

**Quality Assurance/ Quality Control Protocol**  
**Virginia Save Our Streams Program**  
**Eastern Biomonitoring Method for Muddy Bottom**  
**Streams**  
**August 2007**

*The Virginia Save Our Streams Program (VA SOS)*

*A program of the Virginia Chapter of the Izaak Walton League of America*

*Stacey Brown, Coordinator*

Approvals:

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Stacey Brown, VA SOS Coordinator

Date

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### **Element 3. Distribution List**

The following groups and people will receive copies of the VA Save Our Streams (VA SOS) quality assurance plan for sampling muddy bottomed streams with the VA SOS Eastern Biomonitoring Method for Muddy Bottom Streams:

VA Save Our Stream Staff:

- Stacey Brown, Coordinator
- Advisory Committee Members – Jay Gilliam, Paul Bugas, Kent Ford, John Murphy, Joanna Cornell, Wes Jargowski
- Other appropriate personnel to be determined

VA Department of Environmental Quality Personnel:

- Regional Biologists
- Data Liasion
- Biological Monitoring Coordinator
- Other appropriate personnel to be determined

VA Department of Conservation and Recreation

- Appropriate personnel to be determined

US Environmental Protection Agency

- Otto Guttenson, Senior Ecologist
- Other appropriate personnel to be determined

Groups using VA SOS methods

VA SOS Regional Trainers

The quality assurance plan will also be provided to anyone requesting it, and will be made available on the VA SOS website ([www.vasos.org](http://www.vasos.org)).

### **Element 4. Project/ Task Organization**

***Virginia Save Our Streams Program Coordinator or Designee***

- Provides training and follow-up testing to volunteers
- Trains additional regional trainers and quality assurance auditors
- Acts as quality assurance auditor when necessary
- Develops and maintains partnerships with groups and agencies across the state
- Assists in site selection
- Assist volunteers who have failed quality assurance procedures to correct problems

- Database manager – Reviews all incoming data, assesses for inclusion in database, makes all updates to database, makes the data available through reports and on the VA SOS website ([www.vasos.org](http://www.vasos.org))
- Maintains databases of trained, certified, regional trainers, and quality assurance auditors
- Ensures field sheets and training materials are up to date
- Identifies, analyzes, and stores incoming quality assurance samples
- Identifies incoming unknown specimens for volunteers
- Develops and maintains reference and testing collections

### ***VA SOS Regional Trainers***

- Locally trains and certifies volunteers
- Maintains equipment needed to train volunteers

### ***VA SOS Regional Coordinators***

- Does initial review and updates of local data and sends it to VA SOS Coordinator or designee in a timely fashion
- Makes sure volunteers in his or her area are progressing to certification and doing their sampling in a timely manner
- May maintain database of local monitoring data and volunteer monitors
- May purchase and maintain approved sampling equipment for volunteer monitors
- May assist in site selection.
- May develop and maintain reference and testing collections

### ***VA SOS Quality Assurance Auditors***

- Periodically goes into the field with volunteers to review their equipment and procedures
- Sends results of these observations to VA SOS Coordinator or designee in a timely fashion
- Helps volunteers preserve their samples for submittal to VA SOS Coordinator or designee for identification checks

### ***VA SOS Volunteers***

- Attends the proper training and passes the certification test
- Purchases and maintains approved sampling equipment
- Monitors adopted site(s) four times a year or assist in the monitoring of other VA SOS monitoring locations.
- Follows proper procedure for maintaining certification status

### ***VA SOS Data Users***

There are a wide variety of data users for this statewide program. These users include the Virginia Department of Environmental Quality (DEQ), the Virginia Department of Conservation and Recreation (DCR), local Soil and Water Conservation Districts, localities, planning

commissions, and universities. The VA SOS data is available to any interested party on the website ([www.vasos.org](http://www.vasos.org)) or by request.

Virginia Save Our Streams recommends that all potential data users contact the VA SOS Coordinator to discuss the use of the volunteer collected data and the appropriate uses of this data.

## **Element 5. Problem Definition/ Background**

With the passage of the Clean Water Act in the early seventies, there has been a focus on cleaning up our nation's waterways. Great strides have been made in reducing point source pollution, or that pollution that enters the stream through a specific known source, such as a discharge pipe. Discharging parties must obtain permits and are regulated to prevent too much pollution from entering our waterways.

While our waterways have greatly improved since these efforts were implemented, there are still steps to be taken. In the last ten years, there has been a shift in thinking to include non-point source pollution in addition to the point sources. Non-point source pollution is hard to regulate, as it comes from a broad area rather than one easily located source. Non-point source pollution includes nutrient additions and erosion from livestock in streams, runoff of fertilizer from agricultural fields and suburban lawns, and stormwater runoff carrying not just large pieces of litter but also all the oils and chemicals on our roadways and parking lots. It takes a broader monitoring plan to detect these types of pollution and to determine their origin.

This means that already overburdened state agencies must increase the monitoring they must do throughout the state. There are thousands of miles of streams in Virginia that must be monitored, and agencies have very limited resources with which to monitor all these streams. With current workloads and limited resources, it is not feasible that the majority of these streams are monitored on a regular basis. This is where the Virginia Save Our Streams Program helps.

The Virginia Save Our Streams Program has monitors across the state collecting large quantities of benthic macroinvertebrate data. The data collected under this quality assurance plan will be used in DEQ and DCR water quality assessment reports including the 305(b) report. It will be used to identify waters where agency scientists will conduct follow-up monitoring to identify if the water should be classified as impaired on the 303(d) report. VA SOS data not be used to list streams on the 303(d) report. It will be used to identify pollution incidents when immediate agency response is required to mitigate the pollution event. VA SOS data may also be used in the development and implementation of total maximum daily load plans.

In addition, the data collected by VA SOS volunteers can be used locally by Soil and Water Conservation Districts when looking at the effectiveness of implemented best management practices (BMPs). It can also help determine where future BMPs should be implemented. Localities can also use the volunteer data in evaluating current land use practices, to create an integrated water quality management approach to land use development, and to identify pristine conditions so that future developments do not degrade local streams.

## **Element 6. Project/ Task Description**

Throughout the year, monitors attend VA SOS training and certification sessions. This program continues year after year. These sessions are held on an as needed basis.

The VA SOS volunteers monitor the benthic macroinvertebrate populations and the habitat of their adopted stream four times a year, once each season, using a method developed for the VA SOS program by Randolph Macon College scientists (Gowan, 2004). This method is outlined in the Sampling Methods Requirements section of this document. The samples are analyzed in the field using a multimetric index developed as part of the Randolph Macon study. Additional information about the analysis can be found in the Analytical Methods Requirements section of this document. The field analysis gives a water quality score to let the volunteer know if the ecological conditions of the stream are acceptable or unacceptable.

VA SOS volunteers are also asked to record general site conditions and fill out a streamside visual assessment sheet.

Data is submitted and reviewed by regional coordinators and the VA SOS Coordinator or designee. Data is compiled in a database that is kept current. Reports are made to interested parties whenever requested, and data is updated on the VA SOS website biannually.

## **Element 7. Data Quality Objectives for Measurement Data**

### ***Precision and Accuracy***

The VA SOS modified method was developed and tested by scientists at Randolph Macon College (Gowan 2004), to accurately represent the stream condition and compare favorably with the results VA Department of Environmental Quality professional biologists would find when sampling the same sites. The new method compared very favorably with agency findings, and was found to be a good method for volunteers to use to determine the condition of their streams (Gowan 2004).

The precision and accuracy of VA SOS volunteers will be measured in the lab. Every two years, volunteers will be asked to preserve their entire sample and submit it to the VA SOS Coordinator for lab identification (see chapter 14 – Lab and Field Audits). The volunteers must correctly identify the number and type of each organism 90% of the time.

The precision of the VA SOS method will be evaluated every four years. The method will be conducted at the same time as a professional Department of Environmental Quality biologist or quality University staff to determine if the results correlate 90% of the time.

### ***Representativeness***

For the VA SOS program, representativeness depends largely upon site selection. Volunteers are requested to select sites that are representative of the stream and the conditions that are influencing the stream (see Appendix M). However, volunteers are asked not to monitor below permitted discharges. In selecting a monitoring site, volunteers survey the stream section to determine the most appropriate and representative stream segment. Also, more than one sample



(jab) in the stream segment is collected. The jabs are combined into a single sample. The sample for the stream is then sub sampled and the results are composite into the final score.

### ***Comparability***

VA SOS ensures comparability requiring all volunteers to use the protocol designed by scientists at Randolph Macon. This protocol includes taxonomic keys to identify macroinvertebrates correctly. VA SOS also maintains several sets of reference collections for use by volunteers in the field.

The comparability of the VA SOS method to professional methods will be evaluated every four years. The VA SOS method will be conducted at the same time as a professional Department of Environmental Quality biologist or qualify University staff to determine if the results correlate 90% of the time.

### ***Completeness***

VA SOS does not apply rigorous completion standards to the volunteers collecting data. VA SOS expects each monitoring site to be monitored 4 times during the course of a year. The completion of all 4 monitoring events during the year is hampered by several factors: the need for the site (as identified by the monitor or regional coordinator) may have changed during the course of the year or the volunteer may have dropped from the program, drought conditions may prohibit monitoring, a volunteer may be sick, or conditions at the site may have changed. We do instruct volunteer monitors that monitoring over an extended period of time and during the same approximate times per year provides the most useful data.

