West Virginia Highway Construction Monitoring Manual V.3

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WEST VIRGINIA RIVERS

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Acknowledgments

This highway construction monitoring field manual is modeled after West Virginia Rivers and Trout Unlimited (TU)'s West Virginia Pipeline Monitoring Manual, which was developed in summer of 2015. As such, information contained herein was developed from the WV Pipeline Monitoring Manual, as well as materials developed by the Delaware Riverkeeper Network and the Alliance for Aquatic Resources Monitoring (ALLARM) based at Dickinson College.

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Introduction

Since the Federal-Aid Highway Act was signed in 1965, the Interstate Highway System has been an integral part of the U.S. transportation system. In Appalachia, the Appalachian Regional Development Act created the Appalachia Development Highway System (ADHS), which was designed to connect remote areas of Appalachia to Interstate Highway System. The ADHS has 33 corridors, six of which are built in or through West Virginia. As of 2021, Corridor H remains the final corridor to be completed in West Virginia.

Outside of the ADHS, other highway and bypass projects within West Virginia are gaining traction as the legislature promotes a tourism and outdoor recreation economy, attracting more people to West Virginia. Coupled with the 2021 Infrastructure Investment and Jobs Act, a historic investment in roads, bridges and other infrastructure, major highway construction is expected throughout West Virginia in the coming years.

While important, these construction projects pose potential risks to the state's exceptional rivers and streams. In response to community concerns, West Virginia Rivers Coalition (WV Rivers) launched a volunteer-based highway construction monitoring program to monitor streams in areas where highway construction is occurring and to collect baseline water quality data in watersheds where construction is not yet occurring but is expected to in the future.

Building upon our existing network of volunteers conducting shale gas monitoring and/or pipeline monitoring in West Virginia or Virginia, WV Rivers is working with partners to engage and train volunteers to monitor streams and collect baseline data prior to highway construction and to identify potential impacts during and after highway construction.

Through participation in this Highway Construction Monitoring Program, West Virginia citizens who value clean water can assist state and federal agencies in protecting these resources through stream monitoring and field surveillance. Volunteers will complete routine stream monitoring and inspections of stream conditions, report problems to appropriate agencies and upload data to an online database. Through these efforts we can establish baseline watershed health in advance of highway construction activities, promote early detection and reporting of problems that may develop during construction and evaluate long term impacts that may occur due to highway development.

This manual provides guidance and instruction for WV Rivers' Highway Construction Monitoring Program volunteers.

Introduction to Highway Development

Types of Highways

The Federal Highway Administration (FHWA) has three highway functional classifications: arterial, collector, and local roads. Arterial roads allow the greatest speed for the longest uninterrupted distance. Roads in this category would be what we typically think of as a highway, with speeds generally between 50-70 mph. Collector roads allow for a lower speed for shorter distance, and as the name implies, collect traffic from local roads and connect them with arterials. Collector roads generally have speeds around 40 mph. Local roads are all roads not defined as arterials or collectors. They primarily provide access to land with no or little through movement. Neighborhood roads would be an example of roads in this category.

These functional classifications are important because they allow for an establishment of a design speed, or how fast vehicles will be expected to travel on the road. This influences several design factors; including the curves and grade of the road, as well as lane width, should width, median area, and other major design features that will dictate the degree of earth disturbance during construction.

Aerterial highway or expressway.

States can develop their own highway functional classifications. In West Virginia, the state road system consists of five functional classifications: expressway, trunk line, feeder, state local service and park and forest. Expressways serve major intrastate and interstate travel, including federal interstate routes. Trunklines serve city to city travel, while feeder roads serve community to community travel and/or collects and feeds traffic to the higher systems. The highway construction monitoring program will primarily focus on the FHWA-classified arterial and collector roads, which generally overlaps with the state-classified expressway, trunkline, and feeder roads. These highway types require the greatest amount of earth disturbance during their construction.

Highway Development Process

There are 5 main stages to the highway development process, the last of which is construction.

1. Planning - The first stage is planning, where state Department of Transportations (DOT), Metropolitan Planning Organizations (MPOs), and local governments identify transportation needs. Ideally, this is a cooperative process designed to involve various community stakeholders. Through this process, DOT and MPOs identify current and projected future transportation problems and needs, and analyze various transportation improvement strategies to address those needs.

2. Project Development - The second stage is project development, where the transportation project is more clearly defined. This stage includes preliminary engineering and other analyses such as topographic surveys, traffic studies, revenue estimates, etc. for alternative locations and design features. Projects utilizing federal-aid funds must identify streams and wetlands potentially affected by a proposed project and its alternatives. At the end of this stage an alternative is selected.

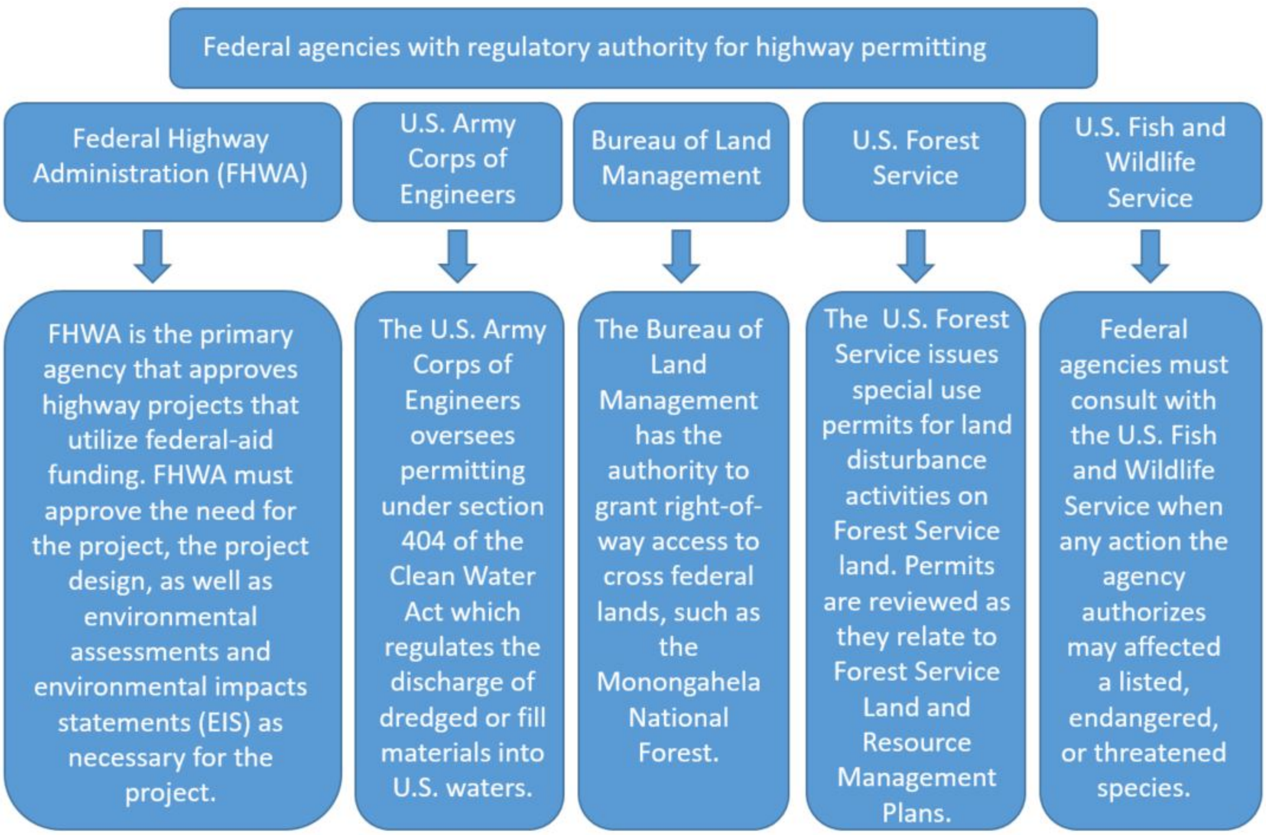
3. Design - The third stage is design, where the design team develops detailed construction plans, specifications, and estimates for the selected alternative.

