WV Save Our Streams
Quality Assurance & Quality Control Manual

Prepared by
the
WV Save Our Streams and Nonpoint Source Program Coordinators

Table of Contents

West Virginia Department of Environmental Protection
Watershed Improvement Branch
47 School Street, Suite 301
Philippi, WV 26416
Phone: (304) 314-6095

Web page: https://go.wv.gov/sos
Program Coordinator: Callie Cronin Sams

Section 1
Goals and objectives

The mission of WV Save Our Streams is to promote the preservation and restoration of our state's waters by providing an understanding of their ecological integrity. This mission is accomplished by training volunteers how to monitor their local wadeable streams and rivers.

The West Virginia Save Our Streams (SOS) Program has one major goal - to improve and protect the water quality of the rivers and streams of West Virginia. West Virginia has two primary and equal objectives to accomplish this goal. The first objective is to provide the state of West Virginia with enhanced ability to monitor and protect its surface waters through increased water quality data collection. Currently the state is only able to monitor a small fraction of its surface waters. Monitoring stations have historically been located around point source discharges, leaving vast stretches of rivers unmonitored because they traverse rural or urban areas for which there are little or no permitted discharges. Without adequate information on these rivers, the state is unable to discern current impacts from nonpoint source pollution or to determine areas, which may improve due to installation of Best Management Practices (BMP's).

The second objective is to improve water quality through educational outreach to West Virginia's citizens. Once citizens are actively involved in stream monitoring and restoration activities, they can begin to initiate projects in their own watersheds to improve stream quality. For example, because of mapping land uses in their watershed and conducting regular water quality monitoring using the program biological monitoring technique, participants can spot trouble areas in need of restoration or pristine areas in need of continuing protection. Activities can be implemented to improve water quality, such as using BMP's on farms, installing wooded buffer zones in riparian areas, cleaning up trash and debris through stream cleanups and other projects. Participants are given how-to fact sheets for these activities as well as information on appropriate state documents and regulations.

The program provides a unique mechanism to instruct West Virginia citizens on the need to monitor and restore the state's waterways. It is West Virginia's Department of Environmental Protection (DEP), Division of Water and Waste Management (DWWM) goal to implement through the program, with the help of a coordinator, a combined effort of local, state, and federal government agencies, local organizations, and volunteers to improve water quality and natural habitat by various projects that help protect our water resources.

Project staff

The program coordinator's responsibilities will be to institutionalize a program statewide for West Virginia. The program coordinator will conduct training workshops for volunteers, teachers, conservation groups and other interested persons in stream water quality. Training will occur wherever a need is determined or wherever a project emphasizing cooperation between watershed partners (i.e.: agencies, citizen groups, business, etc.) is a priority.

WV Conservation Agency (WVCA) employees are occasionally trained as regional coordinators for the program. Regional WVCA offices are equipped with program materials and supplies to conduct training sessions, provide guidance and information for monitors performing QA/QC training checks. In addition, WVCA staff will use program monitoring to document the water quality around BMP demonstration projects.

Regional trainers will provide oversight and assistance to monitors. They will also serve as liaison to the program and help coordinate projects between their region and the program. DEP provides funding to the program through the nonpoint source program. DEP staff will also help coordinate projects between the WVCA and the program. The citizens monitoring coordinator will assist West Virginia monitors with questions about macroinvertebrate identification and program procedure and will design the quality assurance/quality control guidelines.

DEP staff will provide technical advice on monitoring techniques and suggest rivers or streams where they need new monitoring stations. The DEP will receive data reports on the program for use in its nonpoint source pollution and general monitoring programs. The DEP may also use the data received in the state's integrated report.

Certified trainers consist of volunteers who show that they are committed to stream monitoring, are well versed in the program techniques, have been monitoring using SOS methods for a minimum of one-year and have been trained at a trainer's workshop by the program coordinator. These volunteers have been thoroughly evaluated by the coordinator on their teaching methods, field techniques and macroinvertebrate identification skills. They will assist local stream monitors by providing support in pollution problem solving, re-training monitors and checking their data.

Maps of selected site locations

United States Geological Survey Topographic Maps of the 30 x 60 minute series of 1:24,000 scale maps will be used to chart each monitor's exact site location. Maps are available to provide locations of each monitoring site. The site location information will be entered into the programs personal computer database software and is used to target specific monitoring locations and location of pollution problems. Upon approval, other available GIS or mapping software can also be used.

