WEST VIRGINIA SAVE OUR STREAMS

A WVDEP SPONSORED CITIZEN'S VOLUNTEER MONITORING PROGRAM

Cacapon Institute Stream Scholars (Hardy County)

West Virginia Save Our Streams is a monitoring program designed to teach citizen scientist's the techniques to help them monitor and assess their neighborhood wadeable streams and rivers.

The program provides hands-on training; focusing on the methods used to determine the **biological**, **physical** and **chemical** integrity of wadeable streams and rivers.

Can you describe several examples of chemical, physical and biological indicators in streams and rivers?

West Virginia Save Our Streams offers a tiered approach to stream monitoring training

Training Workshops

Beginning Training

Adapted from the IWLA's Save Our Streams program. This is mostly a qualitative approach to monitoring and assessment.

Training is one day (6-8 hours)

Intermediate Training

Expands upon the survey by introducing more quantitative habitat condition assessment and invertebrate analysis.

Training is one or two days

Advanced Training

Adaptation of EPA's Rapid Bioassessment Protocols (RBP's). It is like a professional assessment.

Training is two days

Certified Trainer: This option is for those interested in becoming official **non-paid** designees of West Virginia Save Our Stream's Program. A training course is offered to those persons who have been monitoring for several years using the program's methods and are comfortable teaching those methods to others. After completing the course volunteers can offer stream-monitoring training to other interested **citizen scientists**.

Stream study design

Your **study design** describes the choices you make about why, what, where, when, who, and how you intend to monitor the water. The study design process frames the choices in the form of questions.

Your approach should be similar to the **scientific method**. The questions you ask, the methods you choose, and the way the data is analyzed and checked should be written into your study design.

It's worth taking the time to figure out what you want to do. Your monitoring is much more likely to be successful and sustainable over a longer time, with the right plan.

Safety considerations

One of the most critical considerations for a volunteer monitoring program is the safety of its volunteers. All volunteers should be trained in safety procedures and should carry with them a set of safety instructions and the phone number of their program coordinator or team leader. Safety precautions can never be overemphasized. Below are examples.

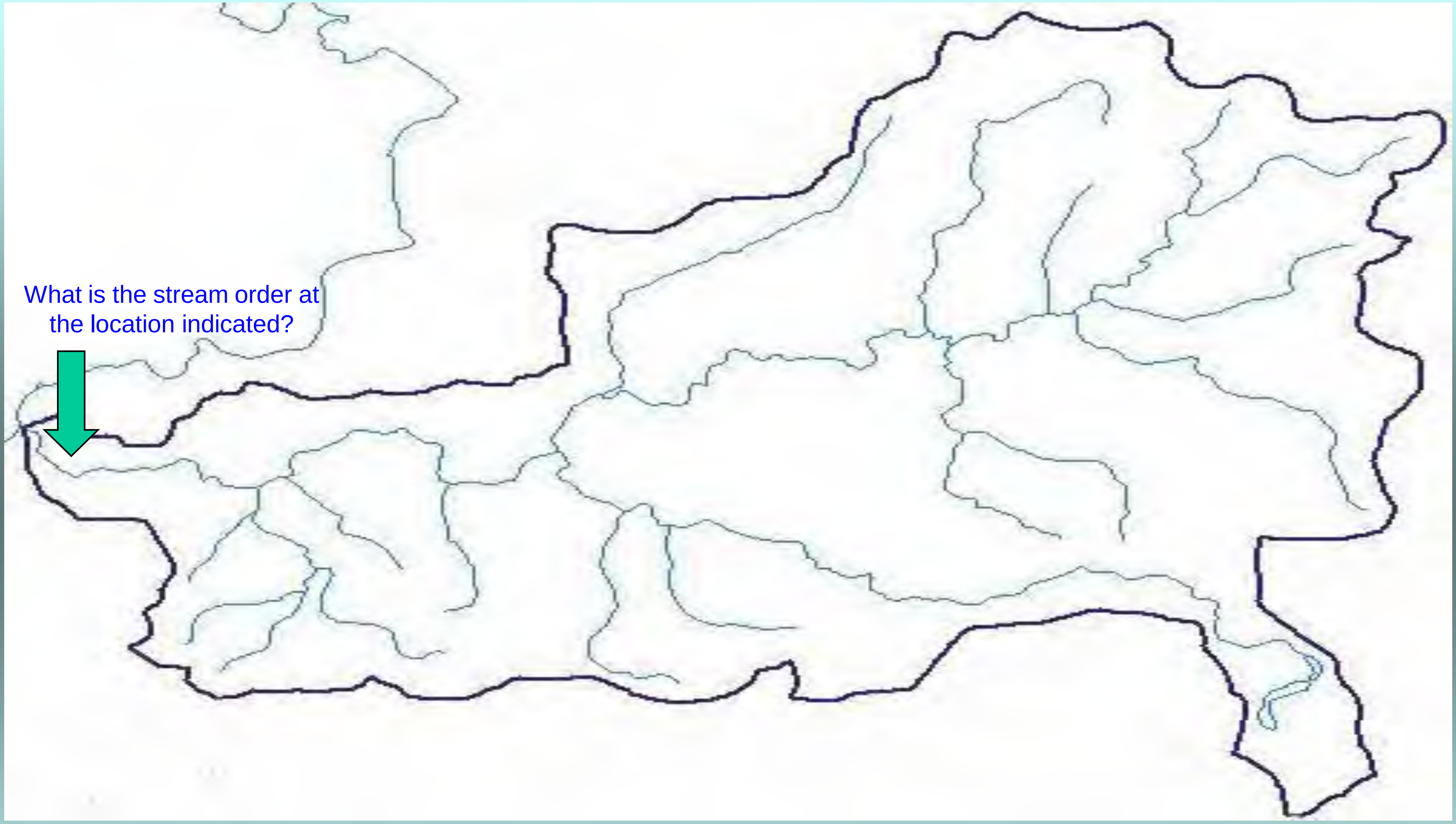
1. **Develop a safety plan**: Find out the location and telephone number of the nearest telephone and write it down. Locate the nearest medical center and write down directions on how to get between the center and your site(s) so that you can direct emergency personnel. Have each member of the sampling team complete a medical form that includes emergency contacts, insurance information, and pertinent health information such as allergies, diabetes, epilepsy etc.
2. **Never drink the water in a stream**: Assume it is unsafe to drink, and bring your own water from home. After monitoring, wash your hands with antibacterial soap.
3. **Always monitor with partner(s)**: Use a minimum of 2 persons; teams of 3-4 or more people are best; always let someone else know where you are, when you intend to return and what to do if you don't return at the appropriate time.
4. **Have first aid kits handy**: Know any important medical conditions of team members (e.g., heart conditions or allergic reactions to bee stings). It is best if at least one team member has first-aid and CPR certification.
5. **Listen to weather reports**: Never go sampling if severe weather is predicted or if a storm occurs while at the site.
6. **Never wade high water**: Do not monitor if the stream is very swift or at flood stage; adult volunteers should not enter swift-flowing water above waist-deep, unless absolutely necessary, and young volunteers should not enter swift-flowing water just above knee-deep.
7. **Park in a safe location**: If you drive, be sure your car doesn't pose a hazard to other drivers and that you don't block traffic.
8. **Put your wallet and keys in a safe place**: Use a watertight bag you keep in a pouch strapped to your waist. Without proper precautions, wallet and keys might end up downstream.
9. **Never cross private property without the permission of the landowner**: Better yet, sample only at public access points such as bridge or road crossings or public parks. Take along a card identifying you as a volunteer monitor.
10. **Confirm your location**: Prior to visiting your site(s) check maps, and make sure all volunteers are aware using site descriptions and specific directions.
11. **Know what to do if you get bitten or stung**: Watch for irate dogs, wildlife (particularly snakes), and insects such as ticks, hornets, and wasps.
12. **Watch for vegetation in your area that can cause rashes and irritation**: Learn to identify (in all seasons) poison ivy, poison oak, sumac and other plants that may cause irritation; be aware of briers and thorny plants as well.

