

Standard Operating Procedure #14: Collection of Macroinvertebrates in Large Rivers

Version 1.0 (2022)

In Water Quality Monitoring Protocol for Large Rivers: Great Lakes Inventory and Monitoring Network

Prepared by

Richard Damstra and David VanderMeulen

National Park Service

Great Lakes Inventory and Monitoring Network

2800 Lakeshore Drive East

Ashland, Wisconsin 54806

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Revision History Log

The following table lists all edits and amendments to this document since the original publication date. Information entered in the log must be complete and concise. Users of this standard operating procedure will promptly notify the project manager and/or the Great Lakes Network (GLKN) data manager about recommended and required changes. The project manager must review and incorporate all changes, complete the revision history log, and change the date and version number on the title page and in the header of the document file. For complete instructions, please refer to Revising the Protocol, SOP #13.

Previous Version #	Revision Date	Author (with title and affiliation)	Location in Document and Concise Description of Revision	Reason for Change	New Version #
Add rows as needed for each change or set of changes tied to an updated version number					

Introduction

Benthic macroinvertebrates have long been used as an indicator for water quality in streams and rivers. Most benthic macroinvertebrates live in rivers for a year or more during their immature stages, and act as integrators of water quality at a site due to their limited mobility and sensitivity to changes in the environment.

Indices of Biotic Integrity (IBI) calculated from macroinvertebrate assemblages can be used as a tool to assess if a stream ecosystem is being subjected to stressors, such as low dissolved oxygen; excessive sedimentation; pollution from toxics, heavy metals, and organics; changes in flow; and temperature extremes (Rosenberg and Resh 1993; Lillie et al. 2003). IBIs are used to quantify the effects that these factors and other human activities have on a biological community, and to create a rating of ecological health (Weigel and Dimick 2011). Single metric benthic macroinvertebrate indices were first developed and used to assess macroinvertebrate assemblages in small Wadeable streams in the mid-1980s (Hilsenhoff 1987, 1998; Karr 1991; Barbour et al. 1999; Lillie et al. 2003). Since then, other researchers and agencies have developed IBIs or multimetric indices for large, non-wadeable rivers applicable to specific rivers or to specific states (Ohio EPA 1987; Royer et al. 2001; Wessell et al. 2008).

In 2011, researchers in Wisconsin developed detailed macroinvertebrate collection procedures using Hester-Dendy (H-D) artificial substrate samplers and IBI calculations for non-wadeable rivers in the state, based on work in other states (Weigel and Dimick 2011; Weigel 2011). Macroinvertebrates collected from the Wisconsin portions of the Mississippi and St. Croix rivers were used in the IBI development, so the procedures are applicable to both Mississippi National River and Recreation Area (MISS) and St. Croix National Scenic Riverway (SACN), the two national park units with large, non-wadeable rivers included in the Great Lakes I&M Network's (GLKN) Large Rivers Water Quality protocol. Including the two network parks in that state effort formed the basis for this standard operating procedure.

The primary objectives for this work are as follows: 1) Track status and trends in macroinvertebrate community composition, IBI, and/or other appropriate macroinvertebrate indices; 2) Monitor the macroinvertebrate community, a meaningful biological indicator that integrates river water quality and physical conditions; 3) Generate data that is compatible with surrounding states' protocols to provide data to state agencies that can be used to assess the health of the river (i.e., impairment status).

Methods

Sites

The procedures outlined in this SOP are limited to use in lotic systems with velocity greater than 0.09 m/s (Weigel and Dimick 2011; Ohio EPA 1987). GLKN will not monitor macroinvertebrates at SACN below Stillwater, Minnesota, because the river becomes lacustrine there, with velocities below the threshold required. Additionally, the Metropolitan Council Environment Services (MCES) has been monitoring macroinvertebrates using a slightly different method at two sites below Stillwater at SACN and at nine sites at MISS annually since 1978 (Table 1). MCES uses a combination of Hester-Dendy samplers and Ponar dredges at those sites (MCES 2014).

SACN has been monitoring macroinvertebrates at the following four sites annually since 2016: Norway Point Landing (GLKN site SACN_02), Never's Dam (GLKN site SACN_04), Folsom Island (River Mile 50.0; not a GLKN site), and Boom Site Landing near Stillwater (River Mile 25.7; not a GLKN site). These sites were chosen by park staff to provide an additional indicator of river health at freshwater mussel beds. We intend to continue sampling at SACN_02 and SACN_04, as well as to add sites at all GLKN sample sites along the lotic sections of the mainstem St. Croix and Namekagon Rivers (Table 1). These sites were chosen because they are spatially distributed along the riverway. Additionally, sampling macroinvertebrates at the same sites where water quality is monitored may help identify how trends in water quality influence the invertebrate community.

Table 1. Name and description of long-term macroinvertebrate sampling sites monitored annually by GLKN, SACN, and MCES staff at SACN and MISS, and the sampling gear used. Sites in bold are co-located with GLKN water quality sites. Sites IDs followed by an asterisk (*) were randomly chosen during the initial GLKN site selection process. River mile indicates upstream distance in river miles from the confluence with the Ohio, Mississippi, and St. Croix rivers for sites on the Mississippi, St. Croix, and Namekagon rivers, respectively.