Rationale for site location

The program will target the areas of West Virginia where severe nonpoint source pollution problems have been identified. Then, training workshops will be held to encourage participants to adopt streams in those areas. The stream monitoring program serves to demonstrate pollution problems and how to monitor and restore water quality. Dozens of workshops have been held around the state that target watersheds impacted by nonpoint source pollution and are rated as high priority watersheds by the state. At each workshop, participants were educated on nonpoint source pollution with a specific focus given to regional problems.

Although workshop attendees are not assigned exact monitoring locations, they are encouraged to select sampling locations that are crucial to documenting nonpoint source problems. These identified sites had a high potential for impact from nonpoint source pollutants. Monitors will be asked to map their watershed and select their station location(s) based on what land uses exist in the area and what parameters they are interested in

testing for. In addition, participants who are interested in monitoring a stream that has been damaged by development, agricultural runoff or other pollution sources are encouraged to monitor both above and below the site. To begin with, however, participants are encouraged to monitor one location and then add additional locations, as they become more comfortable with the monitoring technique.

Project coordination

The program coordinator oversees workshop-training sessions. Each workshop is designed to educate citizens on pollution problem recognition, state regulations and programs pertaining to pollution abatement, such as the West Virginia Nonpoint Source Pollution Management Plan. Workshop sessions will include a slide show or video to demonstrate stream pollution problems, monitoring techniques and restoration practices, and an on-site, hands-on demonstration of the biological stream monitoring technique.

Once a monitor has been trained in accordance with the West Virginia program guidelines, they will receive their equipment and begin to conduct benthic surveys. After each testing date, the monitor sends the results to the program monitoring coordinator to review for accuracy. The program coordinator will review the field survey sheets for any water quality problems and for corrections, if any are needed. Then, if any corrections are needed the sheets will be returned to the monitor with the necessary comments. After the results have been analyzed, the program monitoring coordinator will then input the data into Access database. Any severe pollution problems are investigated further, and the appropriate regulatory agencies are notified.

Regional coordinators and local program monitors will be called upon to assist new monitors in specific technique difficulties and solving pollution problems. All these individuals have been trained in the biological monitoring method and are active participants in the program.

Section 2
Levels of training

Workshops are designed to help individuals identify pollution problems, take macroinvertebrate samples using the biological monitoring technique and teach monitors how to restore severely degraded streams. The workshop will begin with a discussion that introduces possible stream problem and an explanation of the goals of the training. SOS offers several types and levels of training.

Level 1 (**Beginning**): Introduces the concepts of biological/physical stream monitoring. At this level groups perform a basic biosurvey which includes an evaluation of the macro-invertebrate communities focusing on abundance and diversity. Three biotic indices are calculated. A physical and habitat assessment is also performed, and basic chemistry may be collected but it's not required. Groups participating at this level will receive a certificate, resource materials and basic biological monitoring equipment. These workshops are approximately 6-8 hours in length with both in-class and hands-on demonstrations along a stream or river reach.

Level 2 (**Intermediate**): This level expands upon the stream assessment protocols by introducing macroinvertebrate counts and more detailed identification, five-six biotic indices are calculated, and a more thorough physical and habitat assessment is performed. Basic chemistry such as pH, temperature, DO etc. is also collected. Participants receive resources like the above. The level two workshop last one-two days depending upon the requirements of the group. Prerequisites are a level one workshop or some familiarity and experience with biomonitoring methods. Workshops at this level can be completed in one or more days. The

field portion of the workshop will last 6 to 8 hours, and an informal introduction will take place prior to the field portion of the training.

Level 3 (**Advanced**): Closely follows USEPA Rapid Bioassessment Protocols for stream assessment. At this level groups collect macroinvertebrates and ID to family-level. Six or more biotic indices are calculated. Ten habitat conditions are evaluated, and a thorough physical assessment is performed. Water chemistry such as pH, temperature and conductivity are collected. And additional parameters may be added is there is a need. The resources provided are like the above levels but are often more advanced and somewhat specific based upon the goals of the volunteer group. The level three workshops last two-three days with a variety of demonstrations and exercises both inside and along a stream or river reach. Prerequisites are a level one or level two workshop and experience using SOS or other similar biomonitoring methods. Workshops at this level can be completed in two days.

