Virginia Save Our Streams
Stream Quality Survey Instructions
Standard Operating Procedures for Macroinvertebrate Population Surveys
Virginia Save Our Streams Modified Method

The stream quality survey, originally designed by the Izaak Walton League of America and revised and updated by the Virginia Save Our Streams Program (VA SOS), allows volunteer monitors to collect data on the health of their local streams. This data, if collected and recorded properly, assists state agencies, local governments, and concerned citizen sin improving local environmental conditions related to water quality. This document is a comprehensive guide to doing a stream survey that contributes to the state effort to manage and protect Virginia's waterways.

Conducting a survey of the macroinvertebrates, organisms large enough to be seen by the unaided eye, allows you to assess the health of your stream. Many stream-dwelling organisms are sensitive to changes in water quality. Their presence, absence, or population changes through time serves as an indicator of environmental conditions. Macroinvertebrates are easy to find, collect, and identify. By following the instructions below (a summary of the VA SOS Training Session) and filling out the VA SOS Stream Survey, you can diagnose your stream's water quality. Remember, your data is most useful when you have become a certified VA SOS monitor.

Monitoring should be done at one station, defined as a single stretch of stream not more than 100 yards long. If you wish to assess a longer section of a stream, select two monitoring stations at the top and bottom of the stretch, or multiple sites along the length of the stretch at quarter-mile or greater intervals. Be sure to revisit the same station each time so that your results will be comparable. Carefully record the location of your monitoring station on your VA SOS Stream Survey form. If you do not know the latitude and longitude coordinates when you monitor, use an accurate description of the site (i.e. Site located on north side of route 660, 1 mile east of route 607) that enables you or another monitor to return to the same location. The regional coordinator or VA SOS staff will help you identify the coordinates at a later date.

Monitoring should be conducted four times a year for each station you monitor. We suggest a schedule of January, April, July, and October, though consistency is more important that a specific month. In addition, you may choose to monitor after a significant event that may have a significant impact on the stream, such as a chemical or oil spill, a heavy rain following the spreading of manure or fertilizer on lands nearby, or a flood. Do this no more than twice, for an annual maximum of six surveys. The survey itself is a stream disturbance and too heavy a monitoring cycle can negatively impact macroinvertebrate populations.

If you are monitoring more than one station on a stream, you should begin monitoring at the station furthest downstream and work upstream. This will prevent macroinvertebrates disturbed from your first test from washing downstream and getting caught in your net a second time. Each station should include only the organisms present at that location and not those disturbed from previous tests.

Catching the Macroinvertebrates -- Modified Rocky Bottom Sampling

The equipment required includes a kick-seine (1/32" mesh net with supporting pole on each end), a plastic container (preferably one with divisions like a white ice-cube tray), tweezers, a magnifying glass or magnifying cubes, pencils, rubber boots or other stream shoes, and rubber gloves (required for impaired streams). The kick-seine net is available through VA SOS for $25.00 without poles.

Select a riffle typical of the stream, that is, a shallow, fast-moving area with a depth of 3 to 12 inches (8 to 30 cm) and stones which are cobble-sized (2 to 12 inches) or larger. Stone size is important since the macroinvertebrates surveyed prefer these stones for protection and food supply. In addition, the bubbling of the water over the rocks provides needed oxygen for healthy growth.

1. Place the kick seine perpendicular to the flow of water immediately downstream of the 1x1 foot area in the riffle you have selected to sample. The bottom, weighted edge of the net should fit tightly against the stream bottom. You may wish to use cleaned rocks from outside your sampling area to hold the net firmly to the bottom. This will prevent insects from escaping under the net. Tilt the net back, so the water flowing through the net covers a large portion of the net, however, be careful not to tilt the net so much that water flows over the top, allowing organisms to escape.
2. Quickly sample the targeted area for 20 seconds. To sample, lift and rub underwater all large rocks in the sample area to dislodge any clinging organisms. Rub all exposed surfaces of rocks in the sampling area that are too large to lift. Do the rock rubbing for about 15 seconds. For the last 5 seconds, dig around in the small rocks and sediments on the streambed in order to dislodge any burrowing macroinvertebrates.
3. After sampling for 20 seconds, carefully rub off any rocks used to anchor the net. Then remove the seine with an upstream scooping motion to keep all the macroinvertebrates in the net.
4. Place the net on a flat, light colored surface, such as a white sheet, table, or piece of plastic. This makes the organisms easier to see. Using tweezers or your fingers, gently pick all the macroinvertebrates from the net and place them in your collecting container. Carefully look on both sides of any debris in the sample, as many insects will cling to any available litter. Any moving creature is considered a part of the sample. Look closely for very small organisms and take your time. It is important to thoroughly pick all the organisms from the net. Once you have sorted all the organisms off the net, lift the net and examine the underlying area. Collect any organisms that have crawled through the net. Again, it is important to collect all these organisms to have an accurate sample.
5. Once all the macroinvertebrates are removed from the seine, count the number of organisms in the sample. If at least 200 organisms have not been sampled, another net must be collected from a different area in the same riffle. The organisms from the second net will be added to the first. The length of sampling time can be adjusted