Deciding on your monitoring locations

Targeted monitoring approach

Always make sure the area's chosen are accessible. Always obtain the land-owners permission if the area is on private property.

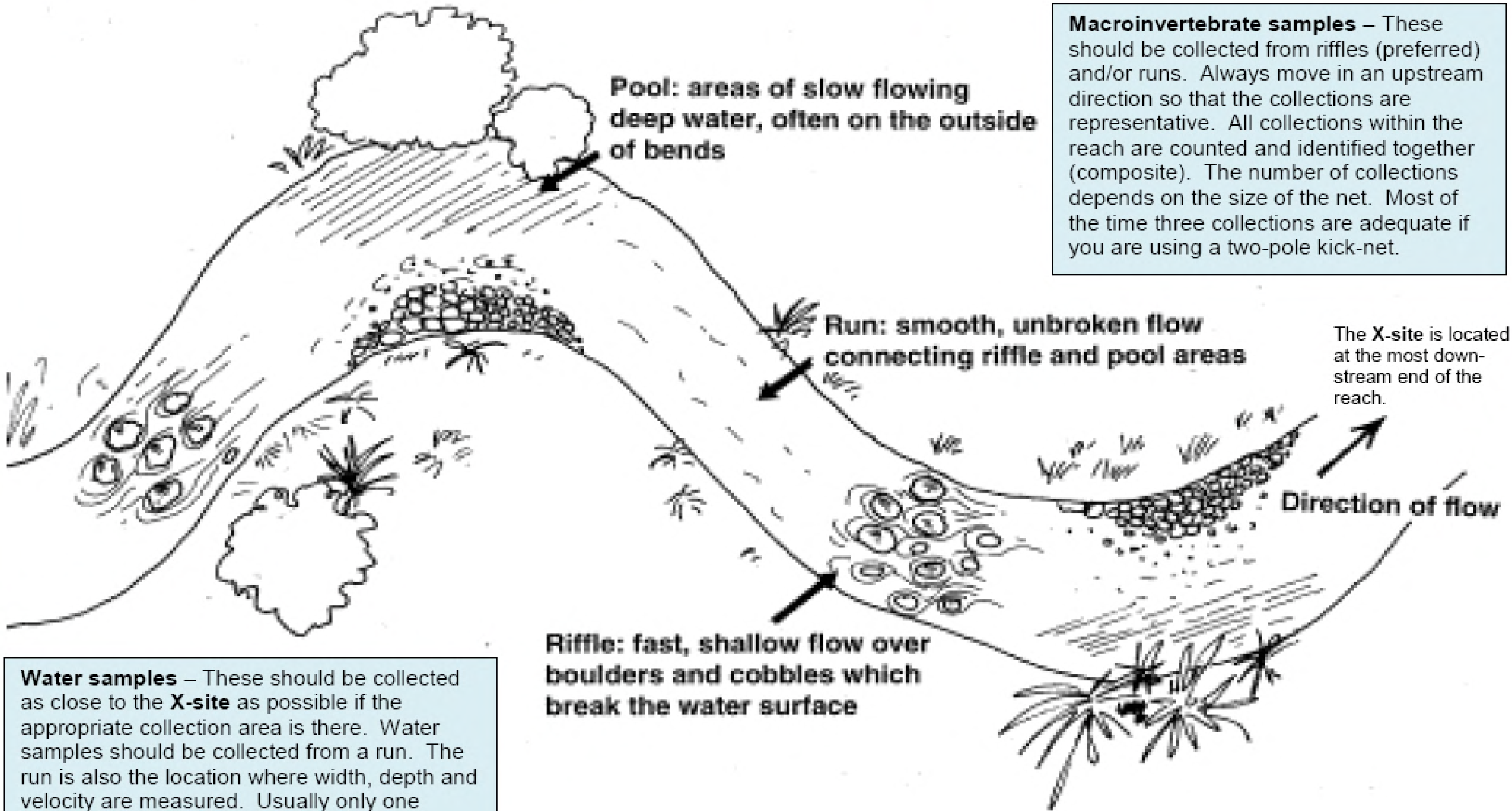
Little Sandy Creek Watershed



Choose stations that are comparable as much as possible. Using stream ordering to choose your stations is good way to begin. To assign stream orders obtain a topographic map of your watershed. Start with the headwater streams (these are 1st order streams); when two 1st order stream meet a 2nd order stream is formed; when two 2nd order streams meet a 3rd order stream is formed. The order of a stream does not change until it meets a stream of the same order.

Most agencies that survey rivers and streams use **100-meters** as the reach length. Volunteers are encouraged to use the same length but other lengths are also acceptable. Most hardware or home stores sell open-reel tape measures of up to **300-feet** (100-meter open-reel tape measures are usually available from engineering supply companies). The 300-foot distance is allowable for the maximum reach length. In some cases younger volunteers may be monitoring so it is best to keep them within your line-of-sight. Certain stream-types may meander and have thick vegetation so the entire length of the reach may not be visible. Under these circumstances the length of the reach can be reduced as a safety precaution. If you reduce the reach size then it should have at least one or more of the channel features described below. The minimum length is **150-feet**.

Macroinvertebrate samples – These should be collected from riffles (preferred) and/or runs. Always move in an upstream direction so that the collections are representative. All collections within the reach are counted and identified together (composite). The number of collections depends on the size of the net. Most of the time three collections are adequate if you are using a two-pole kick-net.



Water samples – These should be collected as close to the **X-site** as possible if the appropriate collection area is there. Water samples should be collected from a run. The run is also the location where width, depth and velocity are measured. Usually only one location is necessary unless there are dramatic physical difference within the reach.

The Stream Reach

Evaluating water chemistry

Chemical monitoring requires more frequency than either physical and biological assessments due to the nature of water chemistry.

WV Save Our Streams can help with planning a chemical monitoring effort that is part of an overall assessment approach but does not provide any free meters or water quality test kits. However, LaMotte, Hach, Hanna and others offer a variety of reasonably priced quality kits.

Water quality monitoring and land use

Land use practices	Recommended water quality analysis
Active construction	DO and BOD, Temperature, TDS and TSS, Turbidity
Forestry harvest	Temperature, TSS, Turbidity
Industrial discharges	Conductivity, pH, Temperature, TDS and TSS, Toxics
Mining	Acidity/Alkalinity, Conductivity, Metals, pH, TDS
Pastureland/Cropland	Bacteria, Nutrients, Temperature, TDS and TSS, Turbidity
Septic systems	Bacteria, Conductivity, DO and BOD, Nutrients, Temperature
Sewage plants	Bacteria, DO and BOD, Conductivity, Nutrients, pH, Temperature, TDS and TSS
Urban run-off	DO and BOD, Conductivity, Nutrients, Temperature

- Bacteria – E-coli/Fecal coliform
- BOD – Biochemical oxygen demand
- DO – Dissolved oxygen
- TSS – Total suspended solids
- TDS – Total dissolved solids
- Nutrients (Nitrates, Phosphates etc.)

Note: Because of the expense and difficulty involved, volunteers generally do not monitor for toxic substances such as heavy metals and organic chemicals such as pesticides, herbicides (agriculture/urban), solvents, and PCBs (industrial/urban). They might, however, collect water samples for analysis at accredited laboratories.

