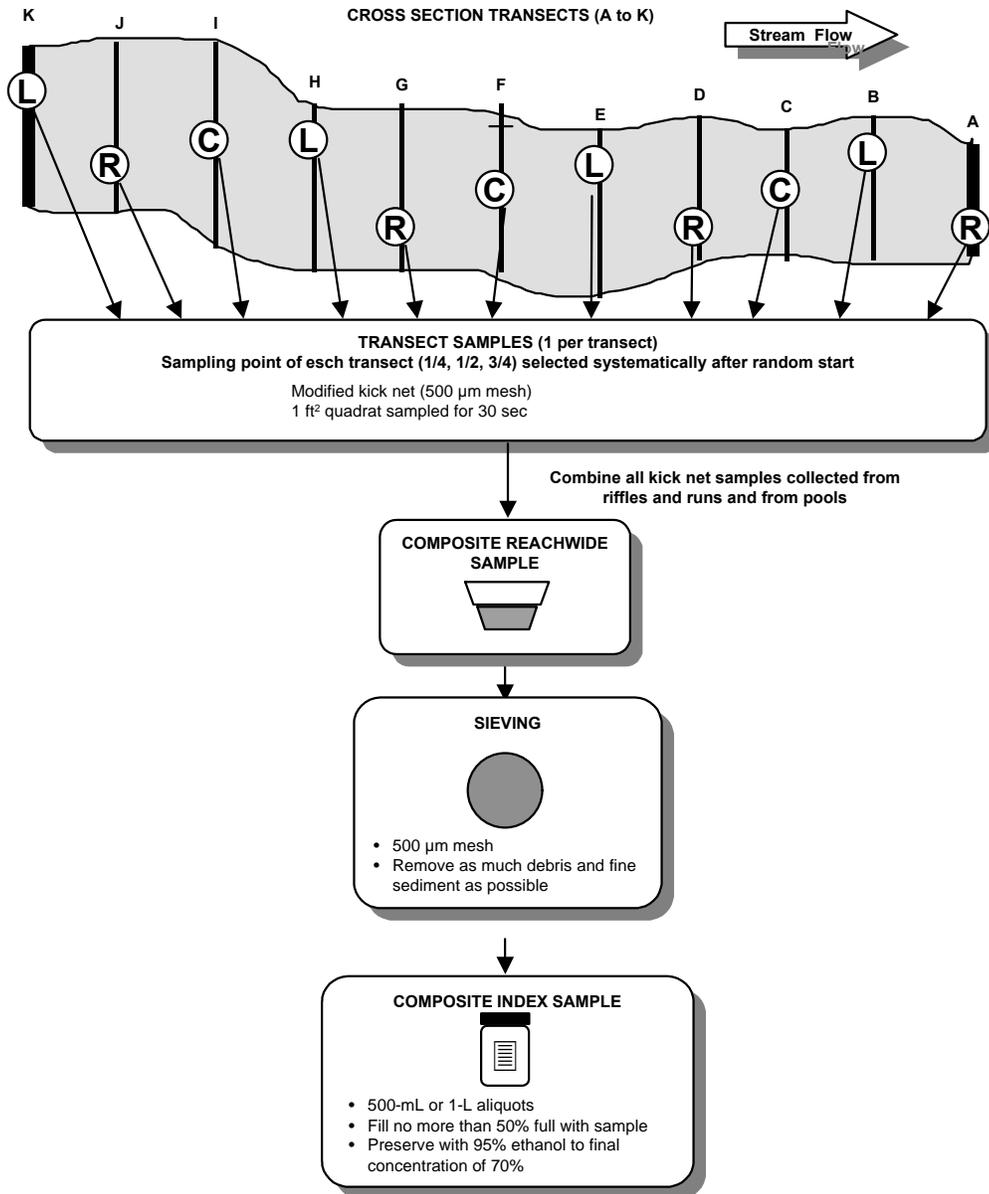


Figure 8-2. Transect sampling design for the benthic macroinvertebrate sample.