Trainers Certification: This is a two-day workshop for those interested in becoming official training designees of SOS. The course is offered to those who have been monitoring using SOS methods for at least one year and is comfortable teaching the methods to others. Previous monitoring experience can be substituted under certain circumstances; however, the trainer must be SOS Certified to the level at which they plan to teach. The program coordinator reserves the right to approve participants based upon level of experience and commitment to the SOS Program.

Specialized Training: Additional specialized training workshops can also be scheduled. These types of trainings are designed to fit more specific needs of a group. Examples include assistance with study designs, sedimentation, and channel measurements (i.e., pebble counts and cross sections), watershed surveys and monitoring nutrient impacts through physical characterizations.

Certification as referenced by **Chapter 22 Article 11, Section 13 of the West Virginia Water Pollution Control Act** is available at levels one through three for the WV Save Our Streams stream-monitoring procedures. This certification extends for a period of one-year. Volunteer groups can be re-certified by participating in a quality assurance workshop provided by the coordinator and other designees.

Identification of macroinvertebrates

Extensive training in macroinvertebrate identification is provided to each workshop participant. The training includes techniques on how to identify them and what pollution problems they indicate. During the training, participants are shown a diverse sample of organisms for identification purposes. In addition, workshop site will be in a stream of good quality to exhibit a good variety of the types of organisms typically found in the stream.

As part of the initial and follow up training workshops, the program coordinator will incorporate the bug library into the monitor's training and testing procedures. This is a complete catalogue of preserved macroinvertebrates native to West Virginia. With this comprehensive macro-invertebrate catalogue, the staff can provide any macroinvertebrates that volunteers may encounter and test each monitor on his/her identification skills.

Also, each workshop attendee receives a copy of names of additional resource guides that are useful in identifying macroinvertebrates. In addition, copies of resource guides are available at each regional office, and these resources are easily available to monitors by request. Monitors are encouraged to preserve any unknown specimens in rubbing alcohol, and deliver them to regional offices, or request a jar and send specimens to the program monitoring coordinator. At the advanced level, either a state approved contractor identifies macroinvertebrates to family level, or state colleges and universities with approved facilities.

Program background and scope statement

The program is a comprehensive stream monitoring and restoration program. The program includes analyses of pollution problems in a watershed, water quality monitoring using a biological approach and stream restoration projects such as litter cleanups, tree planting, installation of BMP's and other conservation projects.

The biological monitoring component of this program is taken from the national Save Our Streams Program, which was modified in June 1988 to incorporate a new method, which was devised by Ohio state biologists in 1985. Ohio used the Save Our Streams model to devise their new method of monitoring which uses a kick-seine to trap stream macroinvertebrates, which are then identified to the family or order level. The stream survey incorporates species diversity and pollution tolerance indices for organisms to determine water quality. The monitoring methods are consistent throughout the levels of training, however incorporating a wider variety of metrics at intermediate and advanced levels provide a more thorough analysis.

The above biomonitoring techniques or a modified version thereof will be used in the West Virginia Monitoring Program. The program's purpose is to aid state agencies in gathering more data of streams not previously monitored in West Virginia. Areas where unknown problems exist or where degradation is occurring over time are identified for agency personnel. Many streams suffering the impact of nonpoint source pollution have never previously been monitored.

The program will collect data on streams previously not monitored by the state to increase the amount of data on water quality, especially in areas degraded by nonpoint sources. This data can then be compared either to other databases including Division of Natural Resources evaluations of typical macroinvertebrate population numbers, data collected by the Watershed Assessment Branch of the Division of Water Resources or other data collected at that monitoring site or other sites within the watershed.

Another equally important purpose of the monitoring program is to educate West Virginia citizens on the need to protect rivers from pollution and to demonstrate the unique sensitive ecosystems dependent on wise use of our river and land resources.