GLKN Site ID	River	Site Name	River Mile	Organization	Gear
NAKA_84.6	Namekagon	Namekagon R. @ Leonard School Bridge	NAM 84.6	GLKN	Hester-Dendy
SACN_01 *	Namekagon	Namekagon R. @ Earl Landing	NAM 41.3	GLKN	Hester-Dendy
NAKA_4.8	Namekagon	Namekagon R. @ Namekagon Tr.	NAM 4.8	GLKN	Hester-Dendy
SACN_A	Upper St. Croix	St. Croix R. @ CCC Bridge	SC 138.9	GLKN	Hester-Dendy
SACN_02 *	St. Croix	St. Croix R. @ Norway Point	SC 104.0	GLKN	Hester-Dendy
STCR_89.7	St. Croix	St. Croix R. @ Hwy 70	SC 89.7	GLKN	Hester-Dendy
SACN_04 *	St. Croix	St. Croix R. Near Trade R.	SC 63.8	GLKN	Hester-Dendy
STCR_50.0	St. Croix	St. Croix R. Near Folsom Is.	SC 50.0	SACN	Hester-Dendy

GLKN Site ID	River	Site Name	River Mile	Organization	Gear
STCR_43.7	St. Croix	St. Croix R. Near Osceola Landing	SC 43.7	GLKN	Hester-Dendy
STCR_25.7	St. Croix	St. Croix R. @ Boom Site	SC 25.7	SACN	Hester-Dendy
STCR_24.0	St. Croix	St. Croix R. Near Stillwater	SC 24.0	MCES	Hester-Dendy/Ponar
STCR_1.7	St. Croix	St. Croix R. Near Prescott	SC 1.7	MCES	Hester-Dendy/Ponar
MISS_871.6	Mississippi	Mississippi R. Near Anoka	UM 871.6	MCES	Hester-Dendy/Ponar
MISS_862.8	Mississippi	Mississippi R. Near Fridley	UM 862.8	MCES	Hester-Dendy/Ponar
MISS_848.0	Mississippi	Mississippi R. Above Lock and Dam No. 1	UM 848.0	MCES	Hester-Dendy/Ponar
MISS_839.4	Mississippi	Mississippi R. Near St. Paul	UM 839.4	MCES	Hester-Dendy/Ponar
MISS_831.0	Mississippi	Mississippi R. Near Newport	UM 831.0	MCES	Hester-Dendy/Ponar
MISS_826.7	Mississippi	Mississippi R. Near Grey Cloud Is.	UM 826.7	MCES	Hester-Dendy/Ponar
MISS_820.4	Mississippi	Mississippi R. Near Government Light	UM 820.4	MCES	Hester-Dendy/Ponar
MISS_816.0	Mississippi	Mississippi R. Above Lock and Dam No. 2	UM 816.0	MCES	Hester-Dendy/Ponar
MISS_800.4	Mississippi	Mississippi R. Near Diamond Bluff	UM 800.4	MCES	Hester-Dendy/Ponar

Timing of Sampling

Annual sampling will occur over a six-week period (42–49 days) between June and September. This time frame is consistent with the Wisconsin State Protocols (Weigel 2011, Weigel and Dimick 2011), and six weeks is considered the “classic” time to deploy Hester-Dendy samplers (Weber 1973). The amount of time can vary depending on the goals of the project or location, with shorter deployments in warmer waters and as long as eight weeks in colder waters. Six weeks allows plenty of time for invertebrates to colonize the samplers, but not so much time that they will emerge to adult form.

The samplers at GLKN sites will typically be deployed in early July, concurrent with routine water quality sampling, and retrieved during a separate trip, distinct from water quality sampling, in mid-August (retrieval takes much more time than deployment). Once the deployment dates are established, care should be taken to make sure that each sampler is deployed and retrieved within 365 ± 7 days of the previous year’s deployment, but safety and other logistical considerations may necessitate some flexibility in sampling schedule.

Equipment and Supplies

Collection of macroinvertebrates will be accomplished by deploying three Hester-Dendy (H-D) artificial substrate samplers at each site. H-Ds are useable in most flowing river habitats and are easy

to obtain, maintain, and deploy. Based on Weigel and Dimick (2011), Weigel (2011), and Ohio EPA (1987), the H-Ds are made up of eight 76-mm × 76-mm (3" × 3") squares of 3.2-mm (1/8") thick Masonite hardboard, with 7-mm (1/4") holes drilled in the middle (Figure 1). The pieces are assembled on an eyebolt, held on with a nut with variable spacing between the Masonite plates (Figure 2).



Spacing between the Masonite squares is 3.2 mm (1/8") for the first three plates, 6.4 mm (1/4") between the next three plates, and 9.6 mm (3/8") between the final two plates. Stainless steel washers, plastic bushings, or custom cut and drilled Masonite spacers may be used to obtain the proper gap width between plates (Figure 2). Equipment and hardware for H-D samplers can be reused in subsequent years if it is clean and in good repair.