**TABLE 8-1. PROCEDURE TO COLLECT BENTHIC MACROINVERTEBRATE SAMPLES**

1. At **1 m downstream** of each cross-section transect, beginning with Transect "A", locate the assigned sampling point (Left, Center, or Right as you face downstream) as 25%, 50%, and 75% of the wetted width, respectively. If you cannot collect a sample at the designated point because of deep water or unsafe conditions, relocate to another random point on the same transect.
2. Attach the 4-ft handle to the kick net. Make sure that the handle is on tight or the net may become twisted in a strong current, causing the loss of part of the sample.
3. Determine if there is sufficient current in the area at the sampling point to fully extend the net. If so, classify the habitat as "riffle/run" and proceed to Step 4. If not, use the sampling procedure described for "pool/glide" habitats (Step 9).  
NOTE: If the net cannot be used, spend 30 seconds hand picking a sample from about 0.09 m<sup>2</sup> ( 1 ft<sup>2</sup>) of substrate at the sampling point. For vegetation-choked sampling points, sweep the net through the vegetation within a 0.09 m<sup>2</sup> ( 1 ft<sup>2</sup>) quadrat for 30 seconds. Place the contents of this hand-picked sample directly into the sampling container. Assign a "U" flag (non-standard sample) to the sample and indicate which transect(s) required the modified collection procedure in the comments section. Go to Step 15.

**Riffle/Run Habitats:**

4. With the net opening facing upstream, position the net quickly and securely on the stream bottom to eliminate gaps under the frame. Avoid large rocks that prevent the sampler from seating properly on the stream bottom.  
NOTE: If there is too little water to collect the sample with the D-net, randomly pick up 10 rocks from the riffle and pick and wash the organisms off them into a bucket which is half-full of water.
5. Holding the net in position on the substrate, visually define a rectangular quadrat that is one net width wide and one net width long upstream of the net opening. The area within this quadrat is ~0.09 m<sup>2</sup> (1 ft<sup>2</sup>). Alternatively, place a wire frame of the correct dimensions in front of the net to help delineate the quadrat to be sampled.
6. Check the quadrat for heavy organisms, such as mussels and snails. Remove these organisms from the substrate by hand and place them into the net. Pick up any loose rocks or other larger substrate particles in the quadrat. Use your hands or a small scrub brush to dislodge organisms so that they are washed into the net. Scrub all rocks that are golf ball-sized or larger and which are over halfway into the quadrat. Large rocks that are less than halfway into the sampling area are pushed aside. After scrubbing, place the substrate particles outside of the quadrat.
7. Keep holding the D-net securely in position. Start at the upstream end of the quadrat, vigorously kick the remaining finer substrate within the quadrat for 30 seconds (use a stopwatch).

NOTE: For samples located within dense beds of long, filamentous aquatic vegetation (e.g., algae or moss), kicking within the quadrat may not be sufficient to dislodge organisms in the vegetation. Usually these types of vegetation are lying flat against the substrate due to current. Use a knife or scissors to remove **only the vegetation that lies within the quadrat** (i.e., not entire strands that are rooted within the quadrat) and place it into the net.

(continued)

**TABLE 8-1. (Continued)**

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8. Pull the net up out of the water. Immerse the net in the stream several times to remove fine sediments and to concentrate organisms at the end of the net. Avoid having any water or material enter the mouth of the net during this operation.
  9. Go to Step 14.

**Pool/Glide habitats:**

10. Visually define a rectangular quadrat that is one net width wide and one net width long at the sampling point. The area within this quadrat is ~0.09 m<sup>2</sup> (1 ft<sup>2</sup>). Alternatively, lay a wire frame of the correct dimensions in front of the net at the sampling point to help delineate the quadrat.
11. Inspect the stream bottom within the quadrat for any heavy organisms, such as mussels and snails. Remove these organisms by hand and place them into the net or bucket. Pick up any loose rocks or other larger substrate particles within the quadrat and hold them in front of the net. Use your hands (or a scrub brush) to rub any clinging organisms off of rocks or other pieces of larger substrate (especially those covered with algae or other debris) into the net. After scrubbing, place the larger substrate particles outside of the quadrat.
12. Vigorously kick the remaining finer substrate within the quadrat with your feet while dragging the net repeatedly through the disturbed area just above the bottom. Keep moving the net all the time so that the organisms trapped in the net will not escape. Continue kicking the substrate and moving the net for 30 seconds. NOTE: If there is too little water to use the kick net, stir up the substrate with your gloved hands and use a sieve with 500 µm mesh size to collect the organisms from the water in the same way the net is used in larger pools.
13. After 30 seconds, remove the net from the water with a quick upstream motion to wash the organisms to the bottom of the net.