Evaluating physical conditions

Water conditions	Substrate conditions	Algae conditions
Colors **Brown**: Usually caused by sediment in the water. Some muddiness (brown color) is natural after storms, but if the condition persists look for an activity upstream that has disturbed the soil such as construction sites, logging, storm water runoff from roads or urban areas, or agricultural activities such as cattle in the stream. **Black**: Usually caused by coalmine drainage, tar or sometimes waste material from road construction. **Green**: Usually due to an algae bloom caused by excessive nutrients in the water. The source could be sewage, fertilizers from farms, homes or golf courses or waste from animal feedlots. **Multi-colored sheen**: Can occur	**Colors** **Brown**: An indication of silt deposits from sediment sources. Most stream bottoms are normally brown in color. **Black**: This deposit can occur naturally in heavy organic soils but can also be due to fine coal particles, tars, ashes, sludge etc. **Green**: Possible indication of excessive algae growth from organic (nutrient) enrichment sources. **Orange**, **yellow** or **red**: A coating of flocculates on the sediments is usually due to polluted coalmine drainage. **White** or **gray**: A white cottony mass is a sewage fungus common to organic polluted waters. An even coating of white or gray flocculates may be metals	**Color** Algae color varies from brown to dark green in most streams and rivers; although color is a noticeable condition of the algae it is not a particular indicator of the types or of the condition represented by the algal community. **Abundance** Coverage in a riffle is estimated based upon the following: none, scattered, moderate or heavy. A heavy coating of matted and floating algae is often an indication of nutrient rich conditions caused by excess nitrogen and phosphorous.

Physical conditions continued

naturally in stagnant waters, but a sheen that is moving or does not break up easily may be an indication of oil pollution. The source could be runoff from streets or parking areas or illegal dumping. In some areas the use of all-terrain (ATV's) vehicles may contribute to stream oil pollution.

Orange or **red**: Usually associated with mine drainage (high iron content in the stream).

Tea colored: Usually associated with wetlands.

White or **gray**: Can be caused by runoff from landfills, dumps or sewage.

Odors

Rotten eggs: This strong sulfur-like odor can be an indication of sewage pollution or polluted coalmine drainage.

Musky: This slight organic odor is often natural, but in some cases may indicate nutrient enrichment from organic waste products or sewage contamination.

Oily: This odor may indicate pollution from oil and gas wells.

Chemical: There are a wide variety of chemical odors usually the result of industrial discharges, solvents and detergents.

(aluminum) precipitated out of solution from contamination due to mine drainage.

Odors

Volunteer monitors do not assess sediment odors; but occasionally it is good practice to compare sediment odors to odors in the water column. Stirring the bottom sediments and collecting a sample of water and sediment near the area that was disturbed assess sediment odors. The odors in the sediments are similar to those described for water.

Streambed composition is either estimated or measured using a pebble count procedure. The major size categories are silt/clay (mud), sand, fine gravel, coarse gravel, cobble, boulder, bedrock and woody debris. See the pebble count section for more details.

Growth habit

The growth habit characteristics are critical to understating the algae. Most stream algae will be evenly coated on the rocks and have a smooth or slimy texture; other types will be filamentous and have a hairy texture; and others will be matted. Matted algae are easily removed from the surfaces by slowly scraping with your fingers. If the algal community is mostly matted pieces will come off in junks like carpet when it has been removed from flooring.

Foam occurs naturally due to the decomposition of leaves (this foam is generally less than three inches high and cream colored). Excessive white foam may be due to detergent pollution.

Evaluating the channel types

Understanding how moving water shapes the stream channel will improve your chances of finding macroinvertebrates. In most streams, the current creates a **Riffle-Run-Pool** pattern that repeats itself over and over.

Riffles have fast current and shallow water. This gives way to a bottom of gravel, rubble or boulder.

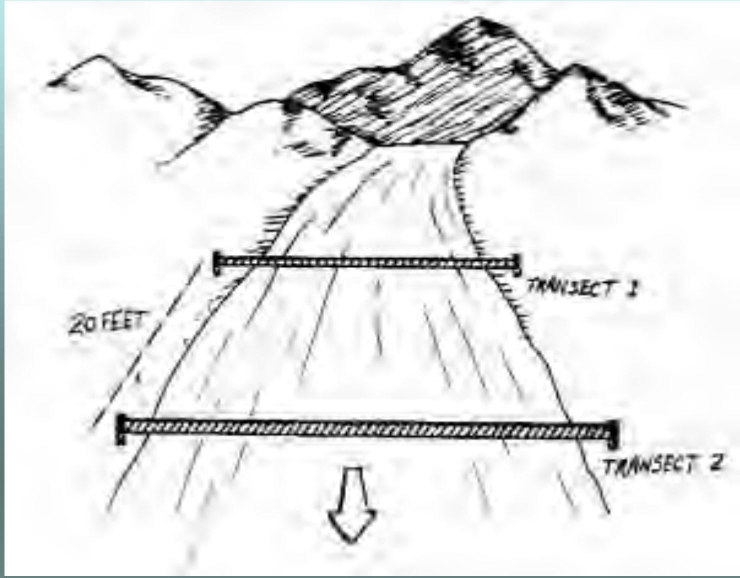
Runs are deeper than riffles with a moderate current and are found between riffles and pools. The bottom is made up of small gravel or rubble.

Pools are smoother and look darker than the other areas of the stream. The deep, slow-moving water generally has a bottom of silt, sand, or small gravel.

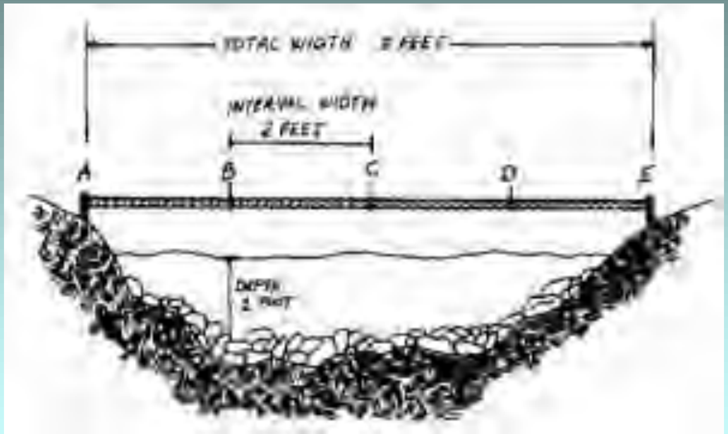
You should measure the wetted width and depth of several channel feature at the same locations each time you survey the stream. At a minimum, always measure the width and depth at the same location within the reach that you measure discharge.