Figure 1. Photo of 76 mm × 76 mm × 3.2-mm thick Masonite hardboard H-D plate. Each plate has an approximately 7-mm hole drilled in the center. Eight of these plates make up each sampler.

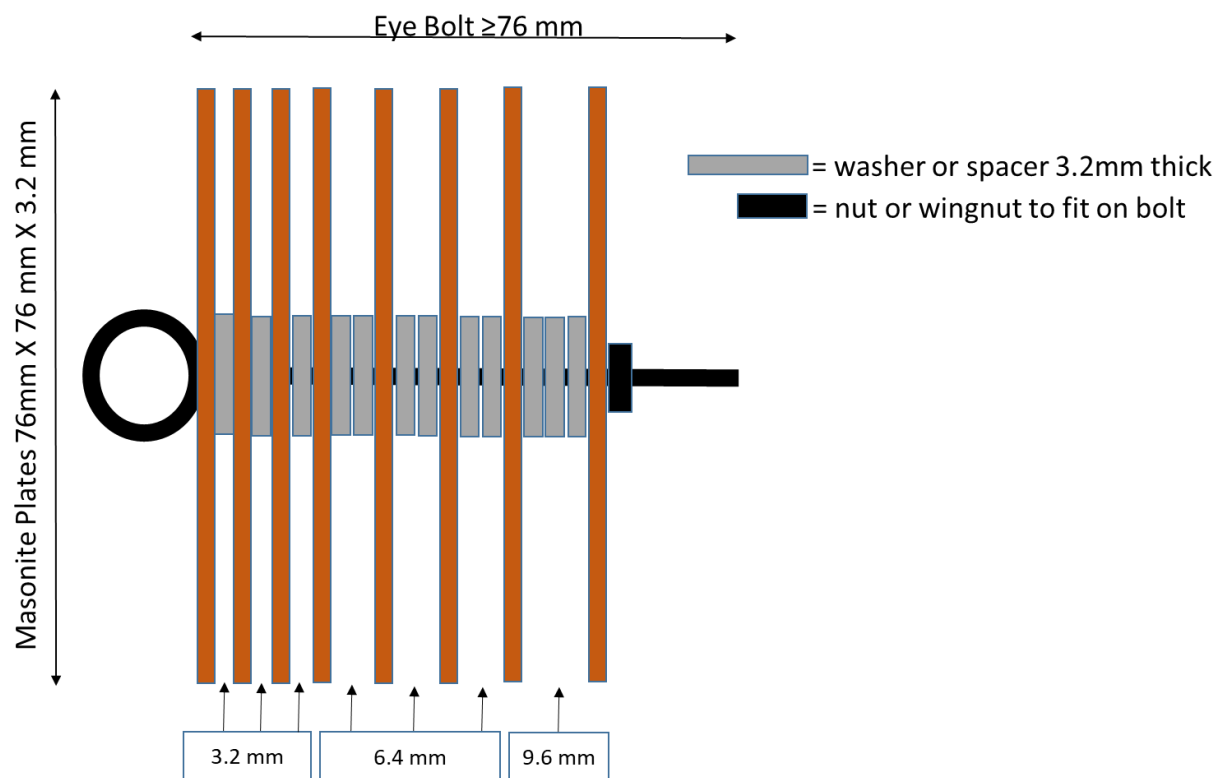


Figure 2. Schematic of Hester-Dendy artificial substrate sampler assembled on an eyebolt. The eyebolt needs to be at least 76-mm long to accommodate proper sampler assembly. Brown rectangles represent Masonite hardboard plates 76 mm × 76 mm × 3.2-mm thick. Spacing between each sampler plate is variable, with spacing distances shown on the bottom of the figure. Grey rectangles represent 3.2-mm thick washers or other spacers used to maintain prescribed distances between sampler plates. The nut should be sized to fit the eyebolt and should be tightened to hold the sampler plates in place.

Refer to the checklist of supplies and equipment needed for collecting benthic macroinvertebrate samples (Table 2) when planning sampling activities. Plan to be sure all equipment is available, clean, and ready for use on the day it is needed. Keep on hand all necessary forms, field logbooks, field data sheets, procedural manuals, and equipment instructional manuals. Copy field data sheets on waterproof paper. See Appendix A for a blank data sheet. Specific sections of the protocol narrative and this SOP that might be important to have in the field should be copied onto waterproof paper and included in the field kit.

Table 2. Checklist of supplies and equipment needed for deployment and retrieval of Hester-Dendy samplers.