depending on the number of organisms collected in the first, with the maximum sampling time per net being 90 seconds. The second net and area beneath are again sorted in their entirety. Again the organisms are counted, and a third net will be collected if 200 organisms have not been obtained. This process is repeated until at least 200 organisms are found or 4 nets are collected, whichever is first. Each net collected must be sorted in its entirety, even if that leads to a sample of well over 200 organisms.

6. Once at least 200 organisms have been obtained, separate the organisms into look-alike groups. Use primarily body shape and number of legs and tails, since the same family or order can vary considerably in size and color. Use the tally sheet and macroinvertebrate key to aid in the identification process. Record the number of individuals you find in each taxonomic group on the tally sheet. Include the total number of organisms in the sample on the lower right corner of the tally sheet. Follow the tables attached to the tally sheet to calculate the individual metrics and the final ecological condition score.

Studying the Find

There are two important pieces of information you are recording in your survey; the diversity of orders or families of macroinvertebrates, and the population within each of these. Diversity is a strong sign of health, especially if the orders are diverse in those families that are pollution sensitive. Populations tell us something about the trend in stream health. Increases in numbers of sensitive species may indicate an improved food supply or better water quality. Decreases could be due to seasonal variations or lowering water quality. In tolerant species a population increase could indicate poor water quality or a change in stream bottom conditions due to sediments. Table 1: Assessing Impairment, will clarify these distinctions.

Streams can suffer from a variety of problems that may be discovered by consistent stream quality surveys through time. These usually fall into three categories given below:

1. **Physical Problems –** These may include excessive sedimentation from erosion, street runoff, or a discharge pipe. Sediment may: create poor riffle characteristics; contribute to excessive flooding; reduce flow rates; change temperature of the water (which decreases oxygen levels); and smoother aquatic life. The result is usually a reduction in the number of all animals in the study area.

   Sometimes the physical problems are not in the stream itself, but due to changes in the structure of the stream bank. Reduced shading from the riverine vegetation increases water temperature and lowers oxygen levels in the stream. This has an adverse effect on fish populations and sensitive macroinvertebrates. Any substantive change to the stream bank can have an effect on stream health.

2. **Organic Pollution –** This is normally from excessive human or livestock wastes or high alga populations due to an increased nutrient load in the stream. The result is

usually a reduction in the number of different kinds of macroinvertebrates in the stream; commonly shredders like stoneflies or some mayflies, leaving more collectors/scrappers such as netspinning caddisflies, scuds, or lunged snails. Sources of organic pollution include runoff from farms, treated sludge from sewage treatment plants, runoff from impervious surfaces like streets, parking lots, and roofs, leaking septic systems, and excessive fertilizer from lawns or golf courses.

3. **Toxicity –** This includes chemical pollutants such as chlorine, acids, metals, pesticides, herbicides, and oil. One of the most serious examples is acid mine drainage from old coalmines in southwestern Virginia. This leaves the stream clear, clean, and dead. A low level of toxicity general lowers the variety and numbers of all macroinvertebrates.

Table 1: Assessing Impairment

In the Case Of:	**Look For:**
Increases in diversity and or population of intolerant groups	Improved Stream Health
Decreases in diversity and/or population of intolerant groups	Upstream degradation; increased sediment loads; less stream shading; new pollution sources
Little variety of insects but high numbers of each kind, normally of tolerant groups	Enrichment of water with organic material, commonly from effluent, manure spreading, or increased runoff
Only one or two kinds of tolerant groups in great abundance (commonly worms or blackflies)	Severe organic pollution (manure or other nutrient pollution) or severe sedimentation
A variety of macroinvertebrates but only a few of each kind	Toxic pollution at low levels
No macroinvertebrates but a clean stream	Severe toxic pollution

Describing the immediate environment   Habitat Assessment

The final portion of the monitoring session is to evaluate the habitat of the stream. This is an important portion of the monitoring as it can help identify sources of pollution and stressors to the macroinvertebrate population

- **Fish water quality indicators** - Some fish, like trout, are sensitive to pollution. Others, like carp, are relatively tolerant. Unless a fish happens to wind up in your net they are not easy to identify without experience. In answering this question you should first look at general characteristics: are the fish seen individually or in schools. Once this is done and you are relatively certain of the type you can note which fish you see. Not all the possibilities are given here.
- **Barriers to fish movement** - This should specifically note barriers within a short distance of your monitoring site, not those more than a mile off. If you have a barrier not listed, please check other and write in the barrier type present at your site.