## **Element 8. Training Requirements/ Certification**

### ***VA SOS Volunteer***

Persons interested in becoming a VA SOS volunteer must attend at least one training session given by VA SOS staff or a regional trainer. This training session includes information about the program and basic watershed education, safety information, instruction in methods of collection and analysis, instruction in macroinvertebrate identification, and hands on experience with the methods (Appendix B). The volunteer then has up to 18 months to practice the method and identification before becoming certified. This practice can be done alone, with other volunteers, or at other official training sessions. If it has been over 18 months since the volunteer last attended an official training session, they must attend another session before becoming certified. The volunteer cannot be certified during their initial training session. If a volunteer conducts aquatic insect studies as his or her profession, they may be able to skip the training session and just take the certification test.

The certification process includes an in-stream observation and a macroinvertebrate identification test. VA SOS staff or a regional trainer may administer the certification procedure. The in-stream observation consists of the volunteer completing an entire sampling session (collecting and processing an entire sample and completing the habitat assessment), while the person doing the certification fills out an observation report (Appendix C). This portion of the test is open book and can be completed as a team with other volunteers attempting certification.

The identification portion of the process is a written test (Appendix C). There are 19 lettered, unidentified vials containing preserved or representatives or live specimens of groups used in the VA SOS method. The volunteer must identify at least 17 vials or specimens correctly in order to pass. While this portion of the certification process is open book, it must be completed individually or by a team by each individual or team wishing to become certified. Teams that pass certification must always sample their sites with all team members present to make the sample valid.

Within two months of successfully completing both parts of the certification process, the volunteer receives a certificate indicating (s)he is a VA SOS monitor. If the volunteer continues to pass further quality assurance measures (see Quality Control Requirements), (s)he will remain a certified volunteer. If the volunteer misses sampling for 18 months, or 6 subsequent sampling events, (s)he will lose his or her certification status and must go through the certification process again.

### ***Quality Assurance Auditor***

Volunteers wishing to become quality assurance auditors must have been a certified volunteer for at least 6 months and have completed at least two monitoring events. During these two monitoring events, the volunteer must have demonstrated their ability to follow the method by completely and accurately filling out the data forms for all monitoring events.

If the interested volunteer meets these requirements, (s)he attends a training session that teaches him or her how to conduct an audit of a volunteer. During this session, equipment needs and condition is covered, as are proper methods. How to complete the audit checklist used during the audit is covered (Appendix D).

The auditor must complete at least two audits every two years to remain an auditor, and must send the audit forms to the regional biologist with three weeks of completion. Incoming audits are reviewed by the Coordinator or designee. Should the audit form not be filled out properly, the Coordinator or designee works with the auditor to improve his or her auditing performance. Should the auditor continually fail to properly complete the forms, (s)he is required to attend another auditor training session or will lose his or her auditing status.

### ***Regional Coordinator***

As this is a local organization position, no additional training is required to be a regional coordinator. However, the VA SOS staff will remain in close contact with the regional coordinators and will act as a resource to these volunteers. In addition, the Coordinator or designee will remain in close contact with these volunteers to help them learn to assess the incoming data for completeness and how to respond to incomplete data forms.

### ***Regional Trainers***

Volunteers wishing to become trainers must have been a certified volunteer for at least 6 months and have completed at least two monitoring events. During these two monitoring events, the

volunteer must have demonstrated his or her ability to follow the method by completely and accurately filling out the data forms for all monitoring events. The potential trainer must also have observed at least two training sessions implemented by VA SOS staff or regional trainers. The initial training session a volunteer attended to become a monitor may count as one of these sessions. In addition, the volunteer must feel comfortable talking in front of a group, and must remember that (s)he is representing the VA SOS program while training volunteers so must accurately and correctly represent the goals and opinions of the VA SOS program.

Should the volunteer meet these requirements, (s)he must go through an additional training session administered by the VA SOS staff before training other volunteers. This training includes a discussion of what is involved in a training session. A checklist of these items will be given to each regional trainer during this training session (Appendix B). In addition, the training session will cover how to be an effective trainer, frequently asked questions, reference collections, and the certification process. The potential regional trainer must complete the macroinvertebrate identification portion of the certification process again, but must receive a 100% in order to become a trainer. (The same form will be used for both the certification process and the regional trainer process – Appendix C).

Once the regional trainer successfully completes the training requirements, (s)he will enter an observational period. VA SOS staff must observe the regional trainer's first training session, either in person or via videotape, for review and comment on the trainer's performance. A training observation report will be completed at that time and a copy will be returned to the trainer within three weeks of the training (Appendix E). The regional trainer must complete at least one training session and certify at least one volunteer per year in order to remain a trainer. In addition, the trainer must undergo an observation by VA SOS staff in person or by video once every two years.

## **Element 9. Documentation and Records**

### ***Volunteer Field Sheets***

All volunteers complete a field sheet packet at each sampling event (Appendix A). The packet includes a front informational sheet, which includes date, location, sampling team, and some basic physical stream information. The second sheet contains raw macroinvertebrate counts, the third sheet has individual metric calculations, and the fourth sheet is a multimetric index calculation. The fifth sheet is a habitat assessment form.

The volunteer saves a copy of these forms and sends another copy, either hard copy or electronically, to the regional coordinator or the VA SOS Coordinator or designee. Those sheets sent to the regional coordinator are copied and sent hardcopy or electronically to the Coordinator or designee. The Coordinator or designee compiles the data in a database, where they are permanently saved. Back-up copies of the database are housed elsewhere outside of the main VA SOS office.

### ***Training and Certification Forms***

A sign-in sheet should be completed at each training session, whether it be for volunteers, quality assurance officer training, or regional trainer training (Appendix F). Regional trainers or coordinators should send a copy of these sheets to the VA SOS office as soon as possible, retaining a copy for themselves. To eliminate duplicative efforts, other arrangements for informing the VA SOS office of the status of certified monitors may be made. The Coordinator or designee will maintain a permanent Microsoft Access database of all volunteers. Back-up copies of this database are housed elsewhere outside of the main VA SOS office.

All certification tests will be handled in the same manner as the sign-in sheets.

### ***Quality Assurance Forms***

A copy of forms filled out by the quality assurance auditor should be sent to the Coordinator or designee within three weeks of the audit (Appendix D). The pass/ fail status of each volunteer will be recorded in the database of volunteers. A copy of the audit will be sent to the volunteer(s) in question, and a copy will be kept on file for a minimum of five years at the VA SOS offices.

All samples preserved for quality assurance purposes (See Quality Control Requirements) must be properly labeled with a sample submittal form (Appendix D). This form will be kept with the sample at all times. After these samples have been identified, the laboratory record sheet (Appendix G) will be housed in the VA SOS records for a minimum of five years, then recycled. The pass/fail status will be recorded in the database of volunteers, and a copy of this status will be sent to the volunteer(s) in question. Preserved samples will be archived for a minimum of five years, then the organisms will be used in reference collection development or donated to a school, college, or university.

The results of the quality assurance audit and identification check will be sent to the volunteer(s) in question within three months of the audited monitoring event.

### ***Unknown Specimen Submittal***

All unknown specimens needing identification by the Coordinator or designee must be properly labeled with an unknown specimen form (Appendix H). After identification, the form will be completed by the Coordinator or designee. A copy of the form will be filed in the VA SOS offices for a minimum of five years, and a copy of the form and the unknown specimen will be returned to the volunteer.

## **Element 10. Sampling Process Design**

Volunteers collect macroinvertebrate samples and complete the VA SOS Field Sheets every three months, or once each season. While sampling can occur any time during a season, it is recommended that sampling occurs in January, April, July, and October, on a regular basis. Descriptive location information and latitude and longitude identify each monitoring site.

Most volunteers have a specific stream they wish to monitor. Often, this stream is located in close proximity to their home, or they spend time on the stream for recreational purposes. To promote continued interest and involvement in the VA SOS program, it is important for the volunteers to be allowed to monitor these locations. Some monitors do not have a specific spot in which they are interested, but rather wish to monitor somewhere in their watershed of interest. In such a case, the VA SOS staff, together with representatives from DEQ and DCR and the help of GIS maps, assess where current volunteer and agency monitoring is occurring, and helps the volunteer choose the site where they can be most effective. Site selection will also take in consideration potential uses of the data (background information, assess effectiveness of BMPS, monitor land use changes, etc). All sites must be located on public property, or the volunteer must obtain permission if they choose to monitor private property. Sites are added to the program as often as new volunteers are trained. Sites may also be changed if the need for the monitoring site has changed. For example, if a volunteer chooses a site below a construction site to evaluate potential impacts, once the construction is complete, the volunteer may choose to abandon the site.

Volunteers are not to conduct their normal sampling within one week of heavy rainfall. Rather, they should sample the stream during its average conditions for that season. Should there be heavy rain, the sampling must be postponed to allow the stream to return to normal conditions.

If the volunteer is not going to be able to complete their sampling for a season, they should alert their regional coordinator or the VA SOS staff, and assist them in locating a substitute volunteer for that season.