Measuring stream discharge

1. **Select the area usually a run**



2. **Calculate the cross-sectional area**

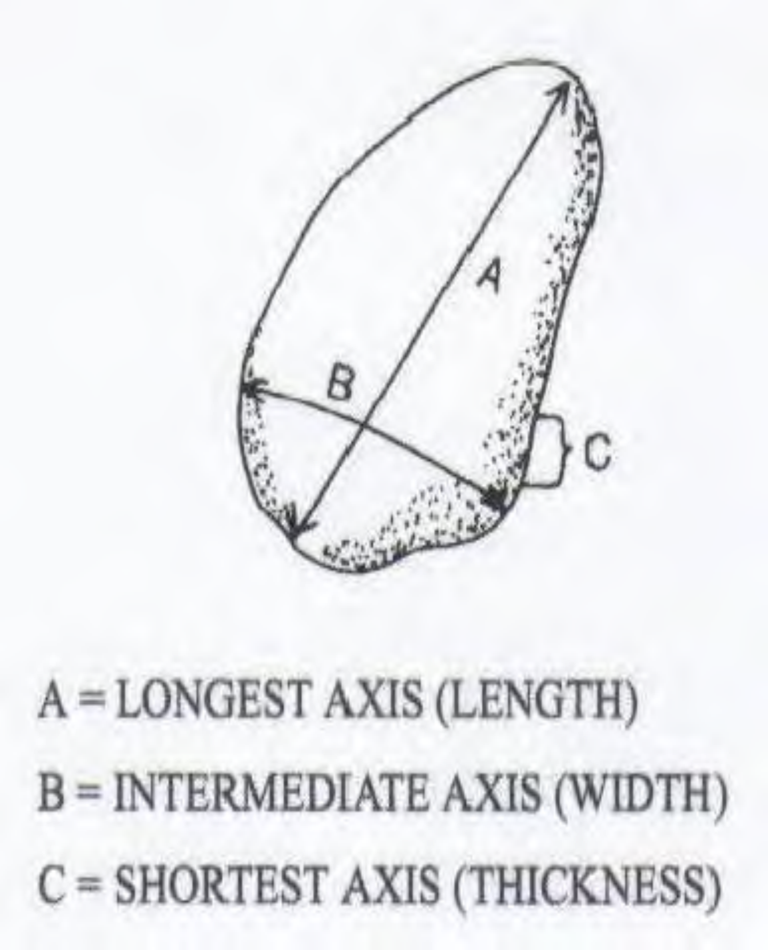


Stream discharge is the speed and volume of water moving across a location of your stream channel. Often very expensive flow meters are used to determine discharge but here we will use a simple method called the **velocity head rod** method for measuring stream flow. You can also use a neutrally buoyant object, such as a miniature tennis ball, and a stopwatch to time how long it takes the ball to travel a defined distance (usually 20 feet). You should float the ball several times and record the average reading. The average time is divided by the distance traveled to determine the average speed (velocity). This velocity is multiplied by the cross-sectional area, which determines the discharge. A correction factor is added to the calculations when using the float method.

Always measure the **cross-sectional area** at the stream section that you used to measure velocity. You can use average width and depth values, or interval values measured across the stream.

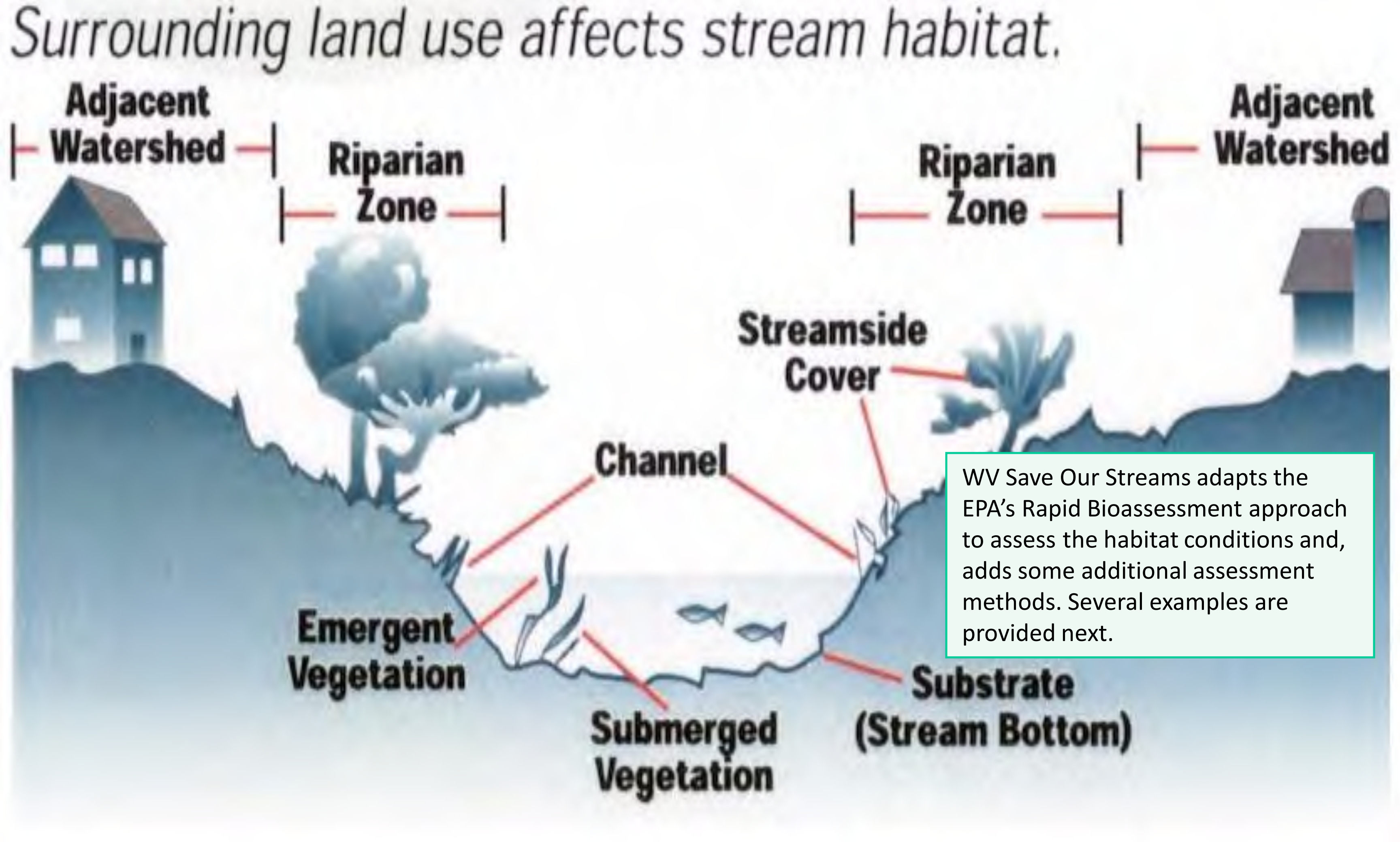
Pebble count

Streambed composition plays an important role in determining stream behavior and **pebble counts provide a simple method to characterize the streambed**. Pebble counts performed over a period, indicate whether streambed composition is changing. For example, a pronounced shift toward finer particles indicates stresses leading to channel instability and potential loss of macro-invertebrate habitat. To analyze pebble count data, classify the particles according to size and construct a graph of size class versus frequency. Like most stream assessment information, pebble count information should be always be compared to a **reference** condition.