Monitoring network design and rational

The program as the approach for a citizen-based monitoring program chose biological monitoring because:

1. The Biological monitoring technique provides a simple, accurate and easy-to-understand method for determining if a stream has been affected by a pollution source.
2. Biological monitoring has been identified by the United States EPA Nonpoint Sources Branch in their 1989 report "Nonpoint Source Agenda for the Future" as the best way to test for the impacts of nonpoint source pollution. In attempting to measure the impact of nonpoint source pollution, the

question of whether a river has been degraded needs to be answered. Biomonitoring can determine if a river has been degraded and accounts for chemical as well as physical pollution, such as excessive siltation.

3. Biological monitoring provides a more practical and reliable approach for volunteer water-quality testing. There is less chance of incorrectly performed testing since the biological approach is far simpler, there is no transport or storage of the collected sample required, and no laboratory is needed for the level of biomonitoring performed in the program. Biomonitoring provides information on the quality of a river segment and does not require repeated, constant, or round-the-clock testing as is required in chemical monitoring. In addition, the simple types of chemical tests that the average citizen can perform may not reveal contamination of a river by serious toxic pollutants. In addition, a lab with sophisticated equipment is needed to test for most toxic chemicals whereas monitoring of a stream's biota can be completed accurately on site with little equipment. Biological monitoring provides information on the quality of a river over an extended period. Biological monitoring can also reveal definite pollution effects, even if the source of this pollution is not clear. Kick-seine net sampling has also been shown to provide good statistical replication (Pollard 1981).
4. Biological monitoring is a method, which allows the average citizen to participate in actual analyses of a stream's health rather than just collection of a water sample. Biological monitoring has been found to provide a fun hands-on and inexpensive approach to water quality monitoring and pollution problem identification.

Section 3
Program overview

Participants are involved in the program through a daylong workshop. Workshops will be scheduled around the state in areas where either the state has requested additional monitoring or where there is a high level of public interest. These workshops are open to the public and will be advertised in West Virginia magazines, newspapers and state and private agency publications.

Workshops are designed to educate citizens on pollution problem recognition and on site regulations and programs pertaining to pollution abatement, such as the West Virginia Pollutant Discharge Elimination System and the West Virginia Nonpoint Source Management Plan. A classroom style presentation is used to show stream pollution problems, monitoring techniques, examples of macroinvertebrates and restoration practices. An on-site, hands-on demonstration in the biological stream monitoring technique is provided after the slide show. Participants then return to the workshop location and register to monitor a specific stream station(s).

Training, parameters, and frequency of collection

Training workshops will consist of a lecture at the stream site by the program coordinator on the concept of a watershed and the relationship between land use and water quality. A lecture is then given on the techniques for selecting the appropriate habitat to conduct the biological benthic survey. An explanation of what constitutes a riffle area is given along with information on rock, the importance of leaf in finding shredder organisms and techniques for positioning the kick-seine for best results. A lecture is given on West Virginia state programs including West Virginia's Nonpoint Plan and the role of the DEP.

Program staff will demonstrate the monitoring technique with assistance from workshop participants. After benthic samples are collected, are removed from the net using a variety of methods and placed in trays of water

so that they can easily be observed. Organisms are then placed in magnifier boxes and given to workshop participants for identification. Workshop participants are instructed in identification techniques that focus on the morphology of the organisms; examples include the number of legs, types and location gills, antenna, segmentation, size, and behavior characteristics including preferred habitat and movement. Materials are provided to aid in identification.

After monitors have been instructed on the skills necessary to properly identify macroinvertebrates, they are asked to identify the specimens in the sample and record them properly on the survey form. Then they are given a chance to look over preserved specimens of all the major stream macroinvertebrate groups found within the state. Monitors are thoroughly instructed in the identification skills necessary to identify all major groups of stream-dwelling organisms.

Program equipment (the basics)

Equipment used in the program is all custom-made and supplied free-of-charge to monitors. Equipment includes:

- One 3 x 3-foot student grade kick-net or a 500-micron Nitex square-meter kick-net for groups that take the advanced training; Advanced volunteer monitoring groups may be eligible to receive a surber-style kick-net.
- Bug box magnifier(s) or other hand-held filed magnifiers.
- One-Fahrenheit or centigrade thermometer.
- Forceps
- Macroinvertebrate identification guides.
- Stream survey data sheets and manuals.
- Supporting literature, fact sheets and other information.
- Additional chemical monitoring equipment is provided in certain circumstances.