Check	Deployment Items
	Hester-Dendy (H-D) samplers, three for each site, plus three additional at duplicate site, with extra spacers, nuts, and plates
	Zip ties, twine, or cable for attaching H-Ds to anchor or other deployment substrate
	Cinder block or similar item to anchor H-D sampler to bottom
	Coated cable with enough wire rope clips to attach to anchor with H-D to buoy or shore, with extra hardware, or other appropriate line/rope for this purpose
	Buoys, flagging, or other way of marking the location of H-Ds underwater
Check	Retrieval Items
	White plastic or enameled steel pans
	Sieve (500 μ m mesh)
	Forceps
	Plastic putty knives
	Squirt bottle with tap water (to wash down H-D plates)
	Ziploc bags with labels, or hard plastic containers that will hold three H-D samplers
	500-1000 mL bottle for holding invertebrates (if processing in field)
Check	Other Required Equipment
	Toolbox with tools for opening/closing wire rope clips and cutting ropes and cables, etc.
	GPS with extra batteries
	Boat hook or pike pole

Check	Other Required Equipment (continued)
	Grappling hook (optional)
	View bucket, or snorkel and mask (optional)
	Waders (if using)
	Boat or Canoe (if using)
	Camera
	Extra rope, Para cord, twine, and zip ties for incidental use in the field
	Clipboard, datasheets, pencils, etc.
	PFDs for each member of crew
	Safety gear for the watercraft you are using for deployment, and any communication gear your need (cell phone, radio, personal locator beacon, etc.)

Sampler Deployment

Before deployment, the H-Ds are assembled as described above, and tethered to an appropriately labeled surface buoy and a weight with cabling to maintain suspension of the H-Ds in the water column (Figures 3 and 4). The surface buoy is also attached to a cinder block anchor to keep the whole assemblage in place under most flow conditions.

Locations where the H-Ds are deployed will depend on site depth, flow, substrate, or other conditions. Sites should be scouted before deployment so that approximate locations of deployment are known, and planning for deployment techniques and necessary equipment for each site can be undertaken. The H-Ds are deployed at locations where flow is >0.09 m/s and depth is such that there is expected to be at least 0.75–1.5 m of water above the H-Ds at throughout the deployment (Weigel 2011; Weigel and Dimick 2011). Usually, the sampler will be deployed close to a riverbank to avoid interfering with watercraft traffic. Typically, areas of extremely turbulent flows should be avoided, since excessive movement of the samplers could cause invertebrates to be dislodged.

It will be up to the judgement of the field crews and the project leader to determine safe and effective deployment techniques at each site. In sites deeper than 1.5 m, H-Ds can be suspended in the water column about 1m below the surface under a buoy (UMRBA 2016) (Figures 3 and 4). For shallow sites (<1.5 m depth) with firm substrates (e.g., gravel, cobble, rock), the H-Ds should be attached directly to a cinder block or other suitable anchor and placed directly on the substrate (Weigel and Dimick 2011; Weigel 2011) (Figures 5 and 6). For shallow sites (<1.5 m) with sandy or other soft or dynamic bottoms, where the brick on the bottom is likely to be covered with sediment before

recovery, the H-Ds can be attached directly to the line, between the anchor and the buoy (Figure 7). If using this method, care should be taken to use a long enough line to ensure that the buoy is not sunk if the water level rises significantly, and that the H-D samplers stay off the bottom of the river.

It may take some experimentation to figure out where to place the H-Ds to achieve these goals. At all shallow sites (<1.5 m), it may be desirable to forgo using a buoy and attach the cable to a fixed object on shore, especially when sites are accessible by wading (Figure 8). Although not detailed in this document, crews may attach the H-D samplers directly to any fixed object, such as a log 1.0–1.5 m under the water, if it is found that the techniques detailed above will not work (Weigel and Dimick 2011; Weigel 2011).

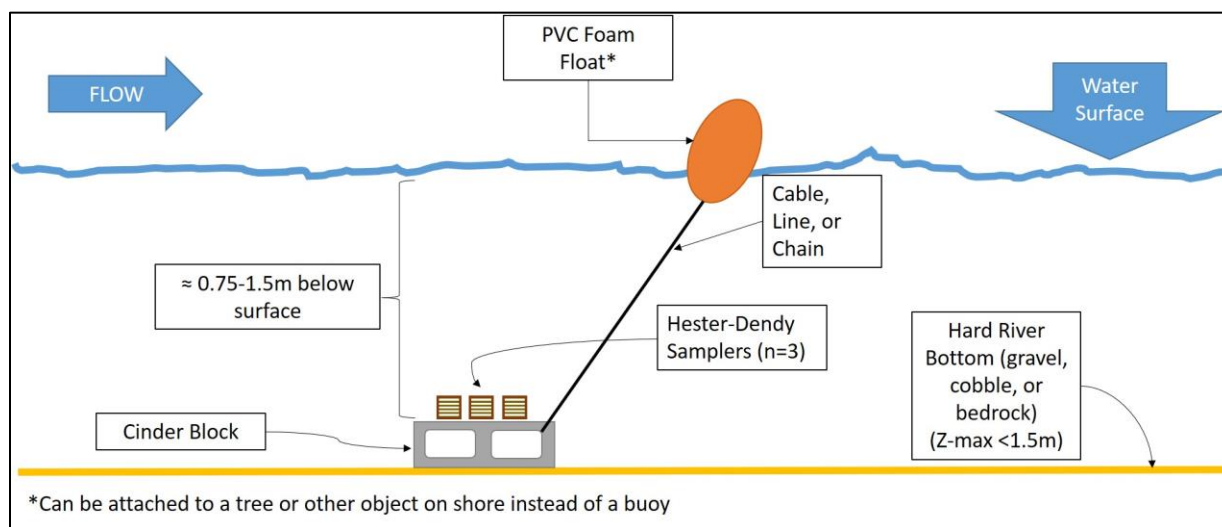


Figure 3. Schematic of suggested deep water (>1.5 m) deployment for Hester-Dendy samplers. Suitable for deployments on any substrate type.