The VA SOS program has some specific safety recommendations to keep all volunteers safe and healthy:

- Always monitor in at least pairs.
- All kits should contain some sort of waterless hand sanitizer and/or peroxide. These should be used frequently, especially before touching face or eyes and before eating.
- Be careful of glass. If a site has known glass, use a garden rake to dig up substrates and consider purchasing neoprene gloves to help protect hands. Should a volunteer get cut, (s)he should clean the cut immediately.
- Be sure to have plenty of water and sunscreen in the summer, and wear plenty of clothing in the winter. In the winter, consider purchasing neoprene gloves to help keep hands warm, and bring plenty of towels to stay dry.
- Be cautious about ticks and Lymes disease. Precautions should be taken as necessary for area conditions.
- Monitoring sites should be conducted in wadable sections of streams. The depth of the stream should be no deeper than 3 feet (the height of the net).
- If high waters are present at the site, this should be noted on the front page of the field sheet and the site should not be monitored at this time.
- Never allow children to go to the stream alone. When monitoring with children, stress that they should not come back to the stream without an adult present.

## **Element 11. Sampling Methods Requirements**

Required equipment includes a d-frame net with a mesh size between 500 to 650 microns, wash bucket or other seining device with a mesh size between 500 to 650 microns, a sheet (or table) for under the net, forceps, a plastic container in which to sort bugs, collection jars and alcohol for collecting unknown specimens, a magnifying glass, pencils, stream shoes, field sheets and a simple calculator. Volunteers are responsible for purchasing and maintaining their own equipment. The VA SOS program provides volunteers with a list of needed equipment and approved vendors (Appendix I).

### ***Choosing where to sample within the stream***

Volunteers identify habitat areas within the stream. The habitat areas are: woody snags, banks, submerged aquatic vegetation, and riffle areas (cobble-stone sized rocks). These habitat areas will be sampled in proportion to their abundance in the stream segment sampled.

### ***How to Sample***

A single sample of macroinvertebrates consists of collecting 20 jabs in productive habitats. A single sample is what is recorded on the data sheets.

A single jab consists of aggressively thrusting the net into the target habitat for a distance of approximately 1 meter; i.e. the distance the net can be swept while standing in one place. This initial “jab” is followed by 2-3 sweeps of the same area to collect the dislodged organisms. The following techniques are recommended for sampling the three major productive habitats in coastal plain streams.

1. Woody snags – snags or submerged woody debris, are sampled by jabbing in medium sized snag material (sticks and branches). Large material (e.g., logs) may be sampled by scraping the net along the surface. Woody debris may be picked up, held in the net, and rubbed by hand.
2. Banks – Stream banks with roots and snag material are sampled similar to snags. Vegetated banks are preferred over unvegetated banks. If the bank is undercut, be sure to jab back under the bank, drawing the net from the stream bottom to the top of the undercut bank.
3. Submerged aquatic vegetation – submerged macrophytes are sampled in deep water by drawing the net through the vegetation from the bottom to the surface of the water. Macrophytes in shallow water are sampled by bumping the net along the bottom in the macrophyte bed.
4. Riffle areas should be sampled by placing the net firmly along the bottom of the stream and using your hand or foot to “rub” around the cobbles in the riffle.

The sample is transferred to the sieve bucket (or other seining device) by banging the net over the bucket opening or by inverting the net into a partially submerged bucket. Contents of the net are transferred into the sieve bucket after each jab

## ***Processing the Sample***

Thoroughly mix the sample in the sieve bucket by swishing it around in shallow water. Be sure to keep the entire sample in the bucket!

Empty the contents of your sieve bucket onto a flat, light colored surface, such as a white sheet, or table. This makes the organisms easier to see. Spread the sample across a square portion of your surface (as large an area as needed so that the material is not clumped into piles). Using a stick as a guide, divide your sample into 4 grids to make 4 squares of the same size. Randomly select one of these squares to start your picking and identification.

Using tweezers or your fingers, gently pick all the macroinvertebrates from selected grid and place them in your collecting container. Carefully look on both sides of any debris in the grid, as many insects will cling to any available litter. You may want to use a squirt bottle filled with water from the stream to wash away some of the mud that might hide organisms. 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 grid.

As you are picking the grid, 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. Our tally sheet and metric calculations should be based on a sample size of at least 100 organisms.

**COUNT THE SCUDS FOUND IN YOUR SAMPLE BUT DO NOT COUNT THEM TOWARDS THE 100 ORGANISMS REQUIRED! In other words you need at least 100 non-scud organisms for your sample.** If you did not pick 100 organisms from the grid. You must select another grid to pick. The second grid must be picked in its entirety.

Record the number of individuals in each taxonomic group on the tally sheet for the second grid. Again, we are looking for 100 organisms. If you do not have 100 organisms after you have picked the second grid, continue onto the 3<sup>rd</sup> and pick that grid in its entirety. Continue picking grids in their entirety until you have at least 100 organisms **OR** you have picked the entire sample.

Volunteers use the tally sheet (Appendix A), the macroinvertebrate identification card (Appendix J), and the macroinvertebrate key in the Save Our Stream's Monitor's Guide to Aquatic Macroinvertebrates (Kellogg 1994), or any other resource to aid in the identification process. Volunteers record the number of individuals they find in each taxonomic group on the tally sheet. When identification and recording are completed, samples are returned to the stream unless the quality assurance audit is occurring (See Quality Control Requirements). All equipment should be thoroughly rinsed at this time so as not to contaminate future samples.

## ***Habitat Analysis***

Volunteers complete a qualitative streamside visual analysis that assesses the general conditions in the stream (Appendix A) every time they conduct a biomonitoring session. Some parameters require volunteers to pick the most representative description for their sites, while other

parameters require volunteers to determine percentages present at their site. Guidelines for completing the habitat analysis are available to the volunteers on the VA SOS website ([www.vasos.org](http://www.vasos.org)) or in the Save Our Stream's Monitor's Guide to Aquatic Macroinvertebrates (Kellogg 1994). These data are used to gain perspective on the macroinvertebrate data collected from the same site.

Virginia Save Our Streams also recommends volunteers complete a quantitative annual habitat assessment of their stream. Volunteers interested in conducting an annual habitat assessment of their stream should attend a training session conducted by VA SOS staff or regional VA SOS trainers. Directors for completing the habitat analysis are available to the volunteers on the VA SOS website and are also included in Appendix N. Data collected by the annual habitat assessment can be used to gain perspective on the macroinvertebrate data collected at the same site and also can be used to evaluate potential threats to the stream's aquatic life.

## **Element 12. Sample Handling and Custody Requirements**

### ***Quality Assurance Samples***

The majority of VA SOS volunteer samples are processed in the field and the macroinvertebrates are returned to the stream within a few hours of their collection. However, samples for the identification quality assurance procedure are preserved for identification by VA SOS staff. The preserved samples are treated as follows:

In the field, the samples are the responsibility of the volunteers. The volunteers must provide the jar and alcohol, and are responsible for preserving the sample. At that time, the volunteer must properly fill out the sample submittal form and properly label the jar (Appendix D). This form and the label must remain with the sample at all times. A copy of the data sheet for the sampling event must also accompany the sample.

The sample then becomes the responsibility of the quality assurance auditor. They must transport the sample to the regional drop-off location within three weeks of its collection.

The VA SOS Coordinator or designee is responsible for picking up the samples and identifying them within three months of their collection. The preserved samples are stored at the VA SOS offices for a minimum of five years. At that time, the organisms will be used in reference collections or donated to schools, colleges, or universities.

### ***Unknown Specimens***

Individual organisms that volunteers collect but cannot identify should either be preserved and send to the VA SOS office for identification (see instructions below) or alternatively, a picture of the organism may be taken for identification.

If the organism is preserved, please place organism in a vial and fill with rubbing alcohol (available at a local drugstore), label properly (Appendix H), and sent to the VA SOS office for identification or delivered to VA SOS employee at an appropriate time. The label should be



written in permanent ink or pencil and placed inside the sample container. The volunteer is responsible for all costs associated with delivering the sample to the VA SOS office. The VA SOS program will return the identified sample to the volunteer for future reference.

If the organism is photographed, take as many photographs as possible to document the number of legs/appendages (if any), the head and mouth features, the thorax and abdomen (top and bottom if possible), any tail features, and other distinguishing characteristics. In addition, a photo with another object (like a ruler) in the picture for scale purposes is helpful.

### **Element 13. Analytical Methods Requirements**

Volunteers use a multimetric index based on four individual metrics to analyze their macroinvertebrate data. Scientists at Randolph Macon developed this index for the VA SOS volunteers (Gowan 2004). Volunteers complete the index by following the steps in four tables found on pages three and four in the field sheet packet (Appendix A). The results of the multimetric index are calibrated to determine if stream condition is acceptable or not. There is no real analytical procedure for analyzing the results of the streamside visual analysis. Rather, the results from this analysis are used to help the data users understand the scores obtained by the macroinvertebrate samples.

### **Element 14. Quality Control Requirements**

There are four quality control requirements that VA SOS maintains for its monitoring program.

#### ***Training and Certification***

All Virginia SOS volunteers must attend an initial training session and complete a subsequent certification test. See the Training Requirements/ Certification section for details on these quality assurance efforts. Upon the completion of these requirements a volunteer is considered a certified monitor. Certified monitors go through the rigors outlined in this quality assurance plan and provide data for the state water quality agencies. If a certified monitor does not collect and submit data to the VA SOS office during the two year period after their initial certification, they are considered inactive and must go through the training and certification process again. VA SOS monitors are those who routinely monitor their sites (at least twice a year) are considered active certified monitors and must maintain their quality assurance status by participating in the field and lab audits as outlined below.