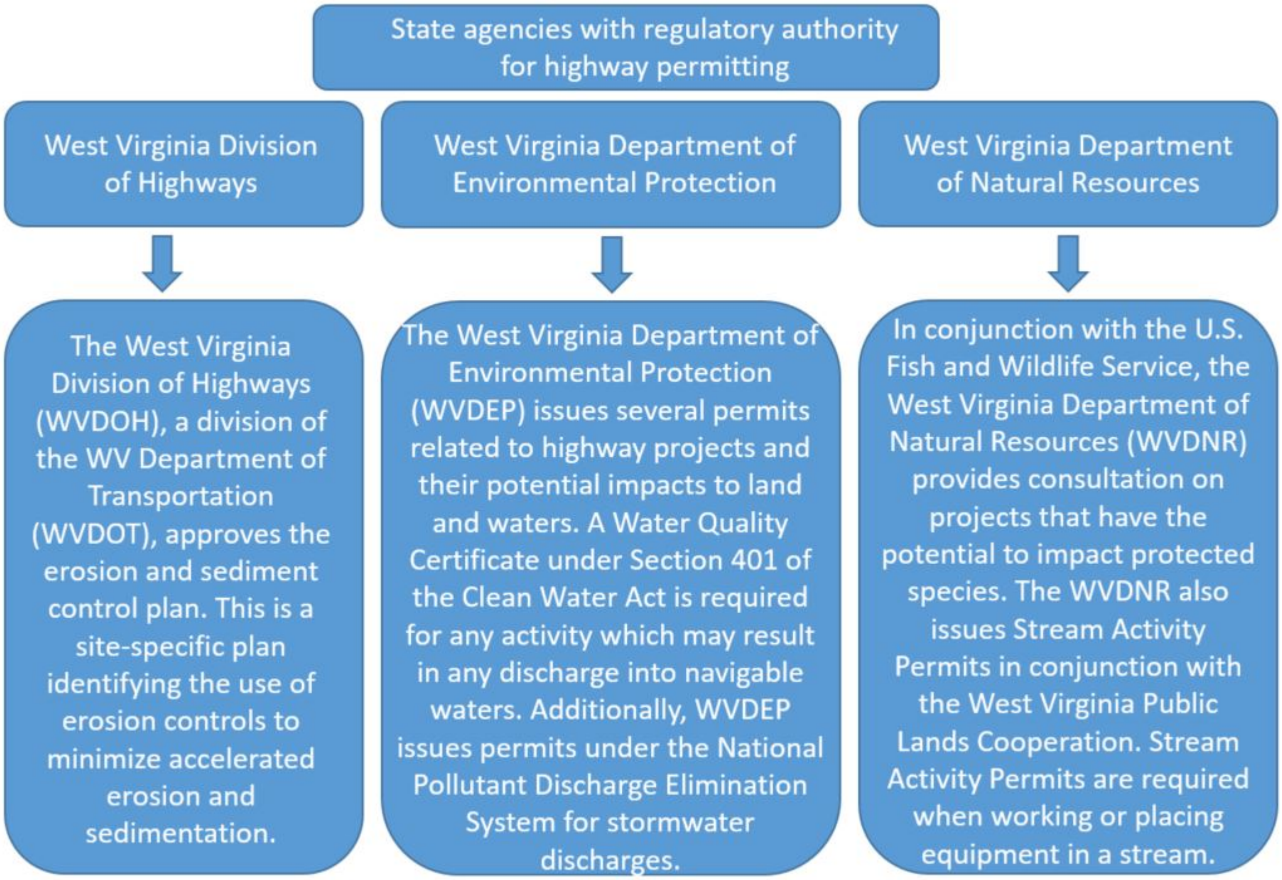
4. Right-of-Way - The fourth stage is right-of-way acquisition. Right-of-way is a general term referring to the land or property acquired for construction of a highway. It includes the entire width of land between the property lines on either side of the highway route. Property acquisition may involve the relocation of residents and businesses, and if necessary, utilities.

5. Construction - The fifth and final stage is construction. The state or local government will select a contractor, who then constructs the agreed upon highway segment.

Highway Construction Regulation

Different aspects of highway construction are regulated by various state and federal agencies. Some agencies have no regulatory authority but may be consulted on particular aspects of highway projects. For example, the U.S. Forest Service provides input where highways are proposed to cross national forest lands. Some highway projects that require the construction of a bridge across a navigable waterway of the U.S. require a Coast Guard bridge permit. The type of regulations that apply to a given highway often depend upon whether a highway is an interstate highway, or received federal-aid funding. Below is a list of agencies and their respective roles in reviewing, approving and permitting interstate highways, related to protection of streams and rivers. This list is not intended to be exhaustive.





Highway Construction Process

Depending upon whether the highway project will utilize federal-aid funding, is proposed to cross state lines, or is located wholly within a state, different federal and/or state regulatory requirements apply. After the contractor obtains the required federal and state authorizations and permits and meets regulatory requirements, highway construction can begin.

The first step in the construction process is surveying the highway right-of-way. Next, the right-of-way is the cleared and grubbed. Clearing removes the above ground debris, such as trees, brush, and boulders; while grubbing removes the underground debris, such as roots and buried logs. Once the path has been cleared, soil is moved and shaped to mark out the path of the road, forming its basic profile. Machines called graders will flatten and compact the soil to make a sturdy foundation for the road. The highway right-of-way will likely cross water bodies along its path. Construction methods used to cross streams and rivers are discussed in the next section.

Once the right-of-way has been cleared, grubbed, shaped and flattened, an aggregate subbase made of gravel and crushed rock will be spread evenly across the road's surface and finely graded. Next, asphalt or concrete is laid over the aggregate. The number of layers depends on the amount of traffic the road is designed for. The heavier the traffic, the more layers of asphalt or concrete are added. After the final layer of asphalt or concrete is laid, the entire road is compacted with a roller truck. Lastly, lines will be painted on the road.

Temporary erosion and sediment control devices must be installed before and during earth disturbances. Upon completion of the highway, permanent stormwater runoff control devices are installed and disturbed areas are re-vegetated. Erosion and sediment control and re-vegetation will be covered in more detail in later sections.

Types of Stream Crossings

In the water-rich areas of West Virginia, numerous waterbodies, streams and rivers will be either temporarily crossed to access construction areas, or permanently crossed by the highway itself. There are several methods used to cross rivers and streams based upon size and width of the waterbody, cost, site conditions, seasons, and, in some cases, input from outside organizations and agencies.

Fords

Fords can be graded natural stream beds or consist of a concrete pad in the stream bed to assist with vehicle traction. Fords can be used to cross wide, shallow streams where the stream bed is stable.

Ford crossing. Photo credit: stormwater.pca.state.mn.us

Culverts

A culvert is an enclosed tunnel structure surrounded by backfill that allows for water flow under a road. They are the most common stream crossings. There are many types of culvert materials and designs, the choice of which depends on the stream conditions, road design, and whether the culvert is temporary or permanent. Below are a few common culvert types used under roadways.

Pipe culvert

Pipe culverts are widely used culverts that are rounded in shape. They can have a single pipe, like those pictured to the right, or multiple pipes. Pipe culverts are relatively inexpensive, and require less excavation than other culvert types. Pipe arch or "squash pipe" is a common type of pipe culvert. Pipe arch culverts are advantageous over rounded pipe culverts as they have a larger waterway opening, lowering the flow velocity.

Pipe culvert. Photo credit: docs.nzfoa.org.nz

Pipe arch culvert. Photo credit: structuralguide.com/culvert

Arch Culvert

Arch culverts are arched structures that can be open-bottomed, or have a structural plate. The open-bottom design is preferable as it retains the natural stream bed. In general, arch culverts maintain a wide stream bed and improve the hydraulic capacity during low flows. They can be more expensive than pipe culverts, and take longer to install.

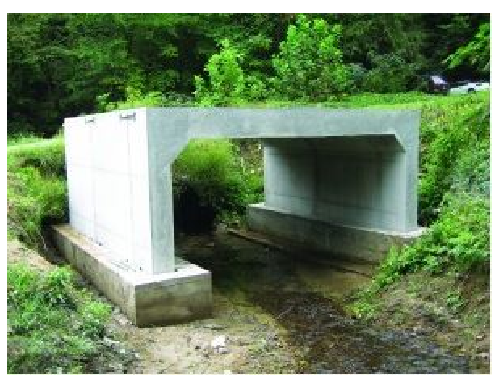
Open-bottomed arch culvert. Photo credit: co.ozaukee.wi.us

Arch culvert with structural plate. Photo credit: fostersupply.com

Box Culvert

Box culverts are rectangular shaped, reinforced concrete structures. Similar to arch culverts, they can be bottomless, avoiding disturbance to the stream bed. Box culverts are popular in road design because the shape provides a rigid structure that is appropriate in areas with poor soil conditions. Additionally, they can accommodate larger flows than pipe alternatives. Box culverts may be precast, or cast-in-place. They are the most expensive of the culvert options, and may require diversion of the stream for installation.

Precast box culvert installation. Photo credit: precast.org



Bottomless box culvert installation. Photo credit: precast.org

Bridges

During highway construction, temporary bridges may be put into place to access construction sites. Permanent bridges may be installed if the width of the waterbody is greater than 20 ft. Depending on the length of the bridge, support columns may be necessary, such as those depicted in the right-hand picture below.

Temporary access bridge. Photo credit: mabeyhire.co.uk

Permanent bridge. Photo credit: wtop.com

Stream Diversions

Some activities associated with highway construction require working "in the dry," or working in the stream while there is no water in the work area. This typically involves the use of a diversion or cofferdam. Diversions are used to isolate a segment of stream, either through diversion channel/ ditches, diversion pipes/culverts or pumping the water around a site. Diversions may be necessary for the installation of box culverts. Cofferdams are temporary barriers used to stop or redirect the flow of water from a construction site work area. A cofferdam may be necessary during the construction of a bridge support column.