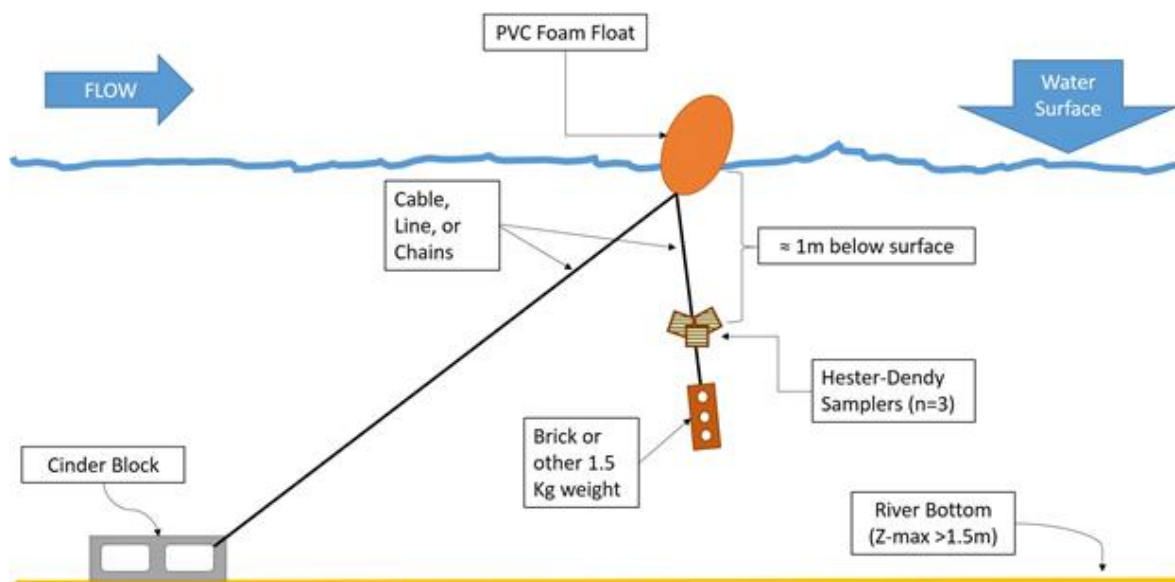


Figure 4. Photograph of H-D samplers suspended under the buoy, attached to a chain for deployment at a site where the water is >1.5 m deep.



Figure 5. Schematic of suggested shallow water (<1.5 m) deployment for Hester-Dendy samplers on firm substrates such as gravel, cobble, boulders, or bedrock. Please note using this method on sand or other soft, dynamic substrates may result in the samplers being buried.



Figure 6. Photograph of H-D samplers attached directly to a cinder block prior to deployment at a shallow (<1.5 m), firm bottomed site.

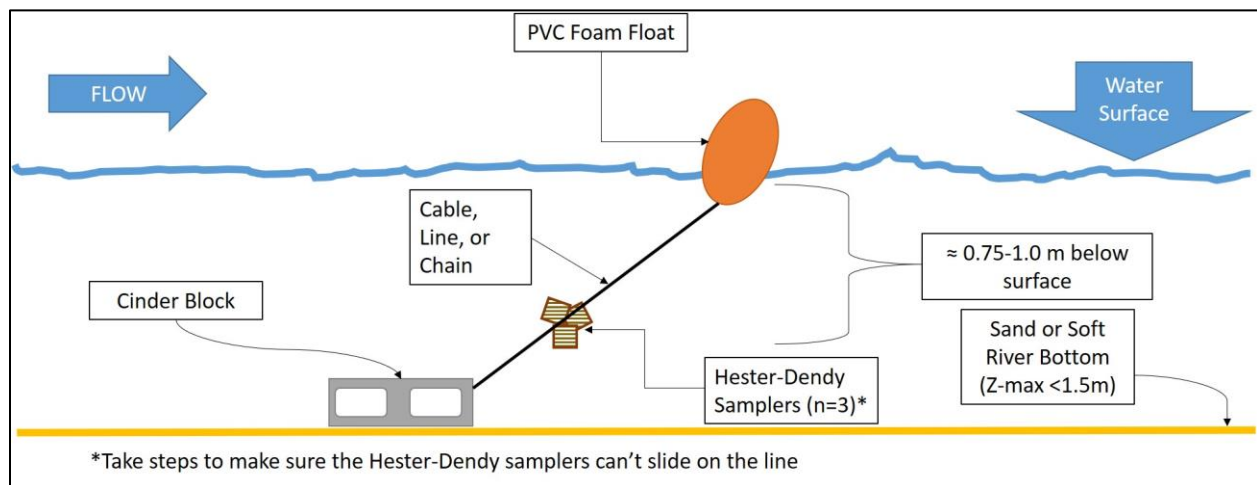


Figure 7. Schematic of suggested shallow water (<1.5 m) deployment for Hester-Dendy samplers on soft substrates such as sand and other dynamic substrates.