#### ***Reference Collection***

VA SOS staff and regional trainers and/or coordinators have a complete reference collection of macroinvertebrates for volunteers to use during the course of their sampling. VA SOS staff is responsible for maintaining these reference collections.

#### ***Field and Lab Audits***

All certified monitors must undergo periodic quality assurance audits. The quality assurance audit will occur once during the two years after the initial certification and at least every four years in subsequent years for active monitors (those who conduct sampling at least twice a year). The quality assurance audits involve a field visit by a quality assurance auditor. The auditor

reviews all volunteer materials to check that the proper equipment is used and is functioning properly. In addition, the auditor watches the volunteers collect and process their sample. The auditor uses a checklist (Appendix D) to assure the volunteers are correctly completing their sampling event. The completed auditing forms are sent to VA SOS staff. The forms are reviewed by VA SOS staff. Should the volunteers fail their audit, the VA SOS staff will work with the volunteer to update his or her equipment and/or collection and processing methods. The volunteers must have each sampling event audited until they pass. Once a volunteer fails an audit, his or her certification is revoked until (s)he successfully completes an audit. Should the volunteer fail three audits in a row, (s)he must attend a training session with an official trainer to refresh his or her sampling methods.

At the time the auditor reviews the volunteers' field methods and equipment, the volunteers will also preserve their entire sample. The samples will be sent to the VA SOS Coordinator or designee (See Sample Handling and Custody Requirements), who will re-identify these samples to check the volunteers' identification skills. Should the volunteer fail to correctly identify a significant portion of the sample (over 10%), his or her certified status will go on hiatus. The VA SOS staff will work closely with the volunteer to help him or her learn troublesome organisms. The volunteer must successfully complete the macroinvertebrate identification test (See Training and Certification) in order to re-instate their certified status. The volunteer must preserve his or her next sample after his or her certification status is re-instated for review by the Coordinator or designee. Should the volunteer fail that identification check, (s)he must go through a training session with an official trainer and must once again go through the certification process in order to be a certified volunteer.

### ***Method Evaluation***

Every four years, VA SOS staff will coordinate sampling with the Virginia Department of Environmental Quality professional biologists or qualified University staff to evaluate the continued correlation of the two methods. Efforts to sample different flow regimes, ecological conditions, and regions will be made to ensure the VA SOS water quality assessment corresponds with the professional assessment under a variety of conditions and across different areas of the state. If the method does not correspond to the professional assessment, the VA SOS method will undergo a re-evaluation by scientists in the aquatic entomology field.

## **Element 15. Instrument/ Equipment Testing, Inspection, and Maintenance Requirements**

Each VA SOS volunteer will be responsible for maintaining his or her own equipment. Prior to each monitoring event, the volunteer should check his or her net and washtub for cleanliness and for any small rips or holes. A sewing repair kit should be included in each kit, and small holes and rips should be repaired prior to sampling. Should the hole or rip be of substantial size (irreparable), the volunteer is responsible for obtaining a new net prior to sampling. The sheet for under the net should also be cleaned and repaired as needed prior to sampling.

In addition, each volunteer is responsible for keeping the rest of his or her equipment up to date, clean, and in good condition. The volunteer is responsible for repairing or replacing all necessary equipment. The volunteer is also responsible for having the proper field sheets with

them, either by making copies or downloading the from the VA SOS website ([www.vasos.org](http://www.vasos.org)). The volunteer should have the most current, up to date field sheets available.

The quality assurance officer will review all equipment and supplies during the field audit.

The VA SOS program will assist volunteers in keeping current, functioning supplies by providing volunteers recommendations as to where to purchase equipment (Appendix I). The VA SOS program will keep all necessary documents current on the website, and will supply copy masters of these documents to those volunteers without Internet access.

## **Element 16. Instrument Calibration and Frequency**

No calibration is needed for macroinvertebrate collection/ processing equipment. However, the quality assurance officer will review all equipment during his or her visit with the volunteer.

Accuracy checks should be conducted for field thermometers. Thermometers should be checked before every use. To check your thermometer, fill a large glass with crushed ice. Add clean tap water until the glass is full and stir well. Put the thermometer stem or probe in the ice water mixture so that the entire sensing area is submerged. Do not let the stem of the thermometer or probe touch the sides or bottom of the glass. Wait at least 30 seconds or until indicator stops moving. If the thermometer does not read 32 degrees Fahrenheit or 0 degrees Celsius, follow the instructions for adjusting your thermometer (if a digital thermometer) or replace the thermometer.

## **Element 17. Inspection and Acceptance Requirements for Supplies**

All equipment must meet specifications for VA SOS macroinvertebrate collection. D-frame dip nets must have mesh size of 600 microns. These nets can be purchased from an approved supplier (Appendix I) or the VA SOS program. The sample wash bucket must have a mesh size of 600 microns or smaller. All other supplies may be obtained from a local supply store or through catalogs. All supplies and equipment are subject to review during the quality assurance officer's regular visit.

The VA SOS program encourages its volunteers to be innovative in order to improve the collection and analytical process. However, all innovations must be reviewed by the VA SOS state office either in person, by mail, or through photographs prior to their use in data collection.

## **Element 18. Data Acquisition Requirements**

The VA SOS uses collection and analytical methods for benthic macroinvertebrates developed for the program by Randolph Macon scientists (Gowan 2004). USGS 7.5-minute quadrangles are used together with GIS maps for site selection and land use data. The GIS maps include land use data, location of dams, roads, and permitted discharges, and collection locations for agencies

(VA DEQ, US FWS, etc). A USGS 7.5-minute topographic map or a GPS unit is used to determine the latitude and longitude of the volunteers' sites.

Some VA SOS volunteers also collect chemical parameter data. When this information is reported to the VA SOS database manager, it is included in the master database. However, their chemical data is not covered by the VA SOS quality assurance plan. Those volunteers collecting chemical data should create and submit their own quality assurance plan for that monitoring.

## **Element 19. Data Management**

Field sheets (Appendix A) are filled out completely by the volunteers in the field. The volunteer should review his or her data sheets from each sampling event to make sure they are filled in as completely and accurately as possible. The volunteers should submit their data hardcopy or electronically as soon as possible, keeping a copy of the data themselves.

Where available, field sheets are sent to the regional coordinators, who review the data for accuracy and completeness. Should there be any data gaps, the regional coordinators contact the volunteers to fill in the missing information as much as possible. The regional coordinators must send his or her region's data to the VA SOS staff hardcopy or electronically within three weeks of obtaining all of that season's monitoring reports for his or her area. Again, the regional coordinators keep a copy of all data forms. Where no regional coordinator is available, the VA SOS Coordinator or designee acts as first reviewer of data.

The VA SOS Coordinator or designee reviews all data coming to the state office. Should there still be missing or incorrect information, the Coordinator or designee works with the volunteers, regional coordinator, and maps if necessary to fill in the gaps. VA SOS staff has final say over whether the data is complete enough to be entered in the state Microsoft Access database by VA SOS staff. The VA SOS Coordinator or designee also maintains a database of all volunteers and their certification status, so can appropriately mark data as certified or not. The database will contain all data from all years. Hardcopy forms will be filed and kept by the VA SOS program for a minimum of five years from its collection. After this time, the data forms will be recycled.

The data for the last five years will be delivered in electronic database form to the Department of Environmental Quality every other year, or when needed. The database is reviewed and manipulated as needed by the DEQ Data Liaison, who works closely with the VA SOS Coordinator or designee to correct any problems found in the database. Other organizations requesting the data are responsible for reviewing the database in accordance with their data needs.

The VA SOS staff will also keep data available on the VA SOS website for easy review by all interested parties. The data on the website will have gone through reviews by the VA SOS Coordinator or designee, and will be updated biannually.

## **Element 20. Assessments and Response Actions**

A quality assurance auditor will review the field performance and equipment of all certified volunteers once every two years. For a discussion of this procedure, please see the Quality Control Requirements section. In addition, the volunteer's identification skills will be reviewed by VA SOS staff through preserved samples in conjunction with a monitor's quality assurance audit (see Quality Control Requirements). Corrective actions, if necessary, will be taken and are discussed in detail in the Quality Control Requirements section.

All field sheets will be reviewed for completeness and anomalies by the collecting volunteer, regional coordinator, and VA SOS Coordinator or designee. Should any problems be detected, the involved parties will work together to fix the problem and assure future field sheets will be complete and meet quality assurance standards. Should the problem be irreparable, the VA SOS Coordinator or designee may decide not to include the data in the statewide public database.

## **Element 21. Reports**

The data collected by the VA SOS volunteers will be available to anyone interested on the VA SOS website ([www.vasos.org](http://www.vasos.org)). The website is updated biannually, and contains highlights of the data from each site. Those parties interested in seeing the full data from any site can request such from the VA SOS program. A full report will be made to the requesting group within three weeks of said request.

Reports, in terms of the full database from the last five years, are made to the VA DEQ every other year or when requested. Should other information, such as information about passage of quality assurance audits and identification passage, be required, it will be delivered upon request. Data collected when a volunteer has failed to pass a quality assurance check will be marked as uncertified when submitted to the DEQ.

As the database of volunteer data will be marked appropriately with certification status, the "raw" results of the quality assurance tests will not be available unless requested, and specific names will only be provided to the Department of Environmental Quality and other appropriate agencies, and to the regional coordinators. The names of volunteers having quality assurance troubles will not be made public to any other interested parties. However, statistics such as percentage passed in each watershed or overall will be available by request and on the VA SOS website.