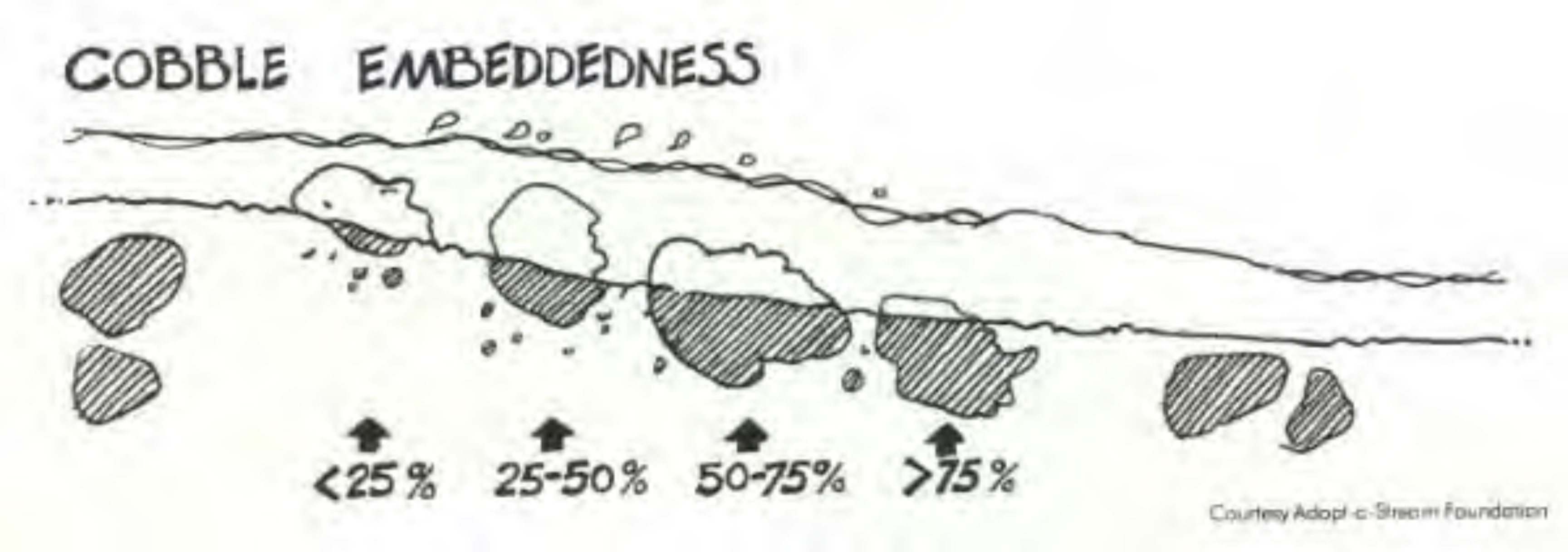


Percent composition, a particle or riffle index, cumulative frequency and various percentile measures (e.g. D50) can be determined from pebble count information.

The habitat condition survey is accomplished using description and a scoring and rating system

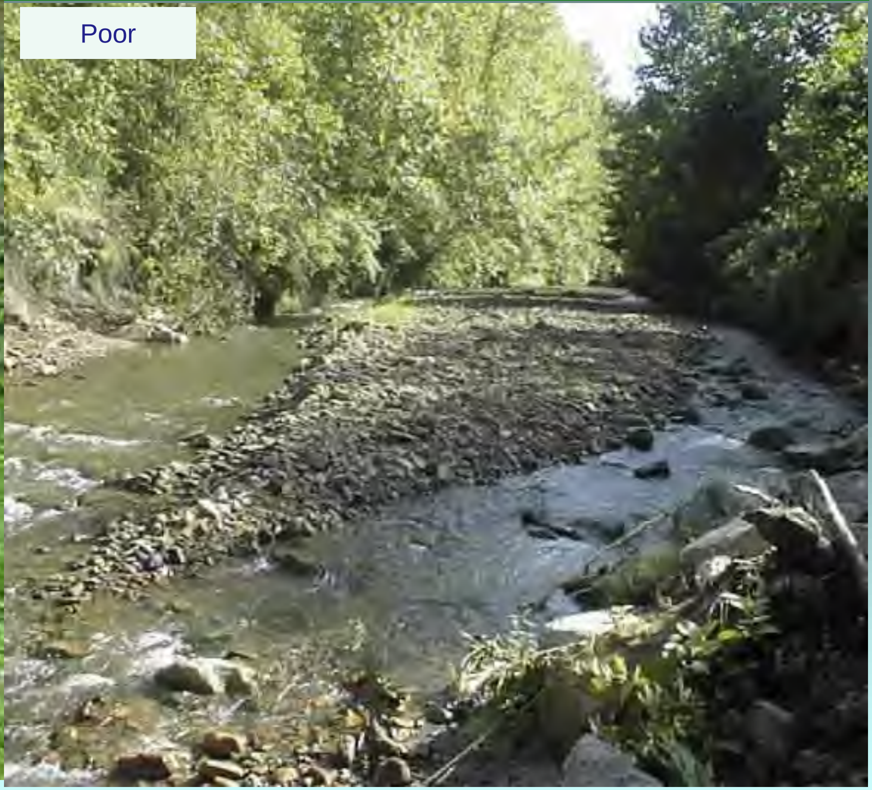


WV Save Our Streams adapts the EPA's Rapid Bioassessment approach to assess the habitat conditions and, adds some additional assessment methods. Several examples are provided next.