Figure 8. Deployment of a H-D samplers without a buoy at a shallow site with firm, rocky river bottom. In this case, the H-D samplers are attached to the top of a cinder block (as in figure 5), and the cinder block is attached to a tree on shore by a steel cable.

If deploying from a boat at anchor, the sampler should be deployed from the bow, with the cinder block deployed first and carefully lowered to the sediment. Take care to ensure that the samplers are in the proper position and are situated with 0.75–1.5 m of water over the samplers. The buoy should be released last, and care should be taken to keep any cables or ropes away from the boat motor, especially when under power. If wading during deployment, wear a PFD and simply drop the cinder block anchor, ensuring that the samplers are on top of the block.

In general, once H-Ds are deployed at a particular site, they will be deployed at the same approximate location (within 30 m) in future years, unless physical change at the site (e.g., sediment infilling) or management concerns (e.g., becomes a high traffic area for recreation, or was tampered with in a prior deployment) necessitate moving the sampler. GPS coordinates, site photos, and physical landmarks will be used to return to the same location year after year.

Upon deployment, fill out the first side of the field data sheet (Appendix 1). In addition to the identifiers for the site (Site ID, date, time, site name, personnel, GPS coordinates), indicate the type of deployment (i.e., Water column under buoy w/weight, Water column attached to anchor line, riverbed, snag), and the substrate type (boulder, cobble, gravel, sand, silt, clay, fine organic, coarse organic, leaves, sticks, large woody debris). Describe the location of the sampler relative to the approximate distance from either the right or left bank (facing downstream). Also note the depth of the water (measured with a depth finder or meter stick) and the estimated depth of the water over the H-D plates. Optionally, a brief text description, or simple drawing, and/or associated photographs may be used to help with later relocation of the H-D samplers.

In addition to the three H-D samplers deployed at each site, a duplicate set of three samplers will be deployed at one randomly determined site per year. The duplicate samplers will help ensure that field and lab procedures are collecting consistent, defensible data. Typically, the duplicate H-D samplers will be deployed immediately adjacent to the other set. Upon returning from the field, download photos, make copies of the deployment datasheets and store in a safe place.

Sampler Retrieval

Retrieve the samplers after they have been deployed for six weeks (42–49 day). A copy of the field sampling sheet that was started during deployment is brought into the field and finished upon retrieval (Appendix 1). Make sure to note date and time of retrieval, personnel involved, the depths at retrieval, notes, the condition of the samplers at retrieval, number of photos taken, and considerations for next year on the provided data sheet (Appendix 1). When retrieving the samplers, remove them from the water as quickly and smoothly as possible, minimizing motions that could dislodge the macroinvertebrates from the H-Ds. As soon as the samplers are out of the water, remove them from the anchor by cutting the zip ties with wire cutters, and place the samplers in a light-colored dishpan to make sure that no invertebrates escape. Alternatively, a sieve with 400–500- μ m mesh can be used to hold H-D samplers (Figure 9).



Figure 9. A dish pan (*left*) is ideal for holding H-D samplers immediately after removing them from the water so invertebrates do not escape. Any light-colored pan will work for this purpose. A sieve can be used as well. Any screen or mesh should be between 400 and 500 μ m.

Because the samplers are typically anchored by heavy cinder blocks, removing them from the water requires care and attention to safety. All crew members working on boats or wading will wear PFDs while retrieving invertebrate samplers.

When recovering H-Ds using a boat, approach the buoy from downstream to avoid tangling the line in the prop. Grab the buoy and bring it on board the boat. Once you have the line in the boat, “cleat” or tie off the line to a secure spot on the boat or have another crew member hold the line. Work the line into the boat until you can grab the H-D samplers. If the samplers are attached to a cinderblock, pull the whole apparatus in the boat as quickly and smoothly as possible. Put the H-Ds into the pan/screen bucket/D-frame net to prevent loss of any organisms. Clip and discard the zip ties.

Once the H-D samplers are secure, you can recover the rest of the apparatus. If the cinderblock or anchor is stuck (fouled) on the bottom, try to remove it by pulling in line until the bow of the boat is directly over the anchor. Then, cleat the line at the bow of the boat and apply engine power slowly and steadily upstream to drive the bow over the anchor “lever” the anchor out of the sediment, being careful to keep the line out of the prop. Once the anchor is free, pull it into the boat.