## **Element 22. Data Review, Validation and Verification Requirements**

All data sheets are reviewed by the collecting volunteer, the regional coordinator where appropriate, and the VA SOS Coordinator or designee. In addition, the DEQ Citizen Monitoring Coordinator reviews the database once every other year. The decision to accept or reject data is made by the VA SOS Coordinator or designee.

Data entry is checked for errors as it is entered. Data will be entered into a spreadsheet set up to calculate metrics and final scores. Should the scores in the spreadsheet be different from those

calculated by the volunteers, the data will be reviewed for accurate entry. Habitat assessments are mainly ranges of scores, and these will be reviewed at the time of entry.

## **Element 23. Validation and Verification Methods**

The data will be reviewed for any inaccuracies and gaps and will be updated as described in the Data Management Section. Data will be updated as available. The VA SOS Coordinator or designee makes the final decision as to whether or not the data is complete and accurate enough to include in the database.

All quality assurance data will also be reviewed and recorded by the Coordinator or designee, as described in the Quality Control Requirements section. Any problems will be dealt with as described in that section by the VA SOS staff.

All data reported to users will have undergone all reviews and will have passed all completeness and accuracy tests prior to reporting.

## **Element 24. Reconciliation with Data Quality Objectives**

### ***Precision and Accuracy***

The precision and accuracy of the VA SOS monitoring program is evaluated during the quality assurance audits and at the time the method is evaluated. If a volunteer fails the quality assurance audits, they must go through corrective action as outlined in Element 14, Quality Control Requirements.

During the method evaluation process, if the VA SOS method does not correlate with the professional method 90% of the time, the VA SOS method will not be considered precise or accurate and will undergo scientific evaluation and validation to make any necessary changes to the actual collection method or the metrics that are calculated.

### ***Representativeness***

The representativeness of the sample will be evaluated during data entry and during the field portion of the quality assurance audits. VA SOS will evaluate the site sampled during data entry (or data review) to make sure the site is representative of the conditions in the area. During the data review, VA SOS staff will also make sure that more than 100 organisms were selected and that the correct number of jabs was sampled. The quality assurance auditor will make sure the volunteer chooses the most appropriate habitat areas in the course of the field audit and that the habitat area is sampled appropriately. If either course indicates the site location is not representative or the habitat areas were not sampled in a representative manner, corrective actions as outline in the Element 14, Quality Control Requirements, will be taken.

### ***Comparability***

Adherence to the VA SOS protocol will be evaluated periodically as outlined in the quality assurance audit section. At the same time the ability to correctly identify the macroinvertebrates will be determined through a lab audit. If the volunteer does not successfully complete either

element, corrective actions as identified in Element 14, Quality Control Requirements, will be taken.

The VA SOS Method will also be evaluated every four years to ensure comparability. During the method evaluation process, if the VA SOS method does not correlate with the professional method 90% of the time, the VA SOS method will not be considered comparable and will undergo scientific evaluation and validation to make any necessary changes to the actual collection method or the metrics that are calculated.

### ***Completeness***

VA SOS will continue to encourage its volunteers to conduct sampling at their sites 4 times a year. This will be considered a complete sample set. No corrective action will be taken if a volunteer fails to monitor his or her site 4 times during a year, but the data may not be considered as useful by VA SOS or data users.

### **References Cited**

Engel, S.R. 2000. The effectiveness of using volunteers for biological monitoring of streams. Masters Thesis, Department of Entomology, Virginia Polytechnic Institute and State University.

Gowan, C. 2004. Research on Virginia Save Our Streams Eastern Method development (not yet published).

Kellogg, L. 1994. Monitor's guide to aquatic macroinvertebrates. The Izaak Walton League of America, Gaithersburg, Maryland.

**Appendix A**

Field sheets for macroinvertebrate and habitat assessment



**For Office Use Only**

Name of Reviewer \_\_\_\_\_

Date Reviewed \_\_\_\_\_

Data sent to \_\_\_\_\_

**Eastern Biomonitoring Method  
for Muddy Bottom Streams**

The purpose of this form is to aid you in gathering and recording important data about the health of your stream. By keeping accurate and consistent records of your observations and data from your macroinvertebrate count, you can document changes in ecological condition. *Please note, this method was designed and tested for conditions in the state of Virginia and may not be appropriate in other areas.*

Date \_\_\_\_\_

Stream \_\_\_\_\_ Station \_\_\_\_\_ # of participants \_\_\_\_\_

Collected By: \_\_\_\_\_

County \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_

Location (please be specific) \_\_\_\_\_

Average stream width \_\_\_\_\_ ft Average stream depth \_\_\_\_\_ in

Flow rate: High \_\_\_\_\_ Normal \_\_\_\_\_ Low \_\_\_\_\_ Negligible \_\_\_\_\_

Weather last 72 hours \_\_\_\_\_

Water Temperature \_\_\_\_\_ F (please specify if reporting temperature in Celsius)

Stream Assessment area 100 meters (please specify if modified) \_\_\_\_\_

**Sampling Site Habitat Percentages**

Habitat Area	Percent of Habitat in Stream Assessment Area (as determined by persons conducting collection)	Number of Jabs taken in Habitat Area (multiply percent of habitat in stream assessment area – previous column – by 20 jabs in sample)
Woody Snags		
Submerged Aquatic Vegetation		
Banks		
Riffle Areas (if present)		













Other Notes: \_\_\_\_\_











Please send data sheets to your regional coordinator or to VA SOS, P.O. Box 8297, Richmond, VA 23226. If you have any questions about the modified method or this particular collection, please call 804-615-5036 or e-mail [stacey@vasos.org](mailto:stacey@vasos.org).

**You may also submit your data online at [www.vasos.org/dataentry.htm](http://www.vasos.org/dataentry.htm)**

**\* Your data is most useful when you pass your certification. Please contact VA SOS to schedule your certification!**

### Macroinvertebrate Tally Sheet

Macroinvertebrates	Tally	Count
<b>Worms</b> 		
<b>Flat Worms</b> 		
<b>Leeches</b> 		
<b>Crayfishes</b> 		
<b>Sewbugs</b> 		
<b>Scuds</b> 		
<b>Freshwater Shrimp</b> 		
<b>Stoneflies</b> 		
<b>Mayflies</b> 		
<b>Dragonflies and Damselflies (not Gomphidae)</b> 		
<b>Gomphidae</b> 		
<b>Hellgrammites, Fishflies, and Alderflies</b> 		

Macroinvertebrates	Tally	Count
<b>Common Nematopinnans</b> 		
<b>Most Caddisflies</b> 		
<b>Beetles</b> 		
<b>Midges</b> 		
<b>Black Flies</b> 		
<b>True Bugs</b> 		
<b>Most True Flies</b> 		
<b>Gilled Snails</b> 		
<b>Lunged Snails</b> 		
<b>Clams</b> 		
<b>Other Subsurface macroinvertebrates</b>		
<b>Total number of organisms in the sample (include other category)</b>		

## Metric Calculations

### Individual Metrics

Metric Number	Metric Organism Group	Number of metric organism		Total number of organisms in the sample		Percent (This is your value for this metric)
<b>1</b>	Mayflies + Stoneflies + Most Caddisflies		÷		Multiply by 100	%
<b>2</b>	Gomphidae		÷		Multiply by 100	%

### Metric 3 - % Tolerant

Taxon	Number
Worms	
Flatworms	
Leeches	
Sowbugs	
Scuds	
Dragonflies and Damselflies (not Gomphidae)	
Midges	
Black Flies	
Lunged Snails	
Clams	
<b>Total Tolerant</b>	
Total Tolerant divided by the total number of organisms in the sample	
Multiply by 100	
<b>This is your Value for Metric 3</b>	

### Metric 4 - % Non-Insects

<i>Taxon</i>	Number
Worms	
Flatworms	
Leeches	
Crayfish	
Sowbugs	
Scuds	
Gilled Snails	
Lunged Snails	
Clams	
<b>Total Non-Insects</b>	
Total Non-Insects divided by the total number of organisms in the sample	
Multiply by 100	
<i>This is your Value for this Metric 4</i>	

## Metric Calculations

### Virginia Save Our Streams Eastern Multimetric Index

Write your metric value from the previous page in the 2<sup>nd</sup> column (Your Metric Value). Determine whether each metric should get a score of 6,3, or 0 - depending upon the range of your metric value. Add all of the values in each column for subtotals. Then add the subtotals together into a final score to determine the Virginia Save Our Streams Eastern Multimetric score and determine whether the site has acceptable or unacceptable ecological condition.