For chemical samples the program recommends select kits available from LaMotte; additional kits and meters may also be approved but always check with the Program Coordinator prior to purchasing this equipment.

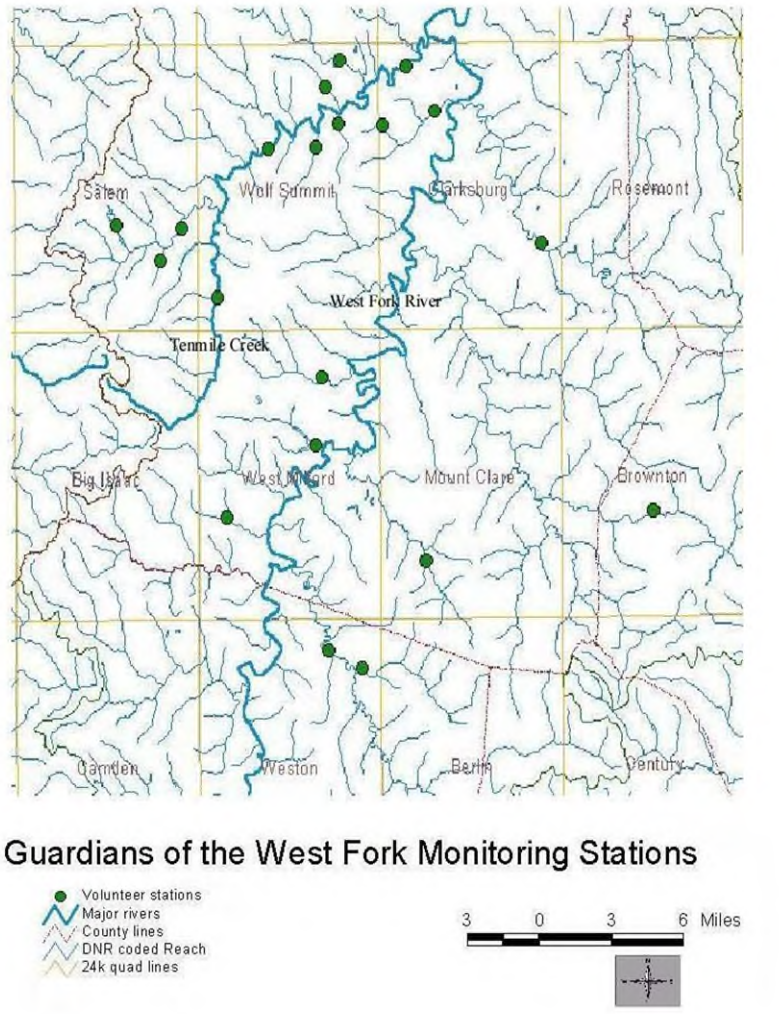
Index of biological integrity

The program has adopted several different indexes of biological integrity (IBI) methods to rate stream health. The IBI approach integrates several types of metrics (multi-metric) to determine an overall **stream score**. The methods are slightly different depending upon the level of assessment.

A final integrity rating for the stream or river of optimal, suboptimal, marginal, or poor is determined based upon stream index score and in some cases the reference sites as chosen by the volunteers with assistance from the program coordinator. Additional training in the use of the appropriate metrics is provided for groups who participate in the intermediate and advanced workshops.

These results are interpreted based on comparison with known yearly fluctuations of macroinvertebrate community structure, monitors have been instructed to conduct further testing both above and below potential impact sources to identify problems and to work with program staff to develop restoration plans.

To determine that monitors have understood both the monitoring technique and the survey form, monitors are split up into teams, given a kick-seine and asked to: choose a riffle to monitor, conduct a stream survey, identify the organisms in the sample and complete a stream survey form. The coordinator or designated staff will note any problems or mistakes in procedure, observes monitoring teams. After successfully completing the monitoring as approved by program staff, monitors reconvene in a large group to discuss procedures and results. Comparisons are also made between upstream and downstream results.



Site selection

After the workshop is completed, monitors are encouraged to adopt sampling stations in their watershed. Monitors usually decide on monitoring stations based on where they live or where DEP sites are located on rivers. On occasions, stations that the DEP needs monitored are supplied and volunteers are requested to adopt those locations. However, more importantly, monitoring groups are encouraged to write a monitoring study design plan specific to their watersheds protection and restoration goals, as they gain experience and familiarity with program methods. If requested, monitors can receive copies of surveys conducted upstream at other locations to compare with their own results.