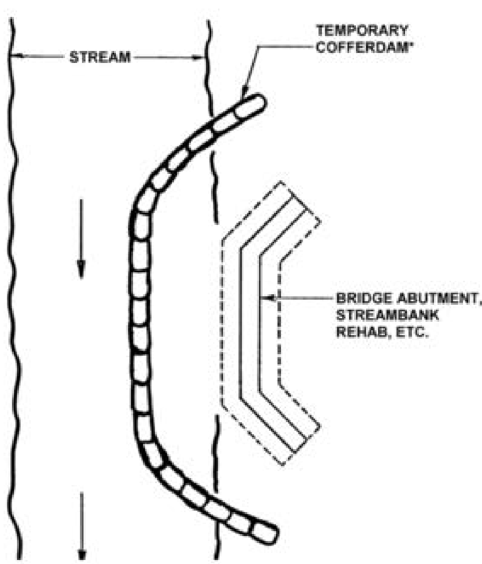


Diagram of a cofferdam.
Photo credit: stormwater.pca.state.mn.us

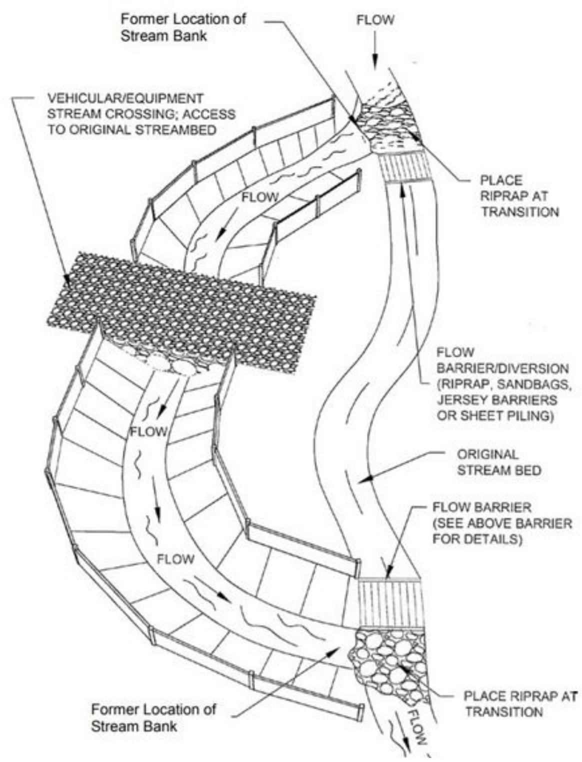


Diagram of a temporary diversion channel.
Photo credit: stormwater.pca.state.mn.us

Issues and Concerns

There are number of aspects of highway constructions that can affect streams, riparian areas and aquatic life, some of which are discussed below.

Stream Crossings

Highways can cover vast distances depending on the length of the project. Because of the rich and widely distributed stream resources across West Virginia, numerous streams and rivers may be crossed during highway construction. The various methods of stream crossings have the potential to negatively affect stream biota and their habitat.

Heavy equipment and machinery that utilize ford crossings can directly disturb the stream bed, mobilizing sediments into the water column and transporting them downstream. This can negatively affect downstream biotic communities and their habitat. Extensive use of ford crossings may also reduce the stability of the stream bed; particularly if restoration of in-stream habitat at the site is inadequate.

Culverts, bridges and stream diversions all have the potential to reduce the stability of the stream bed, which can result in mobilization of sediments downstream. Sedimentation issues may have short-term and/or long-term effects on the biotic communities at the site crossing and downstream of the site. Improperly installed culverts, such as culverts that are too shallow, can make passage difficult for aquatic life during low-flow conditions. If the culvert is too small in diameter, high flows will increase the velocity of the water passing through, and can result in scouring of the stream bottom. This will not only mobilize sediments, but can also result in a perched culvert, which prevents fish from moving upstream.

Land Disturbance in the Watershed

In some cases, highway routes may follow ridge lines or higher elevation areas where they do not cross stream channels. Even if the highway right-of-way does not cross a stream channel, any land disturbance upslope of a waterbody has the potential for water quality impacts. Land disturbances in upland areas can result in stream sedimentation issues during rain events, as water passing through the disturbed area will pick up sediment and may carry it to the stream channel if not managed properly. Deposition of sediments into the stream negatively affects the aquatic ecosystems by smothering habitat, interfering with feeding, reducing dissolved oxygen and clogging fish gills.

Wetland Impacts

Wetlands serve important hydrologic functions within many watersheds. Wetlands can trap sediments, remove other pollutants from water before reaching a stream and reduce peak flows during rain events. Wetland areas adjacent to streams will often be impacted by highway construction. A loss of wetlands and wetland function within a watershed can increase sediment and nutrient loading as well as change the hydrologic characteristics of a stream. While volunteers will be monitoring primarily for stream-related impacts, it is important to understand the connection between adjacent wetlands and streams and how construction activities in or adjacent to wetlands may be impacting stream health.

Vegetation Removal

When clearing and grubbing right-of-ways for highway construction, trees and larger vegetation will be removed. Vegetation removal is of particular concern in heavily forested watersheds. The ground litter and forest cover that trees provide prevent rain from mobilizing sediments on the forest floor. Additionally, as water runs downslope, ground litter, tree roots and ground vegetation can trap sediments, stopping the downslope movement of these sediments. Deep tree roots also stabilize slopes, helping to prevent slope failure or landslides. Forests, especially those found in the riparian area, also serve to reduce other non- point source pollutions, including those from domestic, agricultural and industrial sources. Additionally, conversion from forests to cleared land can affect hydrologic functions in the watershed. This can result in increased peak stream flows intensifying the potential for erosion and local flood events.

Access Roads, Staging Areas and Temporary Work Spaces

There are areas of disturbance related to highway construction in addition to the highway right-of-way itself. New roads may need to be constructed or existing roads improved in order to access remote highway construction areas. Access roads allow construction machinery, delivery trucks and other vehicles to access the highway construction site. Staging areas are areas where work equipment and materials are stored, and where construction workers park. Staging area construction involves the removal of topsoil and laying a gravel pad. Gravel is removed and topsoil replaced after the staging area is no longer needed. Temporary work spaces are areas that are temporarily disturbed to allow for construction of the highway. They are located adjacent to the highway right-of-way and can range in size depending on topography and other factors. Access roads, staging areas and temporary work spaces all require soil disturbance and may cause conversion from forests to cleared areas. These types of infrastructure carry the same risks to water quality discussed in the *Land Disturbance* and *Vegetation Removal* sections.

Types of Erosion and Sediment Management at Work Sites & Erosion Control Concerns

Contractors are tasked with minimizing erosion and sedimentation in areas of highway construction. Temporary erosion controls should be installed immediately after initial disturbance of soil and must be maintained throughout construction and re-installed as necessary. Once the highway is complete, permanent erosion and sediment control controls will be installed. Some temporary erosion controls may be converted to permanent controls. Permanent erosion controls are essential to preventing polluted runoff from highways and bridges from reaching surface waters.

The following are some examples of erosion controls. Pictures of each will be provided during the training presentation.

Sediment Barriers

Sediment barriers are designed to stop the flow of sediments beyond the perimeter of the construction area. Examples of sediment barriers include silt fences, hay or straw bales, compacted earth, sand bags and silt socks. Most sediment barriers are designed to control erosion and direct sediment to a basin. They can also be used to divert clean water from entering a disturbed area.

Contour Ditches

Contour ditches are channels constructed along a slope to intercept and reduce the velocity of runoff and convey sediment laden water to a sediment trap or basin. Contour ditches can also be utilized at the top of cut slopes to divert clean water away from the disturbed area.

Ditch Checks

Also called check dams, ditch checks are barriers constructed of non-erodible rock or logs across a drainage ditch to reduce the velocity of runoff. Ditch checks also allow sediment to settle and reduce erosion.

Sediment Traps

Sediment traps are excavated areas that trap and store sediment, as well as reduce the velocity of runoff. The trap should be stabilized via seeding and mulching, and have a stabilized inlet and outlet. Sediment traps are short-term sediment control structures.

Sediment Basins

Sediment basins are excavated areas used to trap and store sediment caused by erosion. Sediment basins should have stabilized inlets and outlets. At the end of construction, sediment basins can be converted to permanent erosion controls. If this is the case, the sediment basin should be fenced and designed for over topping.

Seeding and Mulching

Seeding and mulching is performed on exposed and/or disturbed areas as quickly as possible following disturbance to minimize erosion during construction. Mulch may consist of straw, hay, wood fiber, erosion control fabric or other materials. Liquid mulch binders may be used to anchor mulching materials.

Revegetation

After the highway is completed, the construction area should be re-seeded with permanent vegetation to stabilize the construction area. Stabilization matting may also be used.

Erosion Control Concerns

Even when erosions controls are installed there is the potential for a reduction or loss of function in preventing sediment from leaving the construction site. There are a few different causes for the reduction in function of erosion controls.

Improper Installation

There are best management practices developed by state and federal agencies that dictate the methods for erosion control installation based upon factors such as local topography and the location of wetlands and waterbodies. For example, these methods may state that silt socks should be staked into the ground at particular intervals, or that ditch checks should be installed at specific intervals based upon the topography of the work areas. Improper installation of erosion controls can lead to a loss of function or complete failure to reduce erosion and sedimentation. There have also been cases where no erosion controls were installed during highway construction. Failure to install erosion controls will likely result in increased sedimentation and erosion issues.

Lack of Maintenance

If erosion controls are not maintained properly, they may fail or lose some or all of their function. Erosion controls should be inspected regularly and repaired quickly if damaged or ineffective. Examples of a lack of maintenance include: failure to replace a silt fence that has been damaged during a rain event; not maintaining fresh gravel on access roads or staging areas; and permitting silt socks to become buried by sediment, allowing runoff to flow over them.

Failure

At times, even if erosion control devices are installed using the proper methods and maintained correctly, they still fail. There is a higher likelihood of failure of erosion control devices in areas of steep terrain during storm events. Large volumes and velocities of runoff can breach silt fences or overtop silt socks, causing sediment to leave the construction area and enter nearby waterbodies.