Metric Number	Metric Organism	Your Metric Value	6	3	0
<b>1</b>	% Mayflies + Stoneflies + Most Caddisflies		> 7.8	0.85 - 7.8	<0.85
<b>2</b>	% Gomphidae		> 0.5	> 0 - 0.5	0
<b>3</b>	% Tolerant		< 63	63 - 85	> 85
<b>4</b>	% Non-Insects		< 27	27 - 70	> 70
<b>SUBTOTALS</b>					

Now add the 3 subtotals to get the Save Our Streams Multimetric Index score: \_\_\_\_\_

- \_\_\_\_\_ Acceptable Ecological Condition (> 14)
- \_\_\_\_\_ Partially Acceptable Ecological Condition (8 - 14)
- \_\_\_\_\_ Unacceptable Ecological Condition (<8)

Streamside Characterization

<b>Fish water quality indicators</b> scattered individuals scattered schools trout (pollution sensitive) bass (somewhat sensitive) catfish (pollution tolerant) carp (pollution tolerant)	<b>Barriers to fish movement</b> beaver dams man-made dams waterfalls (>1ft.) other none	<b>Surface water appearance</b> clear clear, tea colored colored sheen (oily) foamy milky muddy black gray other _____
<b>Stream bed deposit</b> (bottom) gray orange/red yellow black brown silt sand other _____	<b>Odor:</b> none musky oil sewage other _____	<b>Stability of steam bed:</b> Bed sinks beneath your feet in: no spots a few spots many spots
<b>Algae color:</b> light green dark green brown coated matted on stream bed hairy	<b>Algae located:</b> everywhere in spots _____ % bed covered	<b>Stream Channel Shade:</b> >75% full 50%-74% high 25%-49% moderate 1%-24% slight none
<b>Stream bank composition</b> _____% trees _____% shrubs _____% grass _____% bare soil _____% rocks _____% other _____	<b>Stream bank erosion potential</b> >75% severe 50%-75% high 25%-49% moderate 1% - 24% slight none	<b>Riffle composition</b> (=100%) _____ % silt (mud) _____ % sand (1/64"-1/4" grains) _____ % gravel (1/4"-2" stones) _____ % cobbles (2"-10" stones) _____ % boulders (>10" stones)

**Land uses in the watershed:** Record all land uses observed in the watershed area upstream and surrounding your sampling site. Indicate whether the following land uses have a high (H), moderate (M), or slight (S) potential to impact the quality of your steam. (Leave the space blank if there is no impact or if the land use is not present in your watershed.) Refer to the SOS standard operating procedures to determine how to assess H, M, or S.

___ Oil & gas drilling ___ Housing developments ___ Forest ___ Logging ___ Urban uses (parking lots, highways, etc.)	___ Sanitary landfill ___ Active construction ___ Mining (types) _____ ___ Cropland (types) _____	___ Trash dump ___ Fields ___ Livestock pasture ___ Other _____ _____ _____
--	--	--

Describe the amount of litter in and around the stream. Also describe the type of litter in and around the stream. \_\_\_\_\_

Comments: Indicate what you think are the current and potential threats to your stream's health. Feel free to attach additional pages or photographs to better describe the condition of your stream. \_\_\_\_\_

## **Appendix B**

### Training Session Checklist

## **Training Agenda: Initial VA SOS Training**

- I. Introduce myself and the VA SOS program
  - Describe the VA Division of the Izaak Walton League of America
- II. Describe SOS method
  - Explain what a watershed is
  - Describe point source vs. non-point source pollution
  - Explain difference between chemical and biological monitoring
  - Explain macroinvertebrates
  - Types of pollution
    - Toxic
    - Sediment
    - Nutrients
    - Bacteria – Health hazard not readily identifiable with macroinvertebrate biomonitoring
- III. Safety – Stress especially with children
  - Wash hands – gastro-intestinal problems
  - Cuts and scrapes – use peroxide
  - Sample in pairs
  - Watch for glass
- IV. Discuss critters and their identification individually
- V. Discuss the importance of uniformity of method – QA/QC issues
- VI. Demonstrate metric calculation and multimetric calculation
- VII. Demonstrate and describe method
  - Evaluate stream to determine stream habitat areas and percentages
  - Inspect net
  - Approach from downstream
  - Collect correct number of “jabs” in each habitat area
  - Release vertebrates
  - Thoroughly mix sample in wash bucket
  - Place sample on flat surface – divide into 4 equal quadrants
  - Count – need 100 non-scud organisms
- VIII. Demonstrate the habitat assessment (tips at end of Monitor’s Guide)
- IX. Show reference collection

- X. Demonstrate Books, Resources, Discuss Partners
  - DEQ
  - DCR
  - DGIF
  - Dept. of Forestry
  - SWCDs & NRCS
  - IWLA Chapters
  - Local Colleges
  - Regional Trainers
  - VA SOS staff
  
- XI. Cooperate with state and local decision makers
  
- XII. Why do we need to monitor?
  
- XIII. What happens to the data & how to choose sites (contact DEQ so don't duplicate efforts)
  
- XIV. Establish monitoring councils & join watershed roundtables – encourage diverse participation. Everyone has a skill to contribute even if they don't want to be a “front line monitor”
  
- XV. What volunteers should do next
  - Get certified
  - Monitor & report data to VA SOS
  - Become a Regional Trainer or Quality Assurance Auditor



## **Appendix C**

### Certification Tests

Virginia Save Our Streams Program
Eastern Method Macroinvertebrate Identification
Quality Assurance Procedure

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_ E-mail: \_\_\_\_\_

Using the macroinvertebrate groupings found on your tally sheet and bug identification card, identify the organisms in the lettered test vials. You may use whatever written resources you wish; however you may not discuss the organisms with a friend during this procedure. You must get at least 17 correct to pass.

- A. \_\_\_\_\_ J. \_\_\_\_\_
B. \_\_\_\_\_ K. \_\_\_\_\_
C. \_\_\_\_\_ L. \_\_\_\_\_
D. \_\_\_\_\_ M. \_\_\_\_\_
E. \_\_\_\_\_ N. \_\_\_\_\_
F. \_\_\_\_\_ O. \_\_\_\_\_
G. \_\_\_\_\_ P. \_\_\_\_\_
H. \_\_\_\_\_ Q. \_\_\_\_\_
I. \_\_\_\_\_ R. \_\_\_\_\_
S. \_\_\_\_\_

Please answer the following questions:

- 1. How many habitat areas are you looking for? \_\_\_\_\_
2. What is the minimum number of organisms you need in your sample? \_\_\_\_\_
3. What is the number of jabs you will collect at each site? \_\_\_\_\_
4. It is ok to discard a jab if there is too much sediment or debris in the jab T F
5. Fish and Salamanders should be counted in your sample T F
6. How many times a year should you sample your site? \_\_\_\_\_





## **Appendix D**

Quality Assurance Audit Documents

# Virginia Save Our Streams Program Quality Assurance Audit

Date: \_\_\_\_\_

Name(s) and address(es) of volunteer(s) being audited:

**Equipment** - check for completeness, cleanliness, and condition

Were there any problems (circle one, explain in comments if yes)? Y N

Please circle any missing equipment:

- |                      |                      |
|----------------------|----------------------|
| Net with poles       | Monitor's Guide book |
| White sheet          | Magnification        |
| Sorting containers   | Thermometer          |
| Current field sheets | Calculator           |
| ID card              | Forceps              |

### Methods

Please circle any parts of the method that volunteer(s) had trouble with, then explain in comments:

- |  |   |
|--|---|
| Chose the most appropriate habitat areas | Monitor correctly handled unknown specimens |
| Entered downstream of sampling area      | Monitor took the proper number of nets      |
|  | A habitat assessment was completed          |

All organisms were collected from sheet and net

Comments (continue on back if needed): \_\_\_\_\_

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Quality Assurance Auditor: \_\_\_\_\_



## Virginia Save Our Streams Program Quality Assurance Sample Submittal Identification Check

Date: \_\_\_\_\_

Name(s) and address(es) of volunteer(s) being checked:

Sample Information:

Stream \_\_\_\_\_ Station \_\_\_\_\_ County \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_ Location (please be specific) \_\_\_\_\_  
\_\_\_\_\_

Please fill out completely, preserve your sample - don't forget your label, and give your sample and this form to your quality assurance auditor. Please send in your field sheets as soon as possible for fastest processing of your sample.

**For office use:**

Date received by VA SOS: \_\_\_\_\_

Date processed: \_\_\_\_\_

Date results mailed to volunteers: \_\_\_\_\_

Results cannot be returned until VA SOS has received field sheets.

Volunteer passed identification check? Y N

Problem organisms: \_\_\_\_\_

Please fill out in pencil and include in your sample preservation jar:

Date \_\_\_\_\_

Name(s) of samplers: \_\_\_\_\_

Stream \_\_\_\_\_ Station \_\_\_\_\_ County \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_

Location (please be specific) \_\_\_\_\_  
\_\_\_\_\_



## **Appendix E**

VA SOS observation of regional trainer form

September 2001

## Virginia Save Our Streams Program Regional Trainer Observation Form

Date of Observation: \_\_\_\_\_

Date of Training Session: \_\_\_\_\_

Name and address of regional trainer being observed:

### Methods

Please circle the area the regional trainer did not adequately cover in the training session and explain in the comments section.

Introduction of self and program  
Background on Monitoring/ watersheds/  
pollution  
Why monitor?  
What happens with the data  
Safety  
Identification of Macroinvertebrates  
Quality Assurance  
Collection Methods

Analysis of Methods  
Habitat Assessment  
Conducted in-stream event  
Reference collection  
Resources/Books/Partners  
Cooperation with decision makers  
Establishing councils/roundtables  
What to do next

### Personal Conduct

Please circle the area with which the regional trainer did not meet standards and explain in the comments section.