Topographic maps are used to chart actual river locations. Program staff then determines longitude and latitude for river monitoring stations. Participants are asked to monitor their selected sites a minimum of twice each year and/or a maximum of four-times each year (once each season). Sites should be spaced a minimum of ¼ to ½ mile apart.

Participants have the option of either selecting only one station on a river or several. Participants may also elect to monitor more than one stream or river.

Section 4
Data quality reviews

After completing a stream survey at their selected station, monitors mail their surveys to the program coordinator where data is analyzed for accuracy. Survey accuracy is determined by reviewing several questions

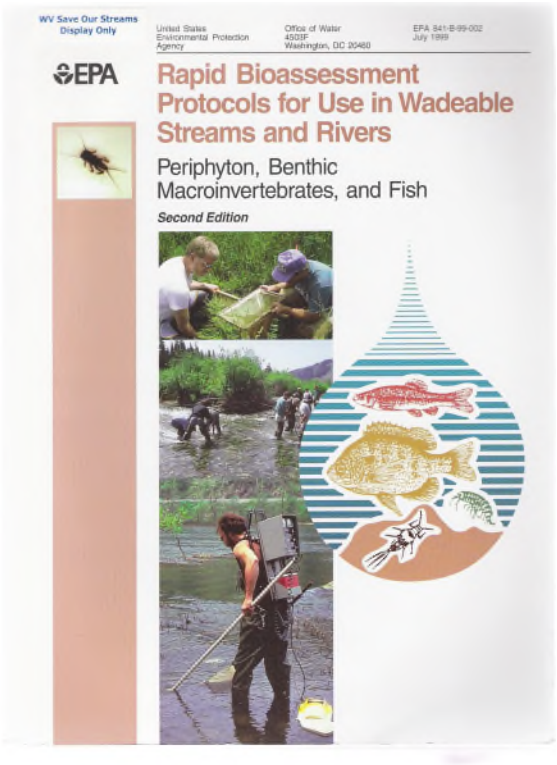
on the survey form, which assist staff in determining if results are correct. For example, if native trout are known to be in the stream, yet results indicate a biologically dead stream, the monitoring is not considered correct.

The Program Coordinator and designated staff will review the field survey sheets and if there are any problems or questions, the monitors will be notified by mail, e-mail or phone of the corrections needed. After the review is completed, the coordinator will return the original field survey sheets to the monitor for their own records.

If the riffle is classified as "60 percent mud," an improper location was selected, and results are not considered accurate. Also, answers to questions like "sample number" demonstrate that a monitor has taken three samples and has recorded the most diverse of the three samples. In situations where incongruities exist, monitors are called, and the results are discussed. Staff has found that usually a simple adjustment in monitoring technique or perhaps moving to a better location is all that is required to improve results. Monitors also submit letters with specific questions on identification problems or pollution issues. The program coordinator can assist monitors with these problems by phone or letter. Local program trainers can also be called upon for site visits or any further assistance that is required.

After results are deemed accurate by program staff the data is input into the Volunteer Access Database (VAD). The volunteer group can also access the VAD and enter data, however, to ensure adequate quality the coordinator should first review the information. Once the coordinator completes the review, volunteer groups are encouraged to enter their own data and use the VAD as an outreach tool.

Follow-up training and problem solving



In addition to the initial training workshop, monitors, are retrained at QA/QC workshops within a year after their initial training and annually thereafter. These workshops are designed to accomplish three things: First, any questions monitors may have been addressed. Second, the volunteer's monitoring skills are evaluated through observing their monitoring techniques and filling out a simple quality assurance checklist for field collection, which is used to review monitor-sampling technique and identify sources of error.

Monitors are given a macroinvertebrate identification quiz in which they are asked to identify preserved specimens from the bug library or complete a blank copy of the macroinvertebrate ID-card. Monitors can use any materials they normally have in the field to identify organisms from all major groups in the program reference collection. These tests are scored, and reports are used to evaluate the accuracy of data at each monitoring station. The QA/QC test can be re-taken by the monitor after a period of two weeks from the original test, if approved by the program coordinator and/or trainer administering the test.