Restoration

The construction of a six-lane highway could require earth disturbance spanning a width of a couple hundred feet. After construction, the right-of-way on either side of the highway centerline will be vegetated with grasses and will then be regularly mowed or treated with herbicide.

Post-construction restoration typically consists of re-seeding permanent vegetation. Stabilization mats may also be used in areas with a high likelihood of erosion. Also, as previously mentioned, sediment basins will likely be converted to permanent erosion controls. Re-vegetation of disturbed areas carries many of the same potential risks from inadequate or failing erosion control practices that occur during construction. If seeding and permanent erosion control devices are not installed correctly or are not maintained properly, issues with erosion and sedimentation may occur and result in excessive turbidity in streams. Also, in areas of steep slopes and wet climates, re-vegetation may not prevent erosion and/or slope failure.

Soil compaction poses another potential long term issue. The large equipment used in highway construction can compact soil, decreasing its permeability and ability to infiltrate precipitation. This can result in an increase in stormwater runoff velocity and volume leading to erosion issues downslope.

Restoration is also required at both temporary and permanent stream crossings. Riparian areas should be re-vegetated with native plants to a similar density of adjacent undisturbed lands. If not properly restored, riparian areas may lose buffering function in protecting water quality. Stream banks should be returned to pre-construction contours to prevent erosion issues. The continued stability and habitat function of stream beds can be negatively impacted at highway stream crossings. If stream restoration is not completed successfully, channel materials may be mobilized causing long term effects on habitat both at the crossing site and downstream.

Highway Construction Monitoring Strategy

Phases of Monitoring

Water quality monitoring will be divided into three phases: baseline monitoring prior to construction, and monitoring during construction and post-construction. The goals for each monitoring phase are detailed below.

Baseline: Baseline monitoring is performed to establish the water quality, flow and geomorphological conditions within a stream in advance of highway development within the watershed. Data collected during baseline monitoring will be used as a reference point to identify potential pollution events during and after highway construction. Baseline data will also be used to evaluate any long-term changes that may occur within the stream as a result of highway construction. During baseline data collection, streamside measurements and sample collection will be completed.

During Construction: Monitoring conducted during highway construction is performed to identify potential pollution events, demonstrate compliance with water quality standards, notify appropriate authorities as needed, and ultimately prevent further damage to the stream system. During highway construction, streamside measurements and sample collection will be completed, as well as visual reconnaissance of erosion and sedimentation control practices performance.

Post-Construction: Monitoring will continue after highway construction has ceased within the watershed. Post-construction monitoring is conducted to identify potential pollution events that may occur due to failure or lack of maintenance of permanent erosion control devices. Additionally, data collected post-construction will be used to evaluate any long-term changes that may occur within the stream.

Selecting Monitoring Sites

Monitoring sites will be chosen based on a variety of factors including, among others: areas where the highway is proposed to cross or parallel a stream channel; areas where erosion and sedimentation controls may discharge into a stream; stream characteristics; access; and availability of volunteers.

A two-step process will be used to identify sampling locations:

1. Identify points of potential impact

First, the point(s) of potential impact along the stream will be identified. Any area where a stream channel is crossed by the proposed highway is considered a point of potential impact. Environmental impact statements should include points along the stream that will be crossed by the proposed route. There may be additional point(s) of potential impact where the highway passes through the watershed, but does not cross the stream channel itself. This includes the locations of drainage from the highway right-of-way to the stream. Erosion and sedimentation control plans should overview these measures, and maps detailing drainage areas can be obtained from permit documents and/or project contractors. Overflow pathways from erosion control measures, such as retention ponds, should be mapped to identify likely locations of drainage from the highway right-of-way to the stream. Locations along the stream where drainage from the highway right-of-way is likely to enter will also be considered a point of potential impact.

2. Select monitoring sites based on the points of potential impact

Next, monitoring sites will be selected. Ideally, there will be a downstream and upstream monitoring site for each point of potential impact. Downstream monitoring locations should be established as close as possible to the point of potential impact, but at least 25 yards below, to allow for any potential stream contaminants to fully mix throughout the stream. Stream access locations will be identified using maps and local knowledge. Monitoring sites will be established at the closest stream access location to the point of potential impact. Ideally, all downstream sites will be within a half-mile of the point of potential impact, but sites may be located further downstream if there is no other closer option for access. Where possible, a site upstream of the point of potential impact should be established. This site will serve as a reference to be used in isolating the source of potential pollution events. Upstream sites will be established as close to the point of potential impact as possible.

Local Monitoring Site Prioritization

The following hierarchy will generally be used in prioritizing monitoring sites for baseline data collection.

Priority Level	Description
1	Downstream sites where the proposed highway will cross the stream channel
2	Downstream sites where the highway right-of-way passes through the watershed
3	Upstream sites where the proposed highway will cross the stream channel
4	Upstream sites where the highway right-of-way passes through the watershed

Though upstream sites are a lower priority for baseline sampling than downstream sites, they provide useful information in characterizing potential construction impacts and should be monitored if an upstream site can be accessed and there is volunteer capacity to do so. Monitoring upstream sites allows for characterization of differences in water quality and flow as a result of highway construction and provides information that will help in pinpointing the source of a potential pollution event. Even if upstream sites are not monitored regularly, due to volunteer capacity, they should always be monitored if a pollution event is suspected.

Site documentation

Site documentation is used to record site-specific information such as location, directions, access information, study reaches and bankfull width. Recording, documenting and making this information available to any volunteer that may monitor at a site ensures that all volunteers are monitoring in the current location and that the correct study reach and bankfull widths are used for pebble counts. Information recorded during the site documentation process includes: GPS coordinates for the site, a description of the site location, travel and access directions as well as study reach and bankfull elevation for pebble counts. Photographs are taken of the site to provide more detail on site location, access, study reach and bankfull width. Where possible, site documentation will be completed by volunteer coordinators or program staff prior to initiating volunteer monitoring. In some cases, it may be necessary for volunteer monitors to perform site documentation themselves. Site documentation forms and instructions are provided in *Appendix D*.

Monitoring schedule

The frequency that you will monitor will depend upon the monitoring phase you are in. Refer to the tables below for information on when to collect your streamside measurements, complete pebble counts and collect water samples.

Baseline Monitoring		
Parameter	**Monitoring Frequency**	**Other Instructions**
Turbidity	Monthly	None
pH	Monthly	None
Water Temperature	Monthly	None
Stage	Monthly	None
Conductivity	Monthly	None
Pebble Counts	Once before construction	During low flow
QA/QC	Twice a year	Once during low flow in fall and once within 24 hours of a rain event in the spring.

During Construction		
Parameter	**Monitoring Frequency**	**Other Instructions**
Turbidity	Weekly/after rain events	None
pH	Weekly/after rain events	None
Water Temperature	Weekly/after rain events	None
Stage	Weekly/after rain events	None
Conductivity	Weekly/after rain events	None
Visual Recon	Weekly/after rain events	None
Pebble Counts	None	None
QA/QC	Twice a year	Once during low flow in fall and once within 24 hours of a rain event in the spring.

Post-Construction for the first 6 months: This is general guidance. The need for higher frequency monitoring after construction will depend on site-specific conditions. Consult with WV Rivers staff on a post-construction monitoring plan. If re-vegetation is not taking, more frequent monitoring may be needed.		
Parameter	**Monitoring Frequency**	**Other Instructions**
Turbidity	Twice a month	None
pH	Twice a month	None
Water Temperature	Twice a month	None
Stage	Twice a month	None
Conductivity	Twice a month	None
Visual Recon	Twice a month	None
Pebble Counts	Once within 6 months of construction	During low flow
QA/QC	Twice a year	Once during low flow in fall and once within 24 hours of a rain event in the spring.

Post-Construction AFTER 6 months: Or other period of time based upon site-specific conditions		
Parameter	**Monitoring Frequency**	**Other Instructions**
Turbidity	Monthly	None
pH	Monthly	None
Water Temperature	Monthly	None
Stage	Monthly	None
Conductivity	Monthly	None
Visual Recon	Monthly	None
Pebble Counts	Once a year	During low flow
QA/QC	Twice a year	Once during low flow in fall and once within 24 hours of a rain event in the spring.

Key Construction Water Quality Parameters and Habitat Measures

As a highway construction volunteer, you will take periodic measurements of certain water quality parameters. To provide some context for, and an understanding of, what we are measuring, we provide a brief discussion of key highway water quality parameters and habitat measures below.

Turbidity

Turbidity is a measure of water clarity – i.e. how much the material suspended or dissolved in the water decreases the passage of light through it. Turbidity is measured in Nephalometric Turbidity Units (NTU).

Suspended materials include soil particles (clay, silt and sand), algae, plankton, microbes and other substances. These materials are typically in the size range of 0.004 mm (clay) to 1.9mm (sand).

Turbidity can affect the color of the water. Because suspended particles absorb heat, higher turbidity levels can increase water temperatures. In turn, this reduces the concentration of dissolved oxygen because warm water holds less dissolved oxygen than cold water. Higher turbidity levels can also reduce the amount of light penetrating the water, which reduces photosynthesis and thus, the production of dissolved oxygen. Suspended materials can clog fish gills, reducing resistance to disease, lowering growth rates and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Additionally, high turbidity can negatively affect recreational experiences and can have impacts on human health. For example, pollutants such as nutrients, heavy metals, organic chemicals, bacteria and pathogens can adhere to sediment particles, and drinking water contaminated with sediment is more expensive to treat.