- **Surface water appearance** - Please indicate the color of the water itself, apart from the substrates. This may indicate runoff problems. Most streams are clear in periods of low flow. At high flow runoff is more likely and may change the color and/or clarity of the water. A tea color often indicates the presence of tannins in the water from decaying leaf matter. A colored sheen may lead to an oil spill of some kind. Otherwise discolored water indicates erosion or other types of runoff upstream from your site that could lead to lower or changed macroinvertebrate populations.
- **Streambed deposit (bottom)** - Please indicate the color/ type of material in the substrate in the riffle you sample. In most riffle monitoring the bottom will consist of gravel, cobbles, and boulders. In some cases there is a layer of muddy material between the cobbles that may increase or decrease through time. This is an indicator of the stream's sediment load and type of sediment. Noting the color and/or consistency of this sediment helps keep track of changes in the environment for macroinvertebrates
- **Odor** - Notes invisible but significant pollution.
- **Stability of the streambed** - Like the color or consistency of the streambed deposit, this is an indicator of sediment load and changes through time. It also helps keep track of the quality of the riffle
- **Alga color and location** - Please note first the color of the algae (make sure that you are looking at the algae itself and not any sediment on it), then estimate the area covered by algae. Algae growth, color, and consistency are responsive to nutrient loads. A matted or hairy alga is a sign of low stream quality. Light or dark green algae in spots indicate a healthy stream. Brown algae often indicates episodic increases in sediment loads. Stream channel shade - Please indicate the shade present on the day you monitor. Shading is an important determinant of water temperature and oxygen concentration in the stream. Oxygen levels are higher in colder water. Sensitive fish and macroinvertebrates do better with higher oxygen levels. Shade quantity should be determined by estimating the overhead cover at the monitoring site. Only five choices are given: full, high, moderate, low, or none.
- **Stream bank composition (=100%)** - Please estimate the percentages of each vegetation type based on the immediate bank (not the entire riparian area). All herbaceous plants and mosses should be included in grasses. The long-term stability of a stream bank is often determined by the makeup of its plant population. Bare banks are eroding. Heavily wooded banks seldom erode even in heavy flooding. By noting the percentage of cover provided by various components of the stream bank you can keep track of changes through time that could affect stream health.
- **Stream bank erosion potential** - This is a subjective estimate of damage to the stream bank through time. It is often comparable to the amount of bare soil, but not exclusively. If the height of the stream bank is greater than the rooting depth of the plants on it, erosion is a distinct possibility. This category is your estimate of the potential amount of the stream bank that could experience erosion during high rainfall or a flood event.
- **Riffle composition (=100%)** - Please be sure to note all the substrate within the riffle, not just those rocks lying on top. Stream bottoms are not static; they do change through time. Riffle composition affects macroinvertebrates. The ideal habitat for many of the creatures is cobbles, stones between 2 and 10 inches in diameter. This

estimate of composition percentage indicates the quality of macroinvertebrate habitat. Silt or mud is determined by feel. If the streambed bottom has smooth feeling like mud it is probably made up of silt and clay particles. When it feels gritty or has visible grains then it is sand. In streams sand grains are those particles between 1/64" and ¼" in size. Gravel consists of all rock between ¼" and 2" in size. Boulders are those rocks greater than 10" in diameter. At times some riffles may have exposed bedrock. Since this is a poor habitat for macroinvertebrates you should note this in the comments at the bottom of the survey.

- **Land uses in the watershed** - The SOS Habitat Survey form asks if land use impacts are high (H), moderate (M), or slight (S). Although these questions are somewhat subjective, record the impacts the following ways. Note H for a land use if it comprises the majority of land in the watershed and is polluting the stream. Or, note H if the land use has a severe impact of stream quality even though the land use does not use a great deal of land, such as a construction site which has caused the stream to be full of silt and muddy water. Note M for a land use if the land use is definitely contributing to stream degradation but is not the major cause for degradation or is one of many causes. For example, parking lot runoff and trash from a shopping mall may contribute significantly to stream pollution but may not be the only cause of stream degradation. Note S for a land use if its impacts are minimal in polluting the stream. For example, although a farm may be present, good farming practices and conservation measures may mean the pollution impact is negligible. If the land use is present, but causing no pollution, write N for none. Finally, leave the entry blank if you notice no forms of this land use upstream from your monitoring site
- **Describe litter** - Many streams downstream of urban areas are dumping grounds for refuse. While not necessarily pollutants, they can degrade, causing pollution or simply be an aesthetic nuisance. Noting which types are present and how much of the stream area is affected may contribute to actions that reduce refuse disposal in the streams.
- **Comments** - Often the information given above needs further clarification. Use this last section to briefly add any thoughts, opinions, or observations you have made about stream health that are not included in the form.