Data reliability may be determined by spot checks in the field to evaluate performance. Choosing monitors at random and field-testing them for accuracy do this. Using a quality assurance checklist, staff or regional coordinators observe the entire monitoring process from riffle identification to finished survey results. This allows evaluation of the monitoring process and corrections to avoid future mistakes.

Program staff will also assist monitors with questions on specific problems throughout the year, such as how to determine the source of pollution or analyze a pollution problem or new stream condition such as spring algae bloom. Staff may also consult with other scientists for any questions on complex technical issues. University staff members have been consulted for assistance in identification of unusual organisms and Division of Water Resources staff has been consulted for unusual water conditions.

An important aspect of the program is the commitment of the DEP to follow up on any citizen monitoring effort, which may reveal a potential water pollution problem.

The coordinator will follow-up with certified monitoring groups as often as possible to assist them with fieldwork and act in an advisory role.

WVDEP's Division of Water Resources staff have reviewed the program monitoring methodology and compared it against their own methods. The Division of Water Resources staff suggestions are included in program techniques and instructions. The program has no formal advisory board for questions but will use the advice of the late Dr. Jim Plafkin of EPA's monitoring branch for monitoring system design and modification. In addition, the program staff maintains reference publications on freshwater invertebrates and other sciences necessary to the program.

The program staff has been trained in the use of protocols for monitoring of benthic macroinvertebrates and will consult the EPA publication 841-B-99-002 Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish, 2nd Edition.

Because of the thorough rubbing of all rock surfaces and the meticulous disturbance of all bottom substrate within the sample area, the program will be able to sample all organism's representative of all major macro habitats within the riffle area. This is evidenced both by the presence of leaf packs and sticks, and the presence of all the major groups of organisms (shredders, scrapers, and filterers) in most samples. Also, all macroinvertebrates caught in the sample are used in the sample (thereby eliminating sample bias) and all are identified to order level, kinds (an estimate of families based upon morphological differences), or family level.

USEPA Region III office will review and approve the program protocols for biological monitoring outlined in this document and supporting attachments.

Revised August 2020

Important note: Several programmatic changes have occurred since the writing of these guidelines. These changes are described in detail on the program's website. Most of the revisions have occurred in format the survey data sheets but the most important revision is that monitors must agree to and sign a memorandum of understanding (MOU), which describes their level of commitment. To learn more, review the list of important program websites on page 13.

Additional resources

The references provided include select guidance documents used by SOS. Additional references include the Standards of Procedures (SOP's) from WVDEP's Watershed Assessment Branch as well as a wide variety of macroinvertebrate identification guides and EPA stream assessment manuals.

1. Dates, G. et al. 1995. **Living Waters: Using Benthic Macroinvertebrates and Habitat to Assess your River's Health**. Publication of the River Network.
2. **Izaak Walton League of America's**, **Save Our Streams Program**. 707 Conservation Lane, Gaithersburg, MD 20878. Web page - http://www.iwla.org/sos/.
3. Jessup, B. et al. 1999. **Family Level Key to Stream Invertebrates**. Maryland Department of Natural Resources, Non-Tidal Assessment Division.
4. Rosgen, D.L. 1998. **A Stream Channel Stability Assessment Methodology**. Wildland Hydrology Books Publishing Company.
5. Tetra Tech Inc. 2000. **A Stream Condition Index for West Virginia Wadeable Streams**. Prepared for U.S. EPA Region III, Office of Water: Science and Technology Division.
6. U.S. EPA, Office of Wetland, Oceans and Watersheds. 1999. **Rapid Bioassessment Protocols for use in Wadeable Streams and River**s, **2nd Edition**. EPA 841-B-99-002.
7. U.S. EPA, Office of Wetlands, Oceans and Watersheds. 1997. **Volunteer Stream Monitoring: A Methods Manua**l. EPA 841-B-97-003.
8. U.S. EPA, Office of Wetlands, Oceans and Watershed. 1996. **The Volunteer Monitor's Guide to Quality Assurance Project Plans**. EPA 841-B96-003
9. Voshell, J.R. 2000. **A Guide to Common Freshwater Invertebrates of North America**. McDonald & Woodward Publishing Company.