The development of highways within a watershed has the potential to increase stream turbidity levels through two primary mechanisms.

1. Overland Flow – Along highway right-of-ways, native trees and vegetation are cleared. The removal of vegetation from the ground surface increase erosion and sedimentation potential of soils. Also, the disturbance of soil in the watershed increases the potential for erosion and sedimentation issues. The increase in erosion and sedimentation potential is compounded in steep terrain. If effective best management practices are not put into place, rainwater flowing overland towards a stream will pick up loose soils, ultimately increasing stream turbidity as the stormwater enters the stream.

2. Disturbance of the Stream Channel – Measures taken during construction, as well as stream crossings, require disturbance within the streambed. A stream may be relocated during construction to keep the construction site dry. This relocation may either be temporary or permanent. For stream crossings, the streambed will be disturbed during culvert and/or bridge installation. Disturbance in the streambed loosens substrate and soil below the streambed which can mobilize these particles in the water column, increasing turbidity in the stream. The installation of culverts and bridges will also permanently alter the stream channel.

Pebble Counts

Pebble counts are a method of characterizing the composition of the streambed. The composition or size of particles in the substrate influences many aspects of a stream, including channel form, erosion rates, sediment supply and in-stream aquatic habitat. Envision a steep fast flowing mountain stream with boulders, cobbles and pebbles strewn about the stream bottom. Now picture a slow moving valley stream with a stream bottom of small pebbles, sand and silt. Pebble counts are a method of numerically documenting the difference in stream bed composition of these two types of streams, and other types, by collecting data that characterizes the composition of stream bed materials. By tallying the size of materials in the streambed, we can graph the particle size distribution for that particular stream, and then compare that graph to later pebble counts looking for changes. Pebble counts may capture more subtle differences in stream bed composition that are not obvious to the naked eye. This is useful in characterizing changes in stream morphology, channel structure and long term-sediment related impacts that may occur as a result of highway-related development.

Other Measures of Stream Health

Highway construction monitoring volunteers will take other streamside measurements to characterize the overall health of the stream. While these parameters may not be directly affected by highway development, they may capture indirect construction-related impacts or pollution events unrelated to highway construction. Additionally, by establishing baseline health, volunteers are protecting streams from different potential sources of future degradation.

Conductivity

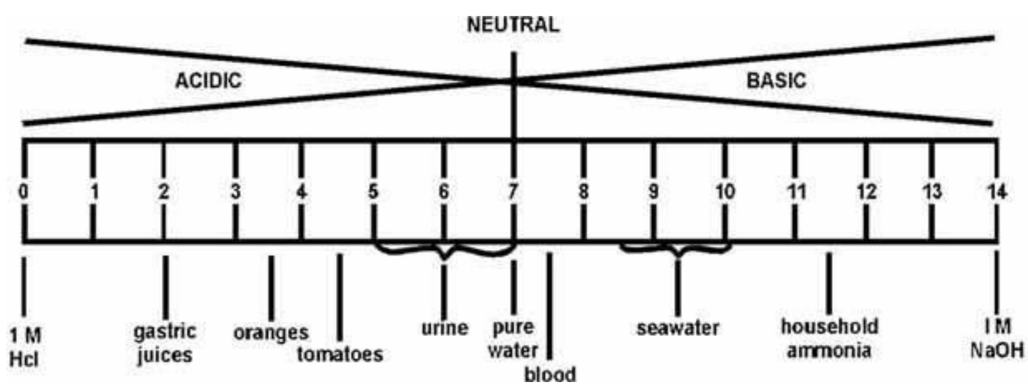
Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Pure water has very low conductivity; the higher the level of dissolved solids, the higher the conductivity. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. For the reason, conductivity is responded as microsiemens (µS/cm) at 25 degrees Celsius (25 C). the conductivity of rivers in the United States generally ranges from 10 to 1500 µS/cm, with mountain streams in West Virginia generally falling in the low end of that range.

Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams that run through areas with granite bedrock tend to have lower conductivity because granite is composed of more inert materials that do not ionize (dissolve into ionic compounds) when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize rapidly when washed into the water. Groundwater inflows can have the same effects, depending on the bedrock through which they flow.

Conductivity is a “bulk” parameter which measures a variety of contaminants in water. In this way, it is a good tool to measure a variety of impacts to stream health. Mining, urbanization and a variety of industrial activities can lead to increased conductivity in streams.

pH

pH is a term used to indicate the alkalinity or acidity of a substance as ranked on a scale from zero to 14.0, with 7.0 being neutral (neither acidic nor alkaline). pH decreases as acidity increases. For reference, the figure below presents the pH of some common liquids.



Source: U.S. EPA

pH affects many chemical and biological processes. For example, different organisms flourish within different ranges of pH. The largest variety of aquatic animals prefers a range of 6.5-8.0. A pH outside of this range reduces biological diversity in a stream because it stresses the physiological systems of most organisms and can reduce reproduction. Low pH can also allow toxic elements and compounds (such as aluminum in acid mine drainage) to become mobile and "available" for uptake by aquatic plants and animals. This can produce conditions toxic to aquatic life, particularly to sensitive species like native eastern brook trout. Changes in acidity can be caused by atmospheric deposition (acid rain), erosion and dissolution of surrounding rock, and certain wastewater discharges, including acid mine drainage.

Water Temperature

The rates of biological and chemical processes in water depend on water temperature. Aquatic organisms – from microbes to fish – are dependent on certain temperature ranges for their optimal health. Optimal temperature for fish depend upon the species: some, such as brook trout, survive best in colder water, whereas others prefer warmer water. Benthic macroinvertebrates are also sensitive to temperature and will move in the stream to find their optimal temperature. If temperatures are outside this optimal range for a prolonged period of time, organisms can become stressed and die. Temperature will be measured in degrees Fahrenheit (F). Brook trout generally prefer water temperatures that do not exceed 68 degrees F.

Stream Water Quality Monitoring

General Rules and Personal Safety Considerations

The following are a few general rules of conduct when performing stream monitoring and/or reconnaissance. Stream stewards should always adhere to these rules.

1. *Always be courteous* to landowners, construction workers and others you meet on the stream; avoid confrontation. If someone becomes confrontational, or if you are physically threatened, leave the scene and contact WV Rivers' Staff Scientist.
2. *Respect private property*; do not trespass on posted property. Seek permission before entering private property. For a landowner permission form, please see *Appendix C*. Please note that due to safety and liability reasons, you are prohibited from entering active highway construction sites without permission. Highway construction sites include the highway right-of-way, the temporary work space adjacent to the highway and equipment staging areas.
3. *If you suspect something unusual or concerning, your first call should be to WV Rivers' Staff Scientist, Jenna Dodson at 304-506-3379 or jdodson@wvrivers.org.* To maintain the credibility and assure agencies that we have sound reporting protocols, we must avoid inaccurate reporting to state or federal regulatory agencies. If you see something that might create public health or safety hazard, please contact 911. Otherwise, submit an observation using the Stream Watch App (*Appendix F*) and WV Rivers will review the situation.
4. *Do not touch, walk or wade in water or soils that may be contaminated without wearing protective clothing*. Hip boots or waders will prevent your clothing and skin from contacting contaminated materials. If you have walked or waded in contaminated water or soil, place your hip boots or waders in a plastic garbage bag. After returning home, wash them with mild detergent and rinse thoroughly before wearing them again.
5. *To avoid contacting contaminated material, always wear gloves when taking samples of materials that you suspect are contaminated.* Latex gloves are available from any drugstore for about $.50/pair.
6. *Do not place yourself in a physically dangerous situation* (for example, scaling a cliff or wading in extremely high water). Remember, there are always risks when wading in streams and it is possible to drown in even an inch of water.
7. *Use good judgment and abstain from drugs or alcohol while monitoring.* For your safety, please do not use drugs or alcohol while travelling to/from your monitoring site or completing your monitoring activities.

WV Rivers volunteers participating in the Highway Construction Monitoring Program are covered under TU's liability insurance policy for any injuries to persons or property resulting from volunteer monitoring activities, contingent upon volunteer monitors closely following the above rules. If you are injured or your property damaged while conducting monitoring pursuant to these protocols and rules, contact Jake Lemon, Jacob.Lemon@tu.org or 814-779-3965 immediately.

Monitoring Kit

A limited number of monitoring kits will be provided to volunteers at each highway monitoring training. It may be necessary to share a kit with other volunteers, but additional kits can be purchased by contacting WV Rivers. The monitoring kit contains the following materials:

Highway Construction Monitoring Kit Components

- A small pocket meter for measuring water conductivity, water and air temperature
- Packets of salt solution
- pH measurement strips and a small plastic beaker for the test
- 120cm Secchi tube
- Squirt bottle for distilled water
- Gage staff for measuring water depth
- Tape measure for measuring stream length and width
- Field notebook
- Clipboard
- Gravelometer
- Sample collection bottles

**Note: If you have already been trained in TU/WV Rivers' shale gas monitoring program and currently have access to a shale gas monitoring kit, then you will only be receiving the gravelometer and sample collection bottles.*

***Note: If you have already been trained in TU/WV Rivers' pipeline monitoring program and currently have access to a pipeline monitoring kit, then you will not receive a kit as the pipeline monitoring and construction monitoring kits are identical.*

Streamside Measurements

Measuring Turbidity

Turbidity in streams, particularly headwater streams, is a very good indicator of stream health and erosion and sedimentation impacts. Turbidity varies naturally across streams and both physical and biological factors can cause turbidity to fluctuate. Recent precipitation events can also significantly influence turbidity readings.