**All samples:**

14. Invert the net into a plastic bucket and transfer the sample. Inspect the net for any residual organisms clinging to the net and deposit them into the bucket. Use forceps if necessary to remove organisms from the net. Carefully inspect any large objects (such as rocks, sticks, and leaves) in the bucket and wash any organisms found off of the objects and into the bucket before discarding the object. Remove as much detritus as possible without losing any organisms.
15. Determine the **predominant** substrate size/type you observed within the sampling quadrat. Place an "X" in the appropriate substrate type box for the transect on the Sample Collection Form. NOTE: If there are co-dominant substrate types, you may check more than one box; note the co-dominants in the comments section of the form.

Fine/sand: not gritty (silt/clay/muck < 0.06 mm diam.) to gritty, up to ladybug sized (2 mm diam.)

Gravel: fine to coarse gravel (ladybug to tennis ball sized; 2 mm to 64 mm diam.)

Coarse: Cobble to boulder (tennis ball to car sized; 64 mm to 4000 mm)

Other: bedrock (larger than car sized; > 4000 mm), hardpan (firm, consolidated fine substrate), wood of any size, aquatic vegetation, etc.). Note type of "other" substrate in comments on field form.

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**(Continued)**

**TABLE 8-1 (Continued)**

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16. Identify the habitat type where the sampling quadrat was located. Place an "X" in the appropriate channel habitat type box for the transect on the Sample collection Form.
- Pool; Still water; low velocity; smooth, glassy surface; usually deep compared to other parts of the channel  
GLide: Water moving slowly, with smooth, unbroken surface; low turbulence  
Riffle: Water moving, with small ripples, waves, and eddies; waves not breaking, and surface tension is not broken; "babbling" or "gurgling" sound.  
RApid: Water movement is rapid and turbulent; surface with intermittent "white water" with breaking waves; continuous rushing sound.
17. Thoroughly rinse the net before proceeding to the next sampling location. Proceed upstream to the next transect (including Transect K, the upstream end of the sampling reach) and repeat Steps 1 through 9. Combine all kick net samples from riffle/run and pool/glide habitats into the bucket.
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A set of completed sample labels, including the label that is used if more than one jar is required for a single composite sample, is shown in Figure 8-4. The ID number is also recorded with a number 2 lead pencil on a waterproof label that is placed inside each jar (Figure 8-4, lower right). If more than one jar is used for a composite sample, a special label (Figure 8-4, lower left) is used to record the ID number assigned to the sample. **DO NOT use two different barcode numbers on two jars containing one single sample.** Blank labels for use inside of sample jars are presented in Figure 8-5. These can be copied onto waterproof paper. If a sample requires more than one jar, make sure the correct number of jars for the sample is recorded on the Sample Collection Form. Again, accurate record-keeping in the field saves substantial amounts of time later.

Check to be sure that the prenumbered adhesive label is on the jar and covered with clear tape, and that the waterproof label is in the jar and filled in properly. Be sure the inside label and outside label describe the same sample. Replace the cap on each jar. Check to make sure the cap is properly marked with the site number. Place the samples in a cooler or other secure container for transporting and/or shipping the laboratory (see Section 3). **Before shipping to the lab (after a sample has been preserved for at least one week), decant the majority of the ethanol from the container. Leave only enough ethanol to keep the sample moist.** Place the lid back on the container and seal with electrical tape. The sample will be refilled with ethanol upon receipt at the benthic laboratory. Check to see that all equipment is in the vehicle.

### **8.3 EQUIPMENT AND SUPPLY CHECKLIST**

Figure 8-6 shows the checklist of equipment and supplies required to complete the collection of benthic macroinvertebrates from streams. This checklist is similar to the checklist presented in Appendix A, which is used at the base location (Section 3) to ensure that all of the required equipment is brought to the stream. Use this checklist to ensure that equipment and supplies are organized and available at the stream site in order to conduct the activities efficiently.