When retrieving samplers during wading, simply lift the anchor as quickly and smoothly as possible and secure the samplers. In all cases, a boat hook, pike pole, or grappling hook and line may be helpful to aide in recovery, especially in cases where the water level has risen very high, submerging the buoy.

While still in the boat (or if wading, while on the shore), disassemble the H-Ds, picking macroinvertebrates off the components with forceps and scraping the Masonite squares with a plastic putty knife. A squirt bottle with tap water can also be used to clean off the H-D pieces. Do not include macroinvertebrates attached to other sampler components (zip ties, cabling, buoy, cinder block). After all pieces for all three samplers have been cleaned off, discard most of the remaining water while retaining the organisms. This can be accomplished by decanting the water into a container with 400–500- μ m mesh to allow the water to drain, such as a graded sieve (Figure 9). The invertebrates from all three samplers should then be washed with 70% ETOH into a single 4-L (1-gallon) bottle or similar container for transport. Enough 70% ETOH should be added to the sample to make a 2:1 ETOH-to-sample ratio. Double-label the container—place a water/chemical-proof label on the outside of the container and write the Site ID, date and time of collection, and the contents (macroinvertebrates) on it. Write the same information in pencil (or other appropriate means that will remain legible in the ETOH) on a small square of Rite-in-the-Rain paper and seal it inside the container.

Duplicate samples will be handled separately from the regular samples and will be collected in a separate container with the same date and time as the regular sample at the same site but will be labeled with the Site ID for duplicates, typically formatted as PARK_98 or PARK_99. An example duplicate Site ID at SACN would be “SACN_98.” Optionally, fabricated dates and times can be provided to the lab to mask the identity of the duplicate site more completely from the lab, but this is up to the discretion of the project manager.

If time or weather conditions do not allow for the H-Ds to be scraped and processed on site, all three H-Ds from each site may be placed into a 4–8 L (1–2 gallon) Ziploc bag (or other appropriate hard-sided container that will fit the H-Ds), double bagged, clearly labeled and kept on ice or refrigerated for up to 24 hours. If bagging and processing samplers later, DO NOT put the duplicate samplers in the same bag with the other samplers. The duplicate must be treated as its own sample. Within the 24 hours, the H-Ds should be cleaned of macroinvertebrates, and those macroinvertebrates should be preserved in 70% ETOH as described above.

Packing, Storing, and Shipping Samples

Samples will be sent to a lab with expertise identifying midwestern macroinvertebrate taxa, who will identify and enumerate the macroinvertebrate samples.

- Before sending macroinvertebrate samples, check to be sure all containers are filled to the top with 70% ethanol to minimize damage to the specimens. When a sample container contains a lot of organic debris, such as leaves and algae, proper preservations may be questionable. In such cases, decant the ethanol solution and refill with fresh alcohol within 24 hours of sampling to avoid specimen decay. If the preservative is too weak, the sample will decay; if the preservative is too strong, the invertebrates will become brittle and more susceptible to breaking during shipping and handling.
- Carefully pack the sample containers in a box lined with a plastic garbage bag; be sure to use enough packing material to cushion the samples.
- Create an inventory sheet with site ID, dates/times, and other pertinent information for each sample to help the lab identify the samples in case of problems with labeling (e.g., leaking bottles cause the ink to run). Hardcopies or electronic copies can be shared with the lab upon shipment. If the lab receiving the samples requires a chain of custody (COC) form for shipped samples, ensure that dates, times, and proper site IDs are on the COC form.
- Call an appropriate courier service ahead of time to arrange pick-up. Check to be sure the courier will accept shipments containing alcohol. Follow the shipper's rules pursuant to shipping alcohol.
- Alert the lab when samples have been shipped and provide them with the tracking number.
- GLKN staff should check with the lab to ensure that the samples have arrived in good condition.

Sample Sorting and Identification Procedure at Lab

The lab will be responsible for sorting, identifying, and enumerating invertebrates in a reasonable amount of time after the samples arrive at the lab, as determined by the project manager. Samples are sorted and subsampled using a stratified grid method to achieve a fixed count of 500 individuals. A randomly selected grid is sorted to completion (i.e., all animals in the grid are sorted). If fewer than 500 animals were sorted from the first grid, then additional grids are counted until ≥ 500 animals are sorted from the grids. The additional grids sorted are stratified by distance from the first. That is, the next grid sorted will be at least two grids away from the first grid sorted. If additional grids are needed to reach 500 animals, then the same pattern is followed, sorting from another grid at least two grids away from the last finished grid. All grids are searched for large and/or rare specimens that were not obtained during the fixed count (Weigel and Dimick 2011).

Once the fixed count has been completed, the samples are identified to the lowest possible taxonomic level. The lab will use the taxa reference list from the EPA WQX/WQP to provide taxa names consistent with NPS-GLKN data systems. This list is found at:

https://cdx.epa.gov/wqx/download/DomainValues/Taxon_CSV.zip and is updated periodically.