You will measure turbidity using a 120cm turbidity tube or a Hach 2100Q turbidimeter. If your group is using a Hach 2100Q turbidimeter, you can find the instruction manual here. If you are using a turbidity tube, you will be using one of two tube types: a removable secchi disk tube or a fixed secchi disk tube. A removable secchi disk tube has a removable secchi disk attached to a string. A fixed secchi disk tube has a secchi disk fixed at the bottom of the tube and a drainage mechanism to release water.

Measuring Turbidity with a Removable Secchi Disk Tube

To begin, remove the secchi disk from the tube and rinse the tube to ensure removal of any residual materials. Approach your sample site walking upstream, and facing upstream, fill the tube with water from the center of the stream or as close to the center as possible, making sure not to disturb or collect any sediment from the stream bed. You will want to collect the sample from the middle of the water column and fill the tube to the zero centimeter mark. Your reading should be taken immediately so that the sediment does not have time to settle at the bottom of the tube. If you notice sediment settling, it is a good idea to put your hand over the opening of the tube and shake it to re-suspend the sediment.

Your reading should be taken in the open, but out of direct sunlight. You may have to turn your back to the sun to shade the sample. Take off your sunglasses before taking a secchi tube reading. Looking down the tube, slowly lower the secchi disk. As soon as you can no longer see the secchi disk, stop lowering the disk. While continuing to look down the tube, slowly raise the disk until it reappears. Lower and raise the disk as many times as needed until you feel confident that you have found the midpoint between where the disk disappears and reappears. At this midpoint, pinch the string to the side of the tube to hold the secchi disk at this depth. Looking through the side of the tube, find where the top of the disk lines up with the measuring tape on the tube and identify the nearest centimeter. Record your measurement to the nearest centimeter.

Once the secchi disk depth is established, find the corresponding NTU (nephelometric turbidity units) that is closest to your measurement using the chart below and record the unit on your field data sheet.

Depth to Turbidity Conversion					
cm	to	NTU	cm	to	NTU
6	=	240	39	=	16
7	=	200	41	=	15
9	=	150	43	=	14
12	=	100	46	=	13
18	=	50	48	=	12
19	=	45	51	=	11
20	=	40	53	=	10
23	=	35	57	=	9
26	=	30	62	=	8
29	=	25	67	=	7
33	=	21	76	=	6
35	=	19	85	=	5
36	=	18	97	=	4
38	=	17	118	=	3

Measuring Turbidity with a Fixed Secchi Disk Tube

To begin, rinse the tube to ensure removal of any residual materials. Approach your sample site walking upstream, and facing upstream, fill a pitcher or bucket with water from the center of the stream or as close to the center as possible, making sure not to disturb or collect any sediment from the stream bed. You will want to collect the sample from the middle of the water column, and may need to collect several pitchers or buckets. Pour the water into the tube until it reaches the 120cm mark at the top of the tube. Your reading should be taken immediately so that the sediment does not have time to settle at the bottom of the tube. If you notice sediment settling, it is a good idea to put your hand over the opening of the tube and shake it to re-suspend the sediment.

Your reading should be taken in the open, but out of direct sunlight. You may have to turn your back to the sun to shade the sample. Take off your sunglasses before taking a secchi tube reading. Place the tube on a hard surface, and look through the tube toward the fixed secchi disk at the bottom of the tube. If the disk is visible, record 120cm, as you have not released any water. If the disk is not visible, slowly push down on the tube to release water from the bottom valve until the disk becomes just visible. Once the disk is just visible, immediately stop pushing down on the tube to stop the release of water. Look through the side of the tube, and locate where the top of the water lines up with the measuring tape on the tube, and identify the nearest centimeter. Record your measurement to the nearest centimeter. You may need to repeat this process if you think you released too much water.

Once the secchi disk depth is established, find the corresponding NTU (nephelometric turbidity units) that is closest to your measurement using the chart below and record the unit on your field data sheet.

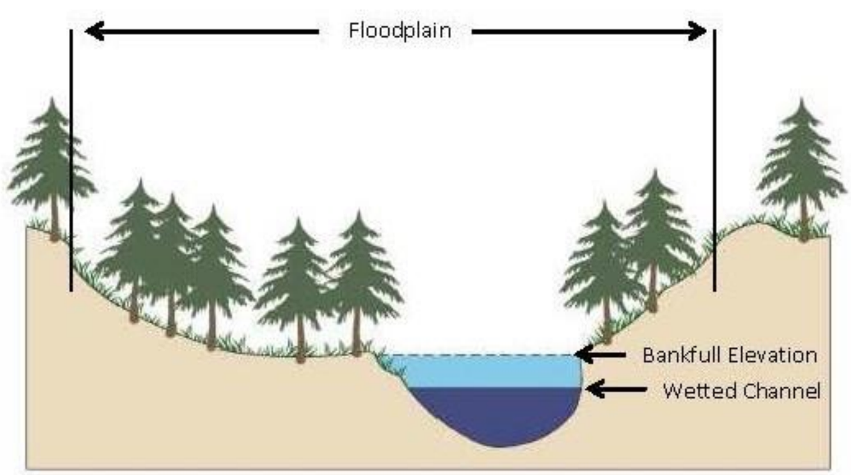
Depth to Turbidity Conversion					
cm	to	NTU	cm	to	NTU
6	=	240	39	=	16
7	=	200	41	=	15
9	=	150	43	=	14
12	=	100	46	=	13
18	=	50	48	=	12
19	=	45	51	=	11
20	=	40	53	=	10
23	=	35	57	=	9
26	=	30	62	=	8
29	=	25	67	=	7
33	=	21	76	=	6
35	=	19	85	=	5
36	=	18	97	=	4
38	=	17	118	=	3

Completing Pebble Counts

Pebble counts are a method of documenting stream bed composition by collecting a representative sample of bed material. The most efficient basic technique is called the Woman pebble count. This requires at least two people: a volunteer with a gravelometer to walk through the stream taking samples and measuring them, and a volunteer note taker who remains on the bank with a field notebook or survey data sheet, tallying the measurements by size class. Size classes are based upon ranges of particle sizes such as those shown in the chart below.

Size Category	Size Range/Description
Silt/Clay	Very Small, Smooth Feel
Sand	Very Small, Grainy Feel
Fine Gravel	2-16 mm
Coarse Gravel	17-64 mm
Cobble	65-256 mm
Boulder	257-1025 mm
Bedrock	>1025 mm or large solid surface
Woody Debris	sticks, leaves etc.

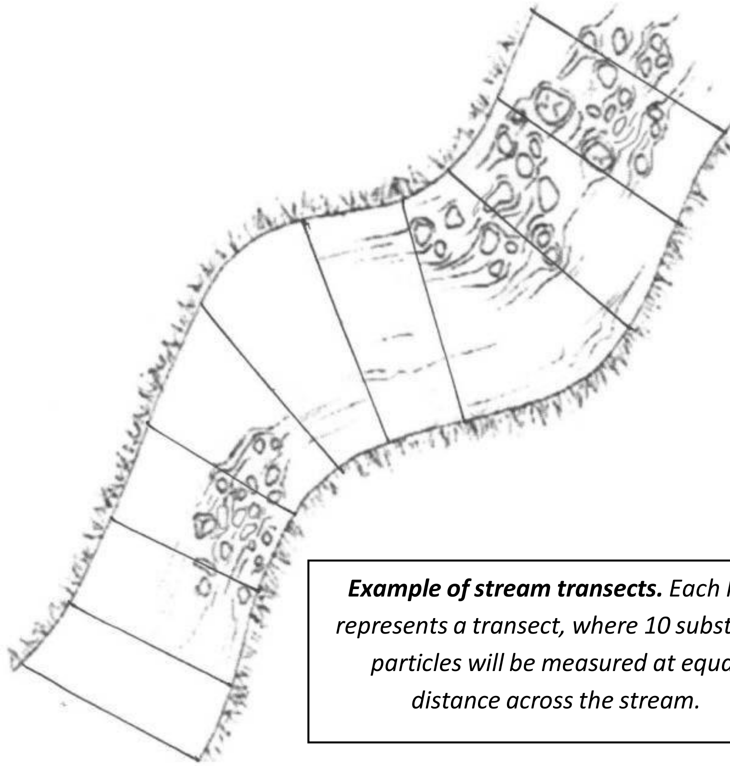
To complete a pebble count, you must first identify the stream reach where you monitor. Ideally, your stream reach will be 100 feet, though this may be reduced due to access issues. Then, you will identify the boundaries of the stream channel or the bankfull elevation at those riffle sections. This is not necessarily the present wetted stream channel. Rather, it is the point on the edge of the stream channel where any further rise in water would result in flooding.



There are three primary indicators of bankfull elevation: stream bank shape, vegetation, and substrate particle size. Often the edge of the stream channel, or bank elevation, will be signified by a change from a steep bank to a gentler slope. Also, most perennial woody vegetation will not grow in the stream channel, and the point near the stream where they are not present may signify the bankfull elevation.