**SAMPLE COLLECTION FORM - STREAMS** Reviewed by (initial): *SP*

SITE ID: WXXP99-9999 DATE: 07/01/2002

WATER CHEMISTRY		
Sample ID	Transect	Comments
<u>229015</u>	<u>X</u>	

REACH-WIDE BENTHOS SAMPLE		
Sample ID	No. of Jars	Comment
<u>999001</u>	<u>2</u>	<u>FOR TRANSECT K OTHER = SMALL WOODY DEBRIS</u>

TRANSECT	A	B	C	D	E	F	G	H	I	J	K
<b>SUBSTRATE</b>	<b>CHAN.</b>	Sub. Chan.	Sub. Chan.	Sub. Chan.	Sub. Chan.	Sub. Chan.	Sub. Chan.	Sub. Chan.	Sub. Chan.	Sub. Chan.	Sub. Chan.
Fine/Sand	Pool	<input type="checkbox"/> F <input type="checkbox"/> P	<input checked="" type="checkbox"/> F <input type="checkbox"/> P	<input checked="" type="checkbox"/> F <input checked="" type="checkbox"/> P	<input type="checkbox"/> F <input type="checkbox"/> P	<input type="checkbox"/> F <input type="checkbox"/> P	<input type="checkbox"/> F <input type="checkbox"/> P	<input type="checkbox"/> F <input type="checkbox"/> P	<input checked="" type="checkbox"/> F <input type="checkbox"/> P	<input checked="" type="checkbox"/> F <input checked="" type="checkbox"/> P	<input type="checkbox"/> F <input checked="" type="checkbox"/> P
Gravel	Glide	<input checked="" type="checkbox"/> G <input type="checkbox"/> GL	<input type="checkbox"/> G <input checked="" type="checkbox"/> GL	<input type="checkbox"/> G <input type="checkbox"/> GL	<input checked="" type="checkbox"/> G <input checked="" type="checkbox"/> GL	<input checked="" type="checkbox"/> G <input type="checkbox"/> GL	<input type="checkbox"/> G <input type="checkbox"/> GL	<input checked="" type="checkbox"/> G <input type="checkbox"/> GL	<input type="checkbox"/> G <input type="checkbox"/> GL	<input type="checkbox"/> G <input type="checkbox"/> GL	<input type="checkbox"/> G <input type="checkbox"/> GL
Coarse	Riffle	<input type="checkbox"/> C <input checked="" type="checkbox"/> RI	<input type="checkbox"/> C <input type="checkbox"/> RI	<input type="checkbox"/> C <input type="checkbox"/> RI	<input type="checkbox"/> C <input type="checkbox"/> RI	<input type="checkbox"/> C <input type="checkbox"/> RI	<input checked="" type="checkbox"/> C <input checked="" type="checkbox"/> RI	<input type="checkbox"/> C <input checked="" type="checkbox"/> RI	<input type="checkbox"/> C <input type="checkbox"/> RI	<input type="checkbox"/> C <input type="checkbox"/> RI	<input type="checkbox"/> C <input type="checkbox"/> RI
Other: Note in Comments	Rapid	<input type="checkbox"/> O <input type="checkbox"/> RA	<input type="checkbox"/> O <input type="checkbox"/> RA	<input type="checkbox"/> O <input type="checkbox"/> RA	<input type="checkbox"/> O <input type="checkbox"/> RA	<input type="checkbox"/> O <input type="checkbox"/> RA	<input type="checkbox"/> O <input type="checkbox"/> RA	<input type="checkbox"/> O <input type="checkbox"/> RA	<input type="checkbox"/> O <input type="checkbox"/> RA	<input type="checkbox"/> O <input type="checkbox"/> RA	<input checked="" type="checkbox"/> O <input type="checkbox"/> RA

TARGETED RIFFLE BENTHOS SAMPLE		
Sample ID	No. of Jars	Comment
<u>999002</u>	<u>1</u>	

NEAREST TRANSECT	A	A	E	E	F	F	G	G	SUBSTRATE SIZE CLASSES
<b>Dom. Substrate</b>	Fine/Sand	<input type="checkbox"/> F/S	F/S - ladybug or smaller (<2 mm)						
Gravel	<input checked="" type="checkbox"/> G	<input checked="" type="checkbox"/> G	<input type="checkbox"/> G	<input checked="" type="checkbox"/> G	<input type="checkbox"/> G	<input checked="" type="checkbox"/> G	<input checked="" type="checkbox"/> G	<input checked="" type="checkbox"/> G	G - ladybug to tennis ball (2 to 64 mm)
Coarse	<input type="checkbox"/> C	<input type="checkbox"/> C	<input checked="" type="checkbox"/> C	<input type="checkbox"/> C	<input checked="" type="checkbox"/> C	<input type="checkbox"/> C	<input type="checkbox"/> C	<input type="checkbox"/> C	C - tennis ball to car sized (64 to 4000 mm)
Other: Note in Comments	<input type="checkbox"/> O	O - bedrock, hardpan, wood, etc							