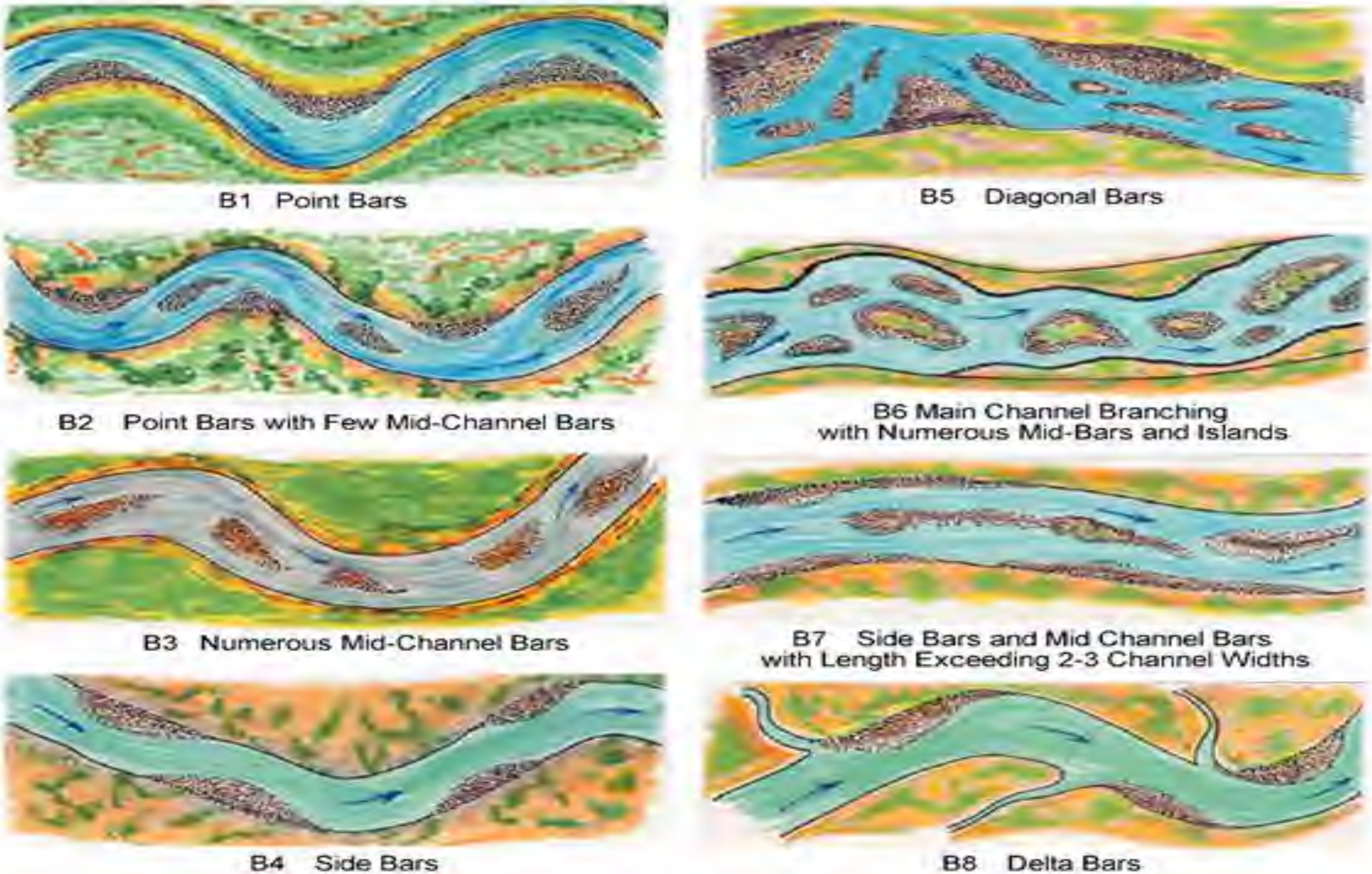


Embeddedness refers to the extent to which rocks (gravel, cobble, and boulders) are surrounded by, covered, or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, fewer living spaces are available to macroinvertebrates and fish for shelter, spawning and egg incubation. **To estimate the percent of embeddedness, observe the amount of silt and sand sediments overlying and surrounding the larger gavel and cobble size particles. Embeddedness is always observed and assessed in riffle habitats, especially those chosen for macro-invertebrate samples.**

Sediment deposition is an estimate of the amount of sediment that has accumulated and the changes that have occurred to the stream channel as a result of deposition. Deposition occurs from large-scale movement of sediment. **Sediment deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of a meander that increase in size as the channel is diverted toward the outer bank) or shoals, or result in the filling of runs and pools. Usually deposition is evident in areas that are obstructed by natural or manmade debris and areas where the stream flow decreases, such as bends.** High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many organisms. Sediment deposition should be rated throughout your reach and should not be confused with embeddedness.



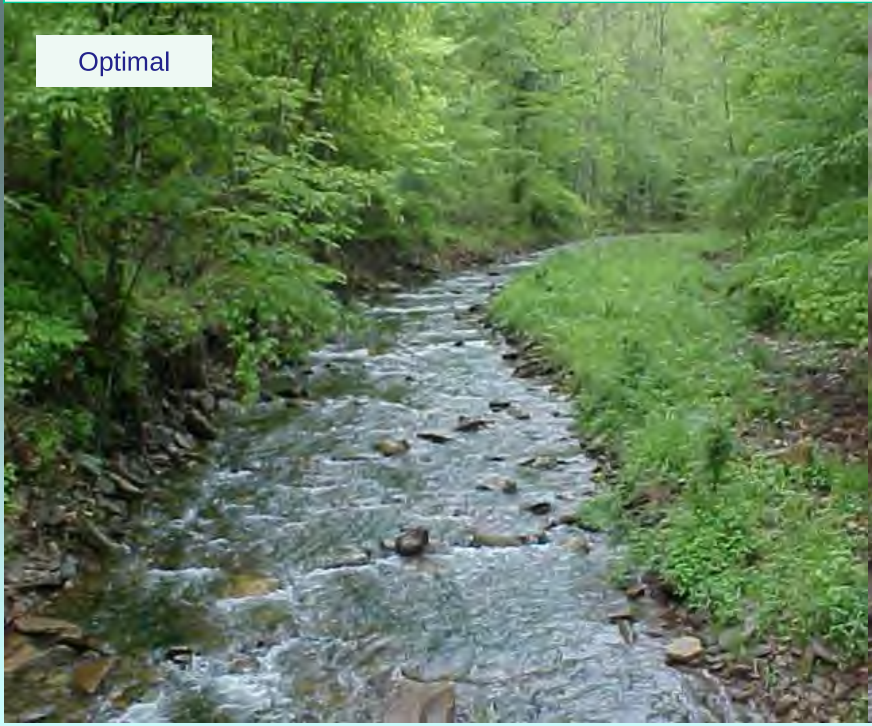
Sediment deposition changes the pattern and profile of streams and rivers. Which of the patterns below are the most normal and why? Which pattern is the most disturbed?

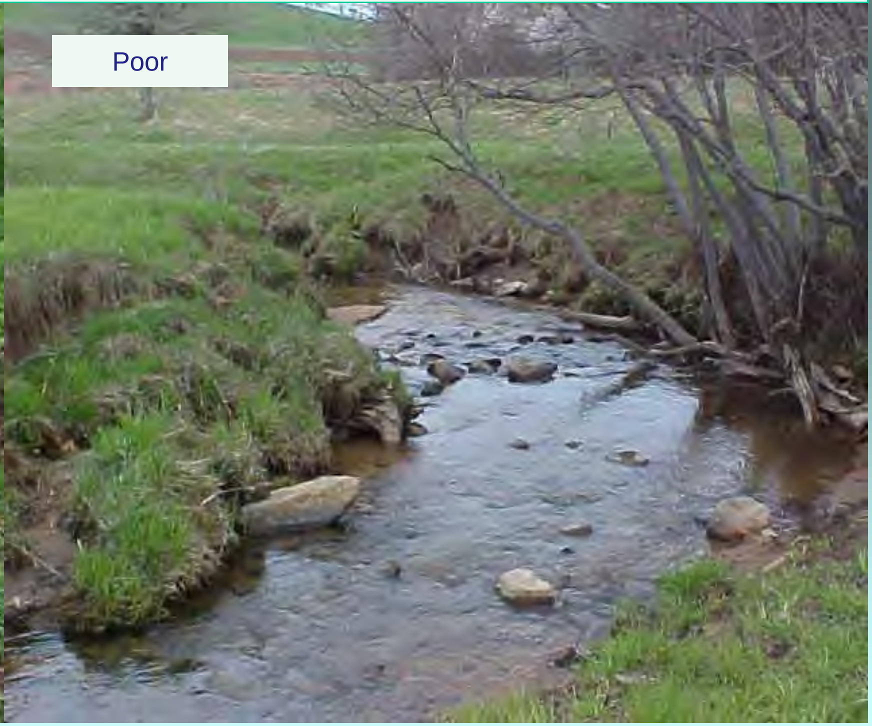


Illustrations of various depositional features as modified from Galay et al. (1973) (Rosgen 1996)

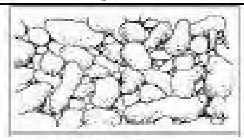
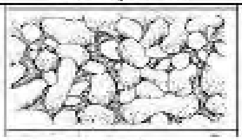
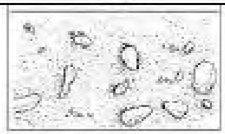
The **bank stability** condition evaluates whether the stream banks are eroded (or have the potential for erosion). **Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered to be unstable. Signs of erosion include crumbling, un-vegetated banks, exposed tree roots, and exposed soil.** Eroded banks indicate a problem of sediment movement and deposition and suggest a scarcity of cover and organic input to streams. Each bank is evaluated separately and the cumulative score (right and left) is used for this parameter.

Riparian buffer width is an estimate of the width of natural vegetation from the edge of the stream bank out through the riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat and nutrient input into the stream. A relatively undisturbed riparian zone supports a robust stream system; narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Residential developments, urban centers, golf courses, and rangeland are the common causes of anthropogenic degradation of the riparian zone. Conversely, the presence of old fields, paths, and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to altering the riparian zone and may be given relatively high scores. Each bank is evaluated separately and the cumulative score (right and left) is used for this parameter.





Habitat Conditions: Rate the habitat conditions by choosing the best description, and then, choose a score from the range within the description. Note: Bank stability and riparian buffer width are assessed on both the LEFT and RIGHT side of the stream.