Finally, smaller substrate particles will be deposited on the edge of the stream channel, so sand and silt may indicate the location of bankfull elevation. For a detailed description of how to identify the bankfull elevation of your stream, see Appendix A. Bankfull elevation and stream reach will be identified during site documentation.

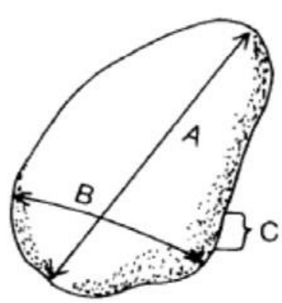
You will be taking measurements along ten equally-spaced transects in your sample reach. For example, if you have access to 100 meters of stream, you will take measurements at transects every ten meters. If you only have access to 30 meters of stream, you will take measurements at transects every three meters. Sample ten substrate particles at each transect. Please use the same transects every time you conduct a pebble count.



Example of stream transects. *Each line represents a transect, where 10 substrate particles will be measured at equal distance across the stream.*

After bankfull elevation and stream transects are identified, you are ready to begin your pebble count. Start the collection at the lower (downstream) end of the study reach at the bankfull elevation you identified. Not looking at where you are pointing, touch the stream bottom directly in front of the toe of your wader with your index finder and pick up the first particle you touch. It is important to avert your gaze as you will likely tend to bias your particle selection to larger particles if you are looking at your sample area. Measurements will be made in millimeters using a gravelometer. Simply find the smallest hole on the gravelometer that the particle will pass through and call out the measurement corresponding with that hole. Be sure to measure embedded particles or those too large to be moved. For these, measure the smaller of the two exposed axes. For the example below, (B) would be the smaller of the two axes. Call out the measurement. The note taker will tally the measurements by size class and repeat back the information to the volunteer in-stream for confirmation.

Diagram courtesy of West Virginia Department of Environmental Protection, http://www.dep.wv.gov/WWE/getinvolved/sos/Pages/SOPpebble.aspx



(A) Long axis
(B) Intermediate axis
(C) Short axis

The intermediate axis is the pebble's diameter.

Take one step across the channel in the direction of the opposite bank and repeat the process, continuing to pick-up particles until you have completed your 10 transects and measured 100 substrate particles. You will want to measure substrate particles in approximately equal distances along the transect (i.e. measure about every two feet if you stream is twenty feet wide). For small streams, you will want to step in a heel-to-toe fashion. For larger streams, a striding step between measurements may be necessary to cover the sampling area. The note taker keeps count of the number of samples measured. Continue your traverse until you reach the opposite bank so that all areas between the bankfull elevations are representatively sampled. You may have to duck under bank top vegetation or reach down through brush to get an accurate count. Move upstream at the predetermined distance and make additional transects to sample a total of at least 100 particles.

Measuring Conductivity, Water Temperature and Air Temperature

The pocket meter provided in your monitoring kit will measure temperature and conductivity. You will receive detailed training on how to use the meter during the Highway Construction Monitoring Program training. Here we will discuss general procedure and tips for field use.

It is recommended that you calibrate the meter at home, before heading to the stream, using the calibration beaker and solution provided in the monitoring kit. Experience has shown that the meter reading will drift with warming or cooling of the calibration solution. Conducting the calibration indoors at home eliminates this problem. It is a simple process and takes less than two minutes. You should calibrate before every sampling trip. After completing the calibration, make a notation of such in your field notebook; include the date, time and conductivity of the standard solution.

After arriving at the monitoring location, turn the meter on and set it aside; this allows it to equilibrate to the ambient temperature. Before placing the meter in the water to measure conductivity, record the air temperature shown on the meter screen on the field data sheet.

You should measure conductivity near the center of the stream, at a location where there is some water movement but not a fast current. Experience has shown that in a fast current the conductivity reading on the screen fluctuates erratically. In a riffle area, the slack water behind a rock provides a good location. You will take two conductivity readings and average them. Place the meter tip in the water so that the electrodes are submersed. Allow the conductivity reading to stabilize, then record the conductivity value on the field data sheet. This is a good time to record the water temperature as well. Water temperature is recorded in degrees Fahrenheit and is the number directly below your conductivity reading.

Measuring pH

It can require up to 10 minutes for the colors on the pH test strip to fully react, so we recommend that you take the pH sample after making observations about weather and stream conditions, and before completing the other stream monitoring tasks. Rinse the small plastic beaker three times with stream water and fill with enough water that the color region of the strip is submersed. Set the sample aside in a safe place. When the other tasks (i.e., conductivity, temperature, stage) are completed, remove the pH test strip and hold it up to the color chart on the plastic box of test strips. Record the pH corresponding to the colors that most closely match those on the wet test strip. Most volunteers interpolate between two values when necessary. If the color falls between two of the pH values on the color chart, record your measurement as the median of those two values. For example, if the color falls between 6.5 and 7.0 record your measurement as 6.75. The pH of our freestone streams generally falls between 5.0 and 6.5. The pH of limestone streams is higher, above 7.0.

Measuring Stream Flow

Measuring stream flow is an important metric that can help us understand the fluctuations between stream flow and conductivity and changes in stream characteristics. If you are a volunteer in the shale gas monitoring program and already use discharge or cross-sectional area to measure flow, please continue using that measurement.

If you are a new volunteer, please measure stream stage as your surrogate for a flow measurement. There are two primary methods of measuring stage.

1. From a permanent structure

Many volunteers monitor by bridges since it allows easy access to the stream and is often a convenient place to park. Since the bridge is a permanent structure, you can measure from a point on the bridge to the top of the water and record the distance. First, choose a location on the bridge that is as close to the center of the stream as possible and is easy to return to each time you monitor. An example would be a guard rail post that is close to the center of the stream. In this example, it is recommended to either mark the post, or record the location in your field notebook (i.e. 7th post from left, facing upstream) so you don't forget. Next, lower the tape until it touches the surface of the water. Choose a spot on the guard rail or post, such as the top of the guard rail, as your reference point and record the distance from that location to the surface of the water. You will measure stage from this reference point every time you monitor. Record your measurement in tenths of a foot. When measuring stage from a bridge your measurement will increase as stream flow decreases and the surface of the water drops. As your stage measurement increases, so should your conductivity readings. This is due to a higher concentration of ions as the water level lowers.

2. In-stream

Stage can also be measured in the stream using a gage staff. Choose a location in the stream that is easy to identify each time you monitor. This location must be covered by water, even during the low flow conditions, but will be wadeable during most flow conditions. It is a good idea to find reference landmarks such as rocks or trees that will help you return to the exact same point each time you sample. Each time you monitor, take a depth measurement at this spot using your gage staff, and record your stage measurement in tenths of a foot. When measuring stage in the stream, your measurement will increase as stream flow increases and the surface level rises. Using this technique, as your stage measurement increases, conductivity readings should decrease. Higher water levels will dilute the ion concentration, resulting in lower conductivity readings.

Lab Analysis

Quality Assurance Quality Control

Quality assurance/quality control (QA/QC) procedures are extremely important to the success of the Highway Construction Monitoring Program. QA/QC procedures ensure data are being properly collected, handled, processed and maintained. In short, these procedures lend credibility to the data we generate. Credible data is a key concern of scientists and environmental regulators who may use our data. We also want to be assured that our data are accurate and meaningful.

Taking Water Samples for QA/QC

You will take water samples twice a year, according to the monitoring schedule located in the 'Monitoring Schedule' section, and send them to the Alliance for Aquatic Resources Monitoring (ALLARM) at Dickinson College for QA/QC analysis. You monitoring kit contains plastic bottles for this purpose. It is important that these water samples be taken properly, so the resulting analytical data will be valid. Proper procedure for taking a water sample is as follows:

1. Put on latex gloves if you are sampling due to a suspected contamination event.
2. Label the bottle with your site name (i.e. MILLCR001), sample number (i.e. MILLCR001-1), collection date, and your name.
3. Remove the cap from the bottle just before sampling. Avoid touching the inside of the bottle or the cap. If you do so, discard the bottle and use another.
4. It is preferable to secure a sample from near the center of the stream, but conditions may dictate that the sample is taken near the bank. If you enter the stream, try to disturb the bottom sediment as little as possible. Approach your sample location walking upstream so that you do not collect water containing stream bottom sediment. Facing upstream, collect the water sample on your upstream side, in front of you.
5. Hold the bottle near its base and put it (opening downward) below the water surface. Collected the water sample 8 to 12 inches beneath the surface, or mid-way between the surface and the bottom, if the stream is shallow.

6. Turn the bottle underwater into the current and away from you. In slow-mowing stream reaches, push the bottle underneath the surface and away from you in an upstream direction. Rinse the bottle twice this way before filling it.
7. Recap the bottle carefully, remembering not to touch the inside.
8. Record the site name, sample number, sample date, and time in your field notebook.
9. Fill out your QA/QC data form, found in *Appendix H.*
10. QA/QC samples should be shipped to ALLARM (address below) within 24 hours of collection from the stream.

ALLARM
Dickinson College
5 N Orange Street
Carlisle, PA 17013

Reporting Your Data Online

Each time you monitor, your data should be uploaded to the online data portal at www.citsci.org. Instructions on how to sign up for and use www.citsci.org can be found in *Appendix B*.

Monitoring Checklist

The checklist below explains the activities that you will conduct at each monitoring location. They are listed in the order that experience has shown to be most efficient; however, you are free to conduct them in any sequence you wish.