Personal appearance  
Effectively delivered information

Used appropriate tone and language  
Properly represented the views of SOS

**Comments** (continue on back if needed): \_\_\_\_\_

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Observer: \_\_\_\_\_



VA Save Our Streams Program  
VA Division of the Izaak Walton League of America  
P.O. Box 8297 Richmond, VA 23226



## **Appendix F**

Event Sign In-Sheets

**Virginia Save Our Streams Program Sign-in Sheet**

Event \_\_\_\_\_ Location \_\_\_\_\_

Date \_\_\_\_\_ Event Leader/ Trainer \_\_\_\_\_

Name	Address	Phone	E-mail	Stream of Interest
		( )		
		( )		
		( )		
		( )		
		( )		
		( )		
		( )		
		( )		
		( )		

## **Appendix G**

Laboratory Sheets for Identification of Quality Assurance Samples

September 2001

# Virginia Save Our Streams Program Laboratory Identification Sheets

Date of Sample: \_\_\_\_\_ Collector: \_\_\_\_\_

Stream \_\_\_\_\_ Station \_\_\_\_\_ County \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_

Location (please be specific) \_\_\_\_\_  
\_\_\_\_\_

Date of Identification: \_\_\_\_\_ Who IDed: \_\_\_\_\_

Organism	Number in Sample	Number volunteer found	# MisIDed
Worms			
Flatworms			
Leeches			
Crayfishes			
Sowbugs			
Scuds			
Stoneflies			
Mayflies			
Dragonflies & Damselflies			
Hellgrammites, Fishflies, & Alderflies			
Common Netspinners			
Most Caddisflies			
Beetles			
Midges			
Black Flies			
Most True Flies			
Gilled Snails			
Lunged Snails			
Clams			
Other			

% Incorrect: \_\_\_\_\_

Identification Check Passed? Y N



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 P.O. Box 8297 Richmond, VA 23226

## **Appendix H**

Unknown Specimen Submittal Form and Label

## Virginia Save Our Streams Program Unknown Sample Submittal

Date: \_\_\_\_\_

Name and Address of submitting volunteers:

Sample Information:

Stream \_\_\_\_\_ Station \_\_\_\_\_ County \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_

Location (please be specific) \_\_\_\_\_  
\_\_\_\_\_

Do you have any thoughts about what this organism might be? \_\_\_\_\_  
\_\_\_\_\_

Please fill out completely, preserve your specimen - don't forget your label, and send your unknown and this form to the VA SOS program (address at bottom).

**For office use:**

Identification of organism: \_\_\_\_\_

Who identified it: \_\_\_\_\_

Please fill out in pencil and include in your unknown preservation jar:

Date \_\_\_\_\_  
Name of submitter: \_\_\_\_\_

Stream \_\_\_\_\_ Station \_\_\_\_\_ County \_\_\_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_  
Location (please be specific) \_\_\_\_\_  
\_\_\_\_\_



## **Appendix I**

Equipment & Approved Suppliers List

## Supply List for VA Save Our Streams Modified Method

### Essential equipment

Basins, ice trays, pencils, sharpener, peroxide, clipboards, rubber bands, scotch tape, sewing kit, white sheet, and a lidded container for the kit (local dollar stores) cost - max \$25

Net-----BioQuip-----about \$70.00

Bucket -----Forestry Suppliers----- about \$90.00

Magnifier boxes -----VA SOS ----- check website for current prices

Waders & Boots ----- Orvis Outlet (Roanoke) ----- 20.00-30.00  
Orvis Outlet: 31-B Campbell Ave., Roanoke VA 24010  
(540) 344-4520

Monitors guide -----VA SOS ----- check website for current prices

Basic handout -----VA SOS ----- free

Thermometer ----- VA SOS ----- check website for current prices

Forceps ----- VA SOS ----- check website for current prices

Basic Calculator ----- Local Office Supply Store----- 1.00-5.00

### Nice, but not necessary

Neoprene gloves -----Gempler's -----13.00-28.00  
Gempler's: P O Box 270, Belleville WI 53508  
(800) 382-8473 <http://www.gemplers.com/>

Trainer's guide -----National IWLA SOS ----- check website for current prices  
National Izaak Walton League: 707 Conservation Lane, Gaithersburg MD 20878-2893  
(800) BUG-IWLA <http://www.iwla.org/iwlastore/index.htm>

70% ethyl alcohol ----- Local Drugstore -----quart 2.00-3.00

Teacher's guide -----National IWLA SOS ----- check website for current prices  
National Izaak Walton League: 707 Conservation Lane, Gaithersburg MD 20878-2893  
(800) BUG-IWLA <http://www.iwla.org/iwlastore/index.htm>

Glycerin-----local pharmacist-----pint 4.50

Wash bottle ----- Nasco ----- 5.00  
Nasco: P O Box 901, Fort Atkinson, WI 53538-0901  
(800) 558-9595 <http://www.nascofa.com/prod/Home>



Tackle box ----- K-Mart -----15.00-25.00

### **Luxurious**

Field Microscope ----- Acorn Naturalist (magiscope)----- 150.00  
Nasco (Walter Explorer Microscope)----- 73.00

Acorn Naturalists: 17300 E. 17<sup>th</sup> St. #J236, Tustin CA 92780

(800) 422-8886 <http://acorn-group.com>

Nasco: P O Box 901, Fort Atkinson, WI 53538-0901

(800) 558-9595 <http://www.nascofa.com/prod/Home>

Field Case for above scopes---Nasco (item #SB26153M)----- 25.00

Nasco: P O Box 901, Fort Atkinson, WI 53538-0901

(800) 558-9595 <http://www.nascofa.com/prod/Home>

Aquatic Entomology by McCafferty ----- Acorn Naturalist ----- 60.00

Acorn Naturalists: 17300 E. 17<sup>th</sup> St. #J236, Tustin CA 92780

(800) 422-8886 <http://acorn-group.com>

Roll-a-table ----- NRS (item#2717)----- 34.50

North West River Supplies (NRS): 2009 S. Main St., Moscow ID 83843

(800) 635-5202 [www.nrsweb.com](http://www.nrsweb.com)

### **Other useful contacts**

Acme Vial: (805) 239-2666

<http://www.acmevialglass.thomasregister.com/olc/acmevialglass/>

Delta Education: (800) 442-5444 <http://www.delta-education.com/>

Forestry Suppliers: (800) 360-5368 <http://www.forestry-suppliers.com/>

Lamotte Company: (410) 778-3100

Water Monitoring Equipment and Supply: [www.watermonitoringequip.com](http://www.watermonitoringequip.com)


The coolest jewelry made from caddisfly cases:

Kathy Stout, Wildscape Inc.: (888) 751-3305 [www.wildscape.com](http://www.wildscape.com)


## **Appendix J**

### Macroinvertebrate Identification Card

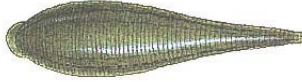
Lines under picture indicate the relative size of organisms



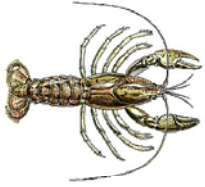
**Aquatic Worm:**  
**Class Oligochaeta**  
 $\frac{1}{4}$ " - 2", can be very tiny;  
thin, wormlike body, tolerant of  
impairment



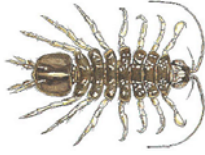
**Flat Worm:**  
**Family Planaridae**  
Up to  $\frac{1}{4}$ ", soft body,  
may have distinct head with  
eyespots, tolerant of impairment




**Leech:**  
**Order Hirudinea**  
 $\frac{1}{4}$ " - 2", segmented body,  
suction cups on both ends,  
tolerant of impairment



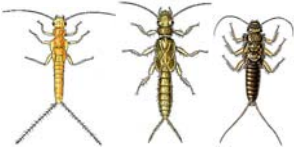
**Crayfish: Order Decapoda**  
Up to 6", 2 large claws, 8 legs, resembles  
a small lobster, somewhat tolerant of  
impairment




**Sowbug: Order Isopoda**  
 $\frac{1}{4}$ " -  $\frac{3}{4}$ ", gray oblong body wider  
than it is high, more than 6  
legs, long antennae, somewhat  
tolerant of impairment



**Scud: Order Amphipoda**  
 $\frac{1}{4}$ ", white to gray, body  
higher than it is wide,  
swims sideways, more than  
6 legs, resembles small  
shrimp, somewhat tolerant  
of impairment



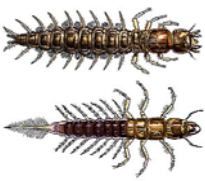
**Stonefly: Order Plecoptera**  
 $\frac{1}{2}$ " - 1  $\frac{1}{2}$ ", 6 legs with hooked  
tips, antennae, 2 hair-like tails,  
no gills on abdomen, very  
intolerant of impairment



**Mayfly:**  
**Order Ephemeroptera**  
 $\frac{1}{4}$ " - 1", plate-like or feathery gills  
on abdomen, 6 hooked legs, 2 or 3  
long hair-like tails, tails may be  
webbed together, very intolerant  
of impairment



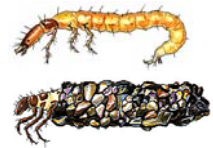
**Beetles: Order Coleoptera**  
 $\frac{1}{4}$ " - 1", disk-like oval body with 6 small  
legs and gill tufts on underside OR  
small black beetle crawling on  
streambed OR comma-like brown  
"crunchy" body with 6 legs on upper  
1/3 and possibly gill tuft on back end,  
OR (miscellaneous body form - rare),  
somewhat tolerant of impairment