	Optimal	Suboptimal	Marginal	Poor
Embeddedness EVALUATED IN RIFFLES	 Fine sediments surrounds <10% of the spaces between the gravel, cobble and boulders.	 Fine sediment surrounds 10-30% of the spaces between the gravel, cobble and boulders.	 Fine sediment surrounds 30-60% of the spaces between the gravel, cobble and boulders.	 Fine sediment surrounds > 60% of the spaces between the gravel, cobble and boulders.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Sediment deposition	Little or no formation of depositional features; < 20% of the reach affected. See below for examples	Some increase in depositional features; 20-40% of the reach affected.	Moderate amounts of depositional features; 40-60% of the reach affected.	Heavy amounts of deposition; > 60% of the reach affected.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

The next two conditions are evaluated on both the left and the right sides of the stream.

	Optimal	Suboptimal	Marginal	Poor
Bank stability	Banks are stable; no evidence of erosion or bank failure; little or no potential for future problems; < 10% of the reach affected.	Banks are moderately stable; infrequent areas of erosion occur, mostly shown by banks healed over or a few bare spots; 10-30 % of the reach affected.	Banks are moderately unstable; 30-50% of the reach has some areas of erosion; high potential for erosion during flooding events.	Banks are unstable; many have eroded areas (bare soils) along straight sections or bends; obvious bank collapse or failure; > 50% affected.
Left ___ Right ___	10 9 8	7 6	5 4 3	2 1
Riparian buffer width	Mainly undisturbed vegetation > 60 ft; no evidence of human impacts such as parking lots, road beds, clear-cuts, mowed areas, crops, lawns etc.	Zone of undisturbed vegetation 40-60 ft; some areas of disturbance evident.	Zone of undisturbed vegetation 20-40 ft; disturbed areas common throughout the reach.	Zone of undisturbed vegetation < 20 ft; disturbed areas common throughout the entire reach.
Left ___ Right ___	10 9 8	7 6	5 4 3	2 1

Totals	> 70	70 - 55	54 - 40	< 40
	Optimal	Suboptimal	Marginal	Poor

Habitat condition comments: ______________________________

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Sediment Deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of a meander that increase in size as the channel is diverted toward the outer bank) or shoals, or result in the filling of runs and pools. Usually deposition is evident in areas that are obstructed by natural or manmade debris and areas where the stream flow decreases, such as bends.

Examples of anthropogenic activities that often have an impact on the quality of our rivers and streams


Active construction


Abandoned and active mining


Agricultural impacts


Suburban developments

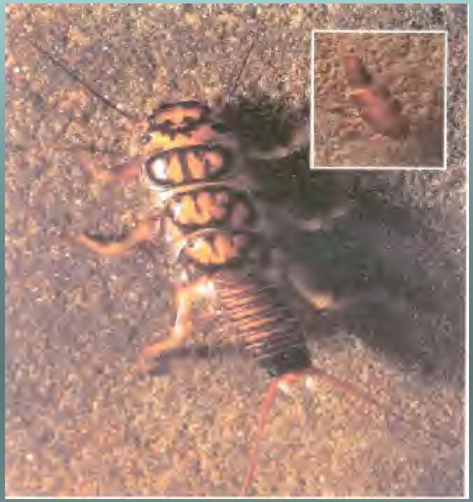
Who are the indicators of biological integrity?

Periphyton are algae, fungi, bacteria, protozoa, and organic matter associated with channel substrates. Periphyton communities are useful indicators of environmental condition because they respond rapidly and are sensitive to a number of human induced disturbances.

Fish communities can indicate stream and riparian quality. Extensive life history information is available for many species, and because many are high order consumers, they often reflect the responses of the entire trophic structure to environmental stress. Fish often provide more publicly as an indicator of environmental stress.

Benthic macroinvertebrates play important functional roles in lotic ecosystems and are good indicators of stream quality. Macroinvertebrates represent the basic link in the food web between organic matter resources (e.g., leaf litter, periphyton, detritus) and fishes. Within specific regions, macroinvertebrate assemblages respond in predictable ways to changes in stream environmental variables. Because many macroinvertebrates have limited migration patterns or a sessile mode of life, they are particularly well suited for assessing site-specific effects.

WV Save Our Streams ask volunteer monitors to focus on the benthic macroinvertebrate communities






What is an insect? [illegible]

Insect Groups

Mayflies

[illegible]

Stoneflies

[illegible]

Case-building caddisflies

[illegible]

Dragonflies and Damselflies

[illegible]

Fishflies and Alderflies

[illegible]

Net-spinning caddisflies

[illegible]

Beetles

[illegible]

True flies

[illegible]

Non-biting midge

[illegible]

True flies continued

Crane fly

[illegible]

Black fly

[illegible]

Watersnipe fly

[illegible]

Non-Insect Groups

Crayfish

[illegible]

Scud/Sideswimmer

[illegible]

Aquatic sowbug

[illegible]

Clams and Mussels

[illegible]

Operculate snails

[illegible]

Non-operculate snails

[illegible]

Aquatic worms

[illegible]

Leeches

[illegible]

Flatworms

[illegible]

Learn more at: [illegible]

Sizes illustrated not proportional

<u>Instructions:</u> [illegible]

<u>Note:</u> [illegible]

Examples of bioassessment equipment

1. **Kick-net**
2. **Sorting trays**
3. **Scrubbing brush**
4. **Buckets**
5. **Spray bottle**
6. **Forceps**
7. **Magnifying lenses**
8. **Seine or screen (EZ-strainer)**
9. **Chemical test kit**

The equipment is often specific to the type of collection procedure used. Additional equipment may include open reel tapes, rulers, GPS and camera, clipboard, field data sheets, labels, chain of custody forms, and a variety of containers for chemical waste or preservation.

Benthic macroinvertebrate collection methods

A variety of nets are used to collect aquatic invertebrates. These include a screen-barrier style of kick-net, a rectangular style of kick-net and a surber net all of which are designed to sample riffles and runs. The dip-net or D-frame net is designed to sample multiple habitats. There are also a variety of stationary sampling devices, drift-nets and grab samplers. WV Save Our Streams has always provided the **screen-barrier** style of kick-net to volunteer monitors at no charge but has recently designed a rectangular kick-net that is more flexible. It can be used by one person and its small size allows it to sample smaller streams as well as multiple habitats.

The focus of most macroinvertebrate collections are the riffles.

Selecting metrics to determine stream biological condition

Metrics are used to analyze and interpret biological data by condensing lists of organisms into relevant biological information. In order to be useful, metrics must be proven to respond in predictable ways to various types and intensities of stream impacts. Most stream ecologist recommend using a multimetric approach that combines several metrics into an overall score.