If you have questions about the stream survey instructions, contact:

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Monitors reminder of physical characteristics of aquatic macroinvertatabrates

Stoneflies **--** Have two wirelike tails. Never have gills on their abdomen. Will do "pushups" in the ice cube trays when oxygen levels fall. Some folks say that stoneflies look "Egyptian" (scarabs?).

Mayflies -- Have three wirelike tails. There are several exceptions that only have two but these are easy to detect because they have gills on their abdomen. The most common of these exceptions is the flatheaded mayfly, which has large eyes on the top of its head. This mayfly has prominent gills that flutter in the ice tray.

Caddisflies -- Caddis are often fat and segmented. They often have a greenish color although this is often dependent on what they have been eating. There is one caddis that is bright orange or bright yellow. This one (I call it my "neon" caddis) is seldom as large as my other caddis and not fat. We differentiate the netspinning caddis because of its much higher tolerance for water pollution.

Netspinning Caddisflies -- Can be brown to green depending on what it has been eating. Has two "tufty" tails. Most importantly it is the only caddis to have significant gills on its abdomen (may require magnification). Does not make a case. Often this one will do the "caddisfly dance". Ask your trainer to demonstrate.

Beetles – ***Adult riffle beetles*** are the only one of the critters that we observe that spends its entire life cycle underwater. They are small black beetles usually found under the net. ***Water pennies*** are small and copper colored. They are unlike anything else you might find. ***Beetle Larvae "Elmidae***" are what I call my apostrophe or comma bug. They often have the size and shape of these punctuation marks. Some folks say they look "crunchy" and if you look real close they have rings like a raccoon's tail and a pulsating anal gill at the posterior end**. *"Other" beetle larvae*** are very diverse in appearance and less common. These are best determined by using your dichotomous key in the beginning of your monitors guide.

Snails **– Gilled snails** must filter their oxygen and food from the water. They require relatively good water quality. Holding one in front of your face with the pointed or helix end pointing upwards, the opening will be to the right. **Lunged or Pouch snails** will open to the left and can exist in poorer water quality. They don't filter out food or oxygen.

Megaloptera **–** That got your attention! This is the scientific name for the Order that includes **Hellgramites, Fishflies, and Alderflies**. Since they are all grouped together in the modified method you don't really need to distinguish between. Just for your knowledge: The primary difference between **Hellgramites** and **Fishflies** is that the **Hellgramites** have cottony gills on their abdomen and **Fishflie**s have a smooth abdomen. Also, a full grown Fishfly will never be as large as a full grown Hellgramite. Another common name for a Hellgramite is a Dobsonfly. **Alderflies** look similar to the others but they have a single spiky tail that looks like a stinger. **Alderflies** are less likely to be found than the other two families.

Damselflies and Dragonflies – **Damselflies** have 3 characteristic paddle shaped "tails". In other words their three "tails" are shaped like the blade of an oar. These are actually supplemental gills and not true tails. Damselflies are fragile or "spindly" looking and have large eyes.**–**

Dragonflies are mainly identified by the shape of their bodies. They range from slightly oval shapes to round. On close inspection you will notice a hinged lower jaw the projects back along the underside of the thorax.

Sowbug – The Sowbug is an isopod and a crustacean. It is closely related to the terrestrial roly-poly bug or pill bug. It had many more than the six legs of the insects. It is often gray in color but that can vary.

Scud – The Scud is an amphipod and also a crustacean. It looks like a shrimp and swims sideways. In clear water the scud will often be translucent.

True Flies – These critters are characterized by having no legs in their juvenile form and being somewhat like a grub worm or maggot. **Atherix (Watersnipe)** come to a point at one end and have "feathery" projections on the posterior end (hairy antlers). **Craneflies** have a distinct maggot like appearance and can be almost as long as your index finger. There is on family that can pump one end of itself into a golfball shape. **Horseflies** are found less often and come to a point on both ends. There are other rare types that can be mistaken for large midges or small worms.

Midges – These are usually the very smallest of the critters an almost always will be found under the net when they are present. They do not vary in width from one end to the other. One type of midge can be coral red.

Blackflies – These are also mostly found under the net when present. Usually very small, they have a distinctive "bowling pin" or "club" shape. When they are placed in the ice cube tray they usually attach themselves to the wall of their space. They have suckers on both ends and can march along in the fashion of an inchworm. If populations increase significantly you should suspect a new source of nutrients to the stream.

Aquatic Worm – Looks very similar to a earthworm except lighter pink and smaller.

Planaria or Flatworms – These are different terms for the same organism. Gray to brown, unsegmented, soft, flat, eye spots on top of head. Undulating motion.

Leeches – Flattened body similar to Flatworms but segmented. No eye spots but suckers at both ends of underside.