Quality Control

Internal Quality Assurance/Quality Control Considerations

Prior to deployment of Hester-Dendy samplers, the field crew leader will randomly select one site per year where an additional blind duplicate set of samplers will be deployed. These duplicate samplers will be deployed near each other in similar depth and flow conditions. Ideally, the duplicate samplers will be side by side with the parent samplers. The duplicate samplers should not be immediately upstream or downstream of the parent samplers so that the different sets of samplers are not receiving drift from each other (UMRBA 2016).

Crews will avoid disturbing the substrate prior to deploying H-Ds. During retrieval, take care to avoid losing organisms from the H-D samplers. Ensure the sampling is conducted according to procedure. Examine H-Ds and any debris thoroughly to be sure that all organisms are included in the sample.

Prior to departure from the sampling site, check to be sure all data forms have been filled out completely. Samples must be labeled on the outside and must contain a label in the bottle on waterproof paper. Both labels should include the same information—the project, date, stream name, site code, and collector's name. If chain-of-custody forms are used by the lab, they should also contain the same information as the sample container labels.

After sampling is completed at a site, rinse all equipment and gear, especially nets and sieve buckets. Inspect to be sure no organisms or debris remain. Follow decontamination procedures described in SOP #5 before using the equipment at a new site.

Laboratory Taxonomy and Quality Assurance/ Quality Control

Labs will use best practices to ensure that specimens are identified accurately, and data are entered correctly. Lab QAQC procedures will be provided upon request. As a check, a blind duplicate sample will be collected in the field and submitted to the lab. The identity of the duplicate site will be kept secret from the lab to ensure the integrity of the identification of animals in the duplicate sample. Upon completion of identification, GLKN staff will compare the duplicate sample to the parent sample. The identifications and species present between the two samples should agree by at least 90%. If 90% agreement is not reached by the lab between the samples, then discussion will be undertaken with the lab to see if action can be taken to improve agreement.

Safety

Appropriate safety considerations are to be taken by field crews. Safety measures include:

- Field work should not be completed alone.
- PFDs should be worn while working on or around the water.
- Take extreme care when deploying heavy items, such as anchors, in the water.
- Avoid standing on lines or cables during deployments and take care to not be entangled in them, especially at time of deployment.
- Always carry a knife, wire cutters, or other means to cut yourself out if you become tangled in lines or cables.

All other safety considerations and precautions for conducting field and laboratory operations should be carried out in accordance with SOP #2: Training and Safety.

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Appendix A. GLKN Large River Macroinvertebrate Sampling Datasheet.

Park: _____ Site Name: _____ GLKN Station_ID: _____

UTM Coordinates: _____ UTM Zone: _____ Datum: _____

Deployment Info:

Deployment Date: _____ Deployment Time: _____

Deployment Personnel: _____

Total Depth @ Deployment (m): _____ Approx. Depth Over H-D Plates (m): _____

Approx. Distance from Near Bank (m): _____ Near Bank (facing downstream; circle one): L R

Deployment Type (Check One):

Water Column Under Buoy w/weight: _____ Water Column attached to Anchor Line: _____

Riverbed: _____ Snag: _____ Other (describe): _____

Dominant substrate at immediate deployment location (Estimate %):

Boulder _____ Cobble _____ Gravel _____ Sand _____ Silt _____ Clay _____

Fine Organic _____ Coarse Organic _____ Leaves _____ Sticks _____ Large Woody Debris _____

Deployment Notes:

of Photos Taken: _____ Where are Photos Stored: _____

OPTIONAL! Sketch of site. Only do this if you think it will aid in re-locating the samplers later. Be sure to note direction of water flow, cardinal directions etc.

Retrieval Info:

Retrieval Date: _____ Retrieval Time: _____

Retrieval Personnel: _____

Total Depth @ Retrieval (m): _____ Approx. Depth Over H-D Plates (m): _____

Was the sampler still in good condition? (Circle One) Y N (If "No", explain below)

Retrieval Notes:

of Photos Taken: _____ Location of Photos: _____

Considerations for Next Year:

GLKN Site Codes @ SACN (PLEASE USE THESE):

Namekagon River @ Leonards: SACN_NAKA_84.6

Namekagon River @ Earl: SACN_01

Namekagon River @ Namekagon Trail: SACN_NAKA_4.8

St. Croix River @ CCC Bridge: SACN_A

St. Croix River @ Norway Point: SACN_02

St. Croix River @ Hwy 70: SACN_STCR_89.7

St. Croix River @ Nevers Dam (aka Trade River confluence): SACN_04

St. Croix River @ Folsom Is. (aka Interstate SP): SACN_STCR_51.9

St. Croix River @ Osceola: SACN_STCR_43.7

St. Croix R. @ Boom Site (Stillwater Main Channel, east of Island): SACN_STCR_26.0A

St. Croix R. @ Boom Site (Stillwater Backwater, west of Island): SACN_STCR_26.0B

St. Croix River @ Bayport: SACN_07

St. Croix River @ Hudson: SACN_09

St. Croix River @ Prescott: SACN_11