Additional Benthos Comments

COMPOSITE PERIPHYTON SAMPLE		
Sample ID	Composite Volume (mL)	Number of transects sampled (0-11):
<u>800990</u>	<u>500</u>	<u>11</u>

Assemblage ID (50-mL tube, preserved)		Chlorophyll (GF/F filter)		Biomass (GF/F Filter)	
Sample Vol. (mL)	Flag	Sample Vol. (mL)	Flag	Sample Vol. (mL)	Flag
<u>50</u>		<u>25</u>		<u>25</u>	

Flag	Comments

Flag codes: K = Sample not collected; U = Suspect sample; F1, F2, etc. = misc. flag assigned by field crew. Explain all flags in comment sections.

**Figure 8-3. Sample Collection Form (page 1), showing information for benthic macro-invertebrate samples.**

**TABLE 8-2. PROCEDURE FOR PREPARING COMPOSITE SAMPLES FOR  
BENTHIC MACROINVERTEBRATES**

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1. Pour the entire contents of the bucket through a sieve (or into a sieve bucket) with 500  $\mu\text{m}$  mesh size. Remove any large objects and wash off any clinging organisms back into the sieve before discarding.
  2. Using a wash bottle filled with stream water, rinse all the organisms from the bucket into the sieve. This is the composite reach-wide sample for the site.
  3. Estimate the total volume of the sample in the sieve and determine how large a jar will be needed for the sample (500-mL or 1-L) and how many jars will be required.
  4. Fill in a sample label with the stream ID and date of collection. Attach the completed label to the jar and cover it with a strip of clear tape. Record the sample ID number for the composite sample on the Sample Collection Form. For each composite sample, make sure the number on the form matches the number on the label. **Please do not record an ID number on the form until you have collected the sample!**
  5. Wash the contents of the sieve to one side by gently agitating the sieve in the water. Wash the sample into a jar using as little water from the wash bottle as possible. Use a large-bore funnel if necessary. If the jar is too full pour off some water through the sieve until the jar is not more than  $\frac{1}{4}$  to  $\frac{1}{3}$  full, or use a second jar if a larger one is not available. Carefully examine the sieve for any remaining organisms and use watchmakers' forceps to place them into the sample jar.
    - If a second jar is needed, fill in a sample label that does not have a pre-printed ID number on it. Record the ID number from the pre-printed label prepared in Step 4 in the "SAMPLE ID" field of the label. Attach the label to the second jar and cover it with a strip of clear tape. Record the number of jars required for the sample on the Sample Collection Form. **Make sure the number you record matches the actual number of jars used.** Write "Jar *N* of *X*" on each sample label using a waterproof marker ("*N*" is the individual jar number, and "*X*" is the total number of jars for the sample).
  6. Place a waterproof label inside each jar with the following information written with a number 2 lead pencil:
 

<ul style="list-style-type: none"> <li>• Stream Number</li> <li>• Type of sampler and mesh size used</li> <li>• Name of stream</li> <li>• Date of collection</li> </ul>	<ul style="list-style-type: none"> <li>• Collectors initials</li> <li>• Number of transect samples composited</li> <li>• Jar N of X</li> </ul>
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  7. Completely fill the jar with 95% ethanol (no headspace). It is very important that sufficient ethanol be used, or the organisms will not be properly preserved.
    - NOTE: Prepared composite samples can be transported back to the vehicle before adding ethanol if necessary. Fill the jar with stream water, which is then drained using the net across the opening to prevent loss of organisms, and replaced with ethanol at the vehicle.
  8. Replace the cap on each jar. Slowly tip the jar to a horizontal position, then gently rotate the jar to mix the preservative. Do not invert or shake the jar. After mixing, seal each jar with plastic tape.
  9. Store labeled composite samples in a container with absorbent material that is suitable for use with 95% ethanol until transport or shipment to the laboratory.
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REACH-WIDE BENTHOS  
WXXP99 - 9999  
071011 2002  
500000  
Jar 1 of 2

BENTHOS - Extra Jar  
Reach Wide Targeted Riffle  
WXXP99 - 9999  
71011 2002  
Sample ID: 500000  
Jar 2 of 2

BENTHOS IDENTIFICATION  
Site Number WXXP99-9999  
Stream PILOT CREEK  
Collection Date 7/1/01  
Sampler KICKNET 1ft<sup>2</sup> 500μ  
Habitat Type REACH-WIDE  
Collector(s) J. DOE  
Number of Transects 11

Figure 8-4. Completed labels for benthic macroinvertebrate samples. The label at lower left is used if more than one jar is required for a composite sample. The label at lower right is placed inside the sample container.