**Hellgrammite, Fishfly, and Alderfly:**  
**Order Megaloptera**  
 $\frac{3}{4}$ " - 4", 6 legs, large pinching jaws, 8  
pairs of feelers along abdomen, 2 hooks  
on tail end OR 1 single spiky tail,  
somewhat tolerant of impairment











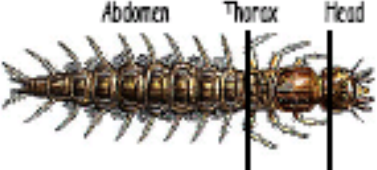

**Common Netspinners:**  
**Family Hydropsychidae**  
Up to  $\frac{3}{4}$ ", 6 hooked legs on  
upper 1/3 of body, 2 hooks at  
back end, underside of  
abdomen with white tufts of  
gills, somewhat tolerant of  
impairment



**Most Caddisfly:**  
**Order Trichoptera**  
Up to 1", 6 hooked legs on  
upper 1/3 of body, may be in  
stick, rock or leaf case, no  
gill tufts on abdomen,  
intolerant of impairment

## Stream Insects and Crustaceans ID Card

Lines under picture indicate the relative size of organisms

 <p><b>Dragonfly and damselfly:</b> <b>Order Odonata</b> ½" - 2", large eyes, 6 hooked legs, large protracting lower jaw, 3 broad ear-shaped tails OR wide oval to round abdomen, somewhat tolerant of impairment</p>	 <p><b>Dragonfly:</b> <b>Family Gomphidae</b> ½" - 2", large eyes, 6 hooked legs, large protracting FLAT lower jaw, wide oval to round abdomen, short stubby antennae that are parallel to each other, intolerant of impairment</p>	 <p><b>Midges:</b> <b>Family Chironomidae</b> Up to ½", distinct head, worm-like segmented body, 2 leg-like projections on each side, often whitish to clear, occasionally bright red, tolerant of impairment</p>
 <p><b>Black Fly:</b> Family <b>Simuliidae</b> Up to ½", end of body wider (like bowling pin), distinctive head, sucker on end, tolerant of impairment</p>	 <p><b>Most True Flies:</b> <b>Order Diptera</b> ½" - 2", bodies plump and maggot-like, may have caterpillar like "legs" along body, may have lobes or conical tails on end, tolerant of impairment</p>	 <p><b>Gilled Snails:</b> <b>Class Gastropoda</b> Up to ½", shell opening covered by a thin plate called an operculum, with helix pointed up shell opens to the right, intolerant of impairment</p>
 <p><b>Lunged Snails:</b> <b>Class Gastropoda</b> Up to ½", no operculum, with helix pointed up shell opens to the left, tolerant of impairment</p>	 <p><b>Clams:</b> <b>Class Bivalvia</b> Up to ½", fleshy body enclosed between two clamped together shells (if clam is alive, shells cannot be pried apart without harming clam), somewhat tolerant of impairment</p>	<p><b>Glossary:</b></p>  <p><b>Tails:</b> There are many different kinds of macroinvertebrate tails. The thin thread-like tails found on stoneflies and mayflies are called cerci. The oar-shaped tails found on a damselfly are not really tails - they are actually gills called caudal lamellae</p>
 <p style="text-align: center;"><b>VA Save Our Streams Program</b> VA Division of the Izaak Walton League of America P.O. Box 8297 Richmond, VA 23226 (804) 615-8036 <a href="http://www.vasos.org">www.vasos.org</a></p>		<p>These sheets are modified from the National Izaak Walton League of America SOS Program Stream Insects &amp; Crustaceans ID Card. <a href="http://www.iwla.org/SOS/index.html">http://www.iwla.org/SOS/index.html</a></p>

Illustrations from: Veahell, J. R., Jr. 2001. Guide to the Common Freshwater Invertebrates of North America. MacDonald and Woodward Publishing Co. With permission of the author.

## Appendix K

### **Stream Health Monitoring By Citizens: New Field and Analytical Methods Suitable for Virginia's Coastal Plain.**

Ryan Knisley,  
Lauren Grimmer  
and  
Charles Gowan  
Environmental Studies Program  
Randolph-Macon College  
Ashland, Virginia

August, 2003

#### Abstract

Citizen volunteers are essential for monitoring health of streams in the Chesapeake Bay watershed, relying primarily on analysis of benthic macroinvertebrates to make assessments. But, methods suitable for citizens working in coastal plain streams are not available, and so we developed a new Save Our Streams Coastal Plains ("SOS") method. In a preliminary test conducted in 2002, SOS scores were strongly correlated to those from a professional method (the Mid-Atlantic Coastal Streams or MACS method), but all sample sorting and organisms identification were conducted by professionals in the laboratory. The goal for the SOS method is for citizens to conduct assessments in the field. In this study, eighteen streams in Virginia's coastal plain were sampled in spring and again in summer using new methods for sorting and identifying macroinvertebrates in the field. To further evaluate the reliability of the SOS method, we calculated MACS scores for each stream and compared them to SOS scores using linear regression. We found that the relationship between SOS and MACS scores was statistically significant ( $P < 0.001$ ) and strong ( $r = 0.84$ ); the relationship was stronger in spring ( $r = 0.87$ ) than in summer ( $r = 0.73$ ). Identifications by citizens in the field and those by professionals in the lab showed good agreement, and SOS field and lab scores were strongly correlated ( $r = 0.93$ ,  $P < 0.001$ ). In addition, citizens successfully sorted macroinvertebrates in the field, except that there was some bias against finding smaller organisms. Despite this, SOS scores based on field sorting were strongly correlated to those based on the entire sample being sorted in the lab under magnification ( $r = 0.91$ ,  $P < 0.001$ ). We compared spring-to-summer scores to evaluate seasonal variation; the correlation was relatively weak ( $r = 0.69$ ), indicating that samples taken in different seasons within the same year may not yield similar results. Finally, we compared SOS scores from spring and summer 2003 to SOS scores from the same streams generated in spring and summer 2002 to assess annual variability. Comparisons between years were variable, with summer-to-summer scores being only weakly correlated ( $r = 0.25$ ), but spring-to-spring ones strongly so ( $r = 0.84$ ). We conclude that citizens are capable of making reliable stream health assessments using SOS methods when identification and sorting occurs in the field, and citizens should adopt the SOS method for the coastal plain of Virginia. Sampling should be repeated seasonally within the same year, and monitoring should extend across years to detect trends in stream health.

## Appendix L

### Reference Materials for Virginia Save Our Streams Volunteer Monitors

Barbour, M.T., J. Gerritsen, and B. Synder. 1999. Rapid bioassessment protocols for use in wadeable streams and rivers: periphyton, benthic macroinvertebrates, and fish, 2<sup>nd</sup> edition. EPA 841-B-99-002 Office of Water, Washington, D.C.

Engel, S.R. 2000. The effectiveness of using volunteers for biological monitoring of streams. Masters Thesis, Department of Entomology, Virginia Polytechnic Institute and State University.

Kellogg, L. 1994. Monitor's guide to aquatic macroinvertebrates. The Izaak Walton League of America, Gaithersburg, Maryland.

United States Environmental Protection Agency. 1997. Volunteer stream monitoring: A methods manual. EPA 841-B-97-003 Office of Water, Washington, D.C.

Voshell, J. Reese. 2002. A guide to common freshwater invertebrates of North America. Illustrated by Amy Bartlett Wright. The McDonald & Woodward Publishing Company. Blacksburg, Virginia.

## Appendix M

### Virginia Save Our Streams Site Selection Guide

#### *Selecting a Monitoring Location*

Selecting representative sites is one of the most important elements in designing a monitoring program. Before selecting monitoring sites, you should determine two things: where and what kind of monitoring is already being done in your watershed and what question would you like your monitoring to answer. The answers to both of these questions will help you map out the most effective monitoring locations.

Site locations will depend on the goal of your monitoring program. If you want to know what the water quality is of a particular stream, you might select a site close to the mouth of the stream. If you want to know the water quality at a particular fishing spot, you might want to select a site within that fishing spot. If you want to know if a development is impacting a stream you might want to have one site upstream of the development and one site downstream of the development. If you want to collect data to assist the state in developing water quality assessment reports, you might want to select a site within a watershed that is not currently monitored.

Virginia Save Our Streams can help you locate your sites by:

- determining which streams are currently monitored in your watershed
- finding out the natural resource questions professionals would like to have answered in your watershed
- providing a map with natural resource characteristics to assist in developing a monitoring plan
- making a site visit to potential monitoring sites to evaluate access and habitat

Your monitoring site should have good access and you should always get landowner permission (unless in a public right of way).

#### *Defining Monitoring Stations*

Monitoring should be done at one station, defined as a single stretch of stream 100 meters 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.

#### *Documenting Monitoring Stations*

Stations should be properly documented by including the stream name, county, and location. The location should be specific and should allow someone to find the property using a road map. For instance the site location could be: East side of route 630 bridge, 2 miles north of route 29. This location is easy to find for anyone using a road map. The following is a poor example of location: at northwest corner of Mr. Earl's property. Unless you know Mr. Earl, you will not be able to find the site! Include latitude and longitude if possible. If you have more than one site on a stream, identify the sites with a station number and always use the same station number for a site! If you cannot remember site number, consider using a descriptive name for the site such as "downstream", "upstream", or "route11".