Metrics	Results	Points	10	8	6	4	2
1. Total Taxa			> 18	18 - 15	14 - 11	10 - 7	< 7
2. EPT Taxa			> 10	10 - 8	7 - 5	4 - 2	< 2
3. Biotic Index			< 3.5	3.5 – 4.3	4.4 – 5.6	5.7 – 6.5	> 6.5

Integrity Rating Scale

STREAM SCORE		> 24	24 - 19	18 - 13	< 13
		Optimal	Suboptimal	Marginal	Poor

Benthic Macroinvertebrates	Abundance	Tolerance Value	Tolerance Score	Number of Kinds
Stoneflies (Order Plecoptera)	3	2	6	3
Mayflies (Order Ephemeroptera)	3	3	9	4
Case-building caddisflies (Order Trichoptera)	1	3	3	1
Net-spinning caddisflies (Order Trichoptera)	3	4	12	1
Common netspinner (Family Hydropsychidae)	3	5	15	1
Free-living caddisfly (Family Rhyacophilidae)		3		
Dragonflies (Sub-order Anisoptera)	3	4	12	1
Damselflies (Sub-order Zygoptera)		7		
Riffle beetle (Family Elmidae)	1	4	4	1
Water penny (Family Psephenidae)	3	3	9	1
Other Beetles (Order Coleoptera)		6		
True Bugs (Order Hemiptera)		8		1
Hellgrammite (Family Corydalidae)	3	3	9	
Alderfly (Family Sialidae)		6		1
Non-biting midge (Family Chironomidae)	3	8	24	
Black fly (Family Simuliidae)		6		
Crane fly (Family Tipulidae)		4		1
Watersnipe fly (Family Athericidae)	3	3	9	
Other True flies (Order Diptera)		7		
Water mite (Order Hydrachnida)		6		1
Crayfish (Order Decapoda)	6	5	30	
Sideswimmer (Order Amphipoda)		5		
Aquatic sowbug (Order Isopoda)		7		
Operculate snails (Sub-class Prosobranchia)		5		
Non-operculate snails (Sub-class Pulmonata)		7		
Clams (Order Veneroida)		6		
Mussel (Family Unionidae)		4		1
Aquatic worm (Class Oligochaeta)	1	10	10	1
Leech (Class Hirudinea)		10		
Flatworm (Class Turbellaria)		7		
Other invertebrates (describe)	Total Abundance		Total Tolerance	Total Taxa (# of kinds)
	36		152	18

Metrics	Results	Points	10	8	6	4	2
1. Total Taxa	18	8	> 18	18 - 15	14 - 11	10 - 7	< 7
2. EPT Taxa	10	8	> 10	10 - 8	7 - 5	4 - 2	< 2
3. Biotic Index	4.22	8	< 3.5	3.5 – 4.5	4.6 – 5.4	5.5 – 6.5	> 6.5

Integrity Rating Scale

Stream Score	24	> 24	24 - 19	18 - 13	< 13
		Optimal	Suboptimal	Marginal	Poor

To learn more:

dep west virginia department of environmental protection

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stream stories

Home > Water and Waste Management > Resources and Education > West Virginia Save Our Streams > SOS workshop study resources

SOS workshop study resources

The resources below will prepare you for a Save Our Streams (SOS) workshop. Begin your study by reviewing the USEPA Volunteer Manual's chapters/sections listed below. Although dated, the manual provides good background information and basic concepts. Once familiar with the basics, continue by reviewing as many of the recommended resources as possible. If your time permits the remainder of these resources should be reviewed as well... Thank you in advance for participating in an SOS workshop.

Stream study	Water quality	Bio-survey methods
Basic concepts	Stream discharge	Habitat evaluation
Study design	Dissolved oxygen	Streamside biosurvey
Safety considerations	Turbidity	Other
Watershed surveys	Alkalinity and pH	Stream survey calculations
Visual assessment	Temperature and conductivity	Latitude and longitude

Introduction to more basic concepts

1. Introduction to the properties of water
2. What is a watershed?
3. What is a stream reach?
4. Introduction to water quality
5. Why are riparian buffers so important? Click Here to learn more
6. The Volunteer Assessment Database (VAD)

Specific procedures and important concepts

1. WV Save Our Streams - Level 1 Standard Operating Procedures
2. Using a kick-net to collect benthic macroinvertebrates.
3. Pebble count collection procedures
4. Velocity head rod (VHR) method for measuring stream flow. Note: SOS VHR prcedure differs slightly

Click-Here to learn about other stream flow (discharge) measurement procedures.

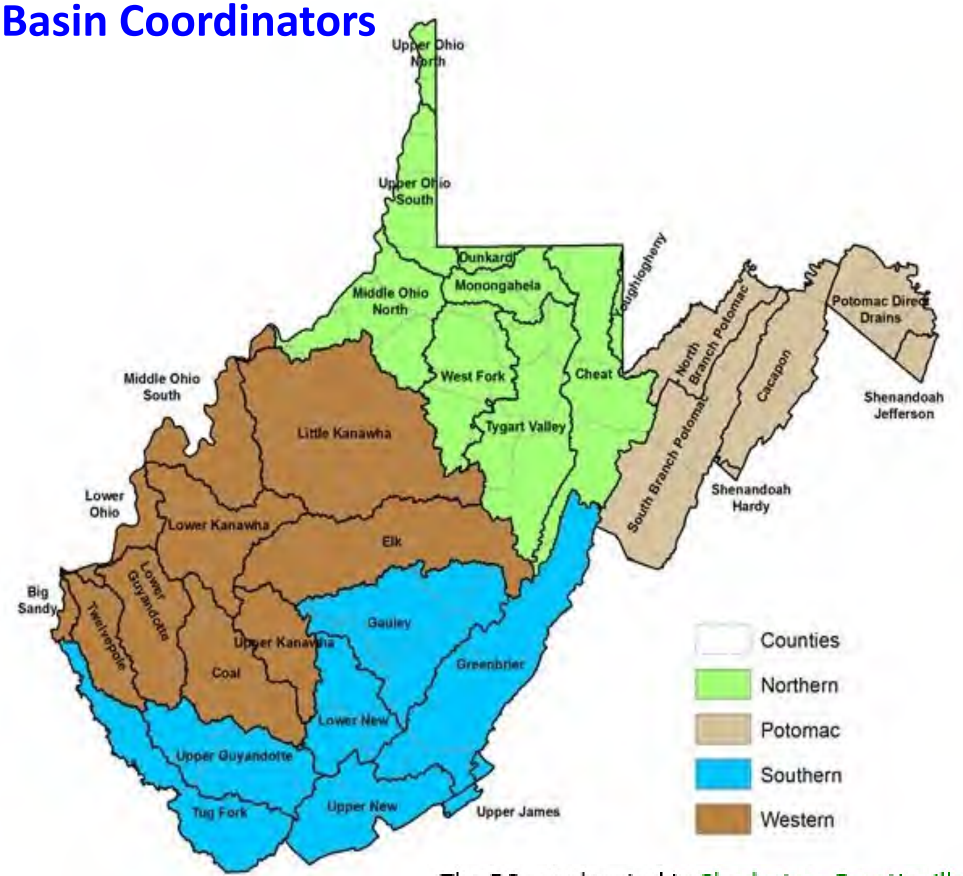
5. Cacapon Institute's Introduction to stream sampling
6. Cacapon Institute's stream monitoring activity
7. Click-Here to lean more about SOS stream survey data sheets
8. Wisconsin's Water Action Volunteers - Habitat evaluations

Benthic macroinvertebrates

1. Bouchard, R.W. 2004. Guide to Aquatic Invertebrates of the Upper Midwest
2. Cacapon Institute's Benthic Portal
3. Click-Here to review the program's level-one benthic ID guide
4. ID Activity: Practise your macroinvertebrate identification skills
5. Representative images of aquatic invertebrates
6. WV Save Our Streams guide to aquatic invertebrates

Contacts and additional information

Basin Coordinators



Nonpoint Source Coordinator

Timothy Craddock, NPS Program Coordinator
WVDEP *Watershed Improvement Branch*
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Click-Here for WIB's calendar

Unless someone like you cares a whole awful lot, nothing is going to get better, its not! - The Lorax

The BCs are located in Charleston, Fayetteville, Romney and Fairmont. **CLICK-HERE** to learn more. To learn about volunteer opportunties and more, check-out our **calendar of events**.

Contact	Phone	Service area
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Martin Christ	(304) 368-2000	Northern
Tomi Bergstrom	(304) 926-0499 x 43862	Western/Project WET
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