**BENTHOS IDENTIFICATION**

Site Number \_\_\_\_\_  
Stream \_\_\_\_\_  
Collection Date \_\_\_\_\_  
Sampler \_\_\_\_\_  
Habitat Type \_\_\_\_\_  
Collector(s) \_\_\_\_\_  
Number of Transects \_\_\_\_\_

**BENTHOS IDENTIFICATION**

Site Number \_\_\_\_\_  
Stream \_\_\_\_\_  
Collection Date \_\_\_\_\_  
Sampler \_\_\_\_\_  
Habitat Type \_\_\_\_\_  
Collector(s) \_\_\_\_\_  
Number of Transects \_\_\_\_\_

**BENTHOS IDENTIFICATION**

Site Number \_\_\_\_\_  
Stream \_\_\_\_\_  
Collection Date \_\_\_\_\_  
Sampler \_\_\_\_\_  
Habitat Type \_\_\_\_\_  
Collector(s) \_\_\_\_\_  
Number of Transects \_\_\_\_\_

**BENTHOS IDENTIFICATION**

Site Number \_\_\_\_\_  
Stream \_\_\_\_\_  
Collection Date \_\_\_\_\_  
Sampler \_\_\_\_\_  
Habitat Type \_\_\_\_\_  
Collector(s) \_\_\_\_\_  
Number of Transects \_\_\_\_\_

**BENTHOS IDENTIFICATION**

Site Number \_\_\_\_\_  
Stream \_\_\_\_\_  
Collection Date \_\_\_\_\_  
Sampler \_\_\_\_\_  
Habitat Type \_\_\_\_\_  
Collector(s) \_\_\_\_\_  
Number of Transects \_\_\_\_\_

**BENTHOS IDENTIFICATION**

Site Number \_\_\_\_\_  
Stream \_\_\_\_\_  
Collection Date \_\_\_\_\_  
Sampler \_\_\_\_\_  
Habitat Type \_\_\_\_\_  
Collector(s) \_\_\_\_\_  
Number of Transects \_\_\_\_\_

**Figure 8-5. Blank internal labels for benthic invertebrate samples.**

**POTENTIAL EQUIPMENT AND SUPPLIES FOR BENTHIC MACROINVERTEBRATES**

<b>QTY.</b>	<b>ITEM</b>
1	Modified kick net ( D-frame with 500 µm mesh) and 4-ft handle
	Spare net(s) and/or spare bucket assembly for end of net
1	Watch with timer or a stopwatch
2	Buckets, plastic, 8- to 10-qt capacity
1	Sieve with 500 µm mesh openings (U.S. std No. 35)
1	Sieve-bottomed bucket, 500 µm mesh openings (alternative to sieve)
2 pr.	Watchmakers' forceps
1	Wash bottle, 1-L capacity labeled "STREAM WATER"
1	Small spatula, spoon, or scoop to transfer sample
1	Funnel, with large bore spout
4 to 6 each sample	Sample jars, HDPE plastic with leakproof screw caps, 500-mL and 1-L capacity, suitable for use with ethanol
2 gal	95% ethanol, in a proper container
2 pr.	Rubber gloves
1	Cooler (with suitable absorbent material) for transporting ethanol and samples
2	Composite Benthic sample labels, with preprinted ID numbers (barcodes)
4	Composite Benthic sample labels without preprinted ID numbers
6	Blank labels on waterproof paper for inside of jars
1	Sample Collection Form for site
	Soft (#2) lead pencils
	Fine-tip indelible markers
1 pkg.	Clear tape strips
4 rolls	Plastic electrical tape
1	Knife, pocket, with at least two blades
1	Scissors
1	Pocket-sized field notebook (optional)
1 pkg.	Kim wipes in small self-sealing plastic bag
1 copy	Field operations and methods manual
1 set	Procedure tables and/or quick reference guides for benthic macroinvertebrates (laminated or printed on write-in-the-rain paper)

**Figure 8-6. Equipment and supply checklist for benthic macroinvertebrate collection.**

## NOTES