1. Take location coordinates to confirm that you are at the correct location identified on the site documentation form.
2. Note weather conditions.
3. Note stream flow and water conditions.
4. Take a sample for pH and place pH strip in sample.
5. Record air temperature.
6. Take conductivity measurement.
7. Record water temperature.
8. Repeat conductivity measurement.
9. Take turbidity measurement.
10. Take stage measurement.
11. Take water samples for QA/QC (if collecting, see Monitoring Schedule).
12. Record pH.
13. Perform visual reconnaissance.
14. Take photographs.
15. Complete pebble count (if collecting, see Monitoring Schedule; if conducting first pebble count establish bankfull elevations).

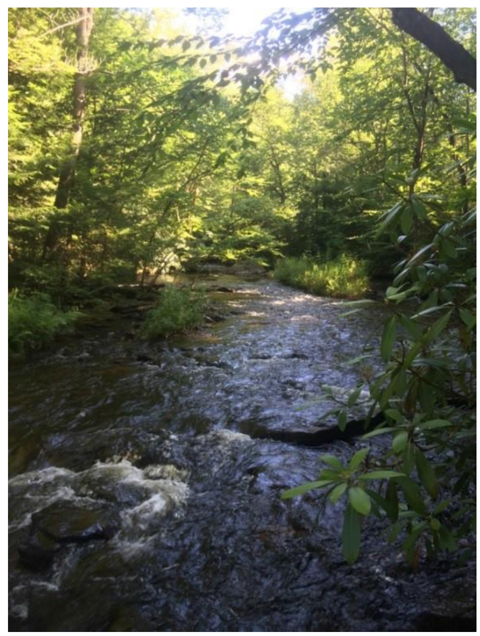
Visual Reconnaissance

Importance of Visual Reconnaissance

In addition to water quality monitoring, highway construction volunteers will conduct visual observations of streams, riparian areas, and areas of earth disturbance for highways. Reconnaissance is conducted by driving or preferably walking and making visual observations, looking for anything out of the ordinary (i.e. conditions that may indicate environmental damage results from highway development activities. Visual reconnaissance has proven to be the most effective way for volunteers to identify pollution events caused by construction activities and is an integral part of the highway construction monitoring program. It also provides volunteers with the tools to identify potential issues before they cause harm to streams.

Conducting Visual Reconnaissance

During the highway construction monitoring training, you will receive detailed instructions on what to look for during visual reconnaissance, when to conduct reconnaissance and what to do with the information you have collected. When conducting visual reconnaissance you should adhere to the same general rules discussed in the *Stream Water Quality Monitoring* section on page 22. In addition to the visual reconnaissance checklist in *Appendix E*, you should be sure to have the Stream Watch App downloaded onto your phone. Detailed instructions for how to download the Stream Watch App can be found in *Appendix F*. All submissions through the Stream Watch App will be reviewed by WV Rivers, TU, and if needed, WV DEP. Follow up and potential enforcement actions will be taken as needed.



You will first take a photo of the stream at your sample location each time you monitor, and upload it to www.citsci.org along with your data. An example of a good stream picture is on the right. These pictures can be used to identify and characterize changes in stream characteristics.

Using your checklist, look for indications of potential pollution in the stream, at the construction work site and at access roads and staging areas (if applicable). If an option detailed on the checklist is observed, submit an observation using the Stream Watch App. Depending on what you are observing you may want to take multiple pictures. It is good to have a close- up picture of the specific problem you observed as well as zoomed out picture that shows adjacent areas and gives broader context to the observation. Within the app, fill out the required information and write a detailed description of what you observed in the comment field (e.g. silt socks buried in the sediment allowing sediment laden runoff to pass over them near Laurel Creek stream crossing). If you observe a pollution incident, it is important that you investigate further, both upstream and downstream. If you observe discolored water and/or high turbidity readings, it may be due to erosion issues due to highway construction or could be due to other causes, natural or man-made. Moving upstream of the stream crossing or potential point of impact to the next access area and finding normal water clarity indicates that the source lies somewhere between the two measurements, further pinpointing where sediment is entering the stream. Once investigation is complete, be sure to submit your Stream Watch App observation. WV Rivers and TU are notified when a Stream Watch observation is submitted, and will contact you for follow up.

Some examples of observations that may indicate pollution near highway construction work sites are given below. More detailed guidance is provided in the checklist in *Appendix E*.

What To Look For

In the Stream

When performing visual reconnaissance in streams you will primarily be looking for indications of erosion and sedimentation issues such as the following.

Sediment plume in the stream

Increased Sediment Deposition on Stream Bed

Photo courtesy of *Jake Lemon*

Increased Bank Erosion

Photo courtesy *of Jake Lemon*

Stream Water Discolored

Photo courtesy of *Rick Webb*

Other examples for what to look for in the stream include (also provide in checklist in *Appendix E)*:

- Oily film on water surface
- Dead fish in the water or on stream bank
- Other visual evidence of sediment entering the stream

In the highway right of way, work site, access roads and staging areas

When performing visual reconnaissance near a construction work site you will primarily be looking for lack of erosion controls or failed erosion controls, as well as indicates of sediment moving off of the construction site.

Earth disturbance to edge of water body with no erosion controls

Photo courtesy of *Autumn Environmental*

Failed Silt Fence

Photo courtesy of *Autumn Environmental*

Buried and overtopped silt sock

Photo courtesy of *Jake Lemon*

Tear in silt fence fabric

Photo courtesy of *Autumn Environmental*

Improper installation of erosion controls

Photo courtesy of the *Pennsylvania Council of Trout Unlimited*

Erosion gullies on access road

Photo courtesy of the *Pennsylvania Council of Trout Unlimited*

Muddy Access Road

Photo courtesy of the *Pennsylvania Council of Trout Unlimited*

Water Bypassing Erosion Control

Photo courtesy of *Autumn Environmental*

Equipment in Stream

Photo credit: *notennesseepipeline.org*

Other examples for what to look for at the right of way, work site, access roads and staging areas include (also provided in checklist in *Appendix E)*:

- Signs of sediment discharge outside construction area (sediment stained leaves/vegetation)
- Topsoil piles are not stabilized
- Erosion gullies in right-of-way
- No mulching on slopes, just bare soil
- Mulching lost due to wind or water erosion
- Mud tracked on main road from right-of-way
- Lack of gravel on access roads
- Sediment laden runoff running into access road ditches to stream without filtration (silt fence, silt sock, etc.)
- Seeding of disturbed soils not completed within one week of final grading
- Construction debris not removed after re-vegetation is complete
- After first growing season, vegetation is not comparable in density and cover to adjacent undisturbed lands

Whom to Contact…And When

When to Report

It is important that potential pollution issues are reported in a timely manner and to the right people. If any of the following events occur, please report the event to the appropriate contacts identified at the end of this section.

- You observed something listed in the Visual Reconnaissance checklist.
- You measured a high turbidity reading for your site when there has been no recent precipitation event.
- Your measured turbidity reading downstream of a stream crossing or potential point of impact is higher than a turbidity reading taken upstream.
- Your measured turbidity reading after a precipitation event is higher than baseline readings taken after a precipitation event.
- Your conductivity reading taken downstream of a stream crossing or potential point of impact is 2 times higher than the conductivity reading taken upstream.
- Your conductivity reading is 2 times that of a previous conductivity reading taken at a similar flow.
- You observe or measure anything that, in your opinion, may indicate a pollution event.

How to Report

If high turbidity or conductivity readings are measured at your site you should:

- Take measurements upstream of the highway crossing or point of potential impact if possible.

If you observe a sedimentation event in the stream you should:

- Investigate upstream to attempt to find the source.
- Submit an observation using the Stream Watch App (*Appendix F*).

If you observe an issue with erosion controls or sediment management that isn't yet affecting the stream you should:

- Submit an observation using the Stream Watch App (*Appendix F*).

Note: We encourage all monitors to use the Stream Watch App as it streamlines the process of reporting incidents. However, if you are not able to use the Stream Watch App, you can email your photos, descriptions, and corresponding GPS locations to jdodson@wvrivers.org.

Whom to Contact

It is important that reports are made through the West Virginia Highway Construction Monitoring Program. This ensures that there is a second set of eyes and ears on the issue, and that we are reporting verified potential pollution events, which maintains the credibility of the program. Additionally, following this reporting chain of command will help to ensure that the correct agencies are contacted.

If you need to report an incident or issue, first submit a Stream Watch App observation. WV Rivers and TU are immediately notified upon submission and will follow up with you. If no one has reached out to you with within 24-48 hours, please follow up with a phone call to the contacts listed below, following the order listed, to confirm that your submission was received.

1. Jenna Dodson: Staff Scientist
   Email: jdodson@wvrivers.org (primary contact)
   Phone: 304-506-3379

2. Madison Ball: Restoration Program Manager; Friends of the Cheat
   Email: madison@cheat.org (if within the Cheat Watershed)
   Phone: 304-329-3621 x 7

3. Autumn Crowe: Program Director; West Virginia Rivers Coalition
   Email: acrowe@wvrivers.org
   Phone: 304-992-6070

4. Jake Lemon: Monitoring and Community Science Manager; Trout Unlimited
   Email: Jacob.Lemon@tu.org
   Phone: 814-779-3965

5. Angie Rosser: Executive Director; West Virginia Rivers Coalition
   Email: arosser@wvrivers.org
   Phone: 304-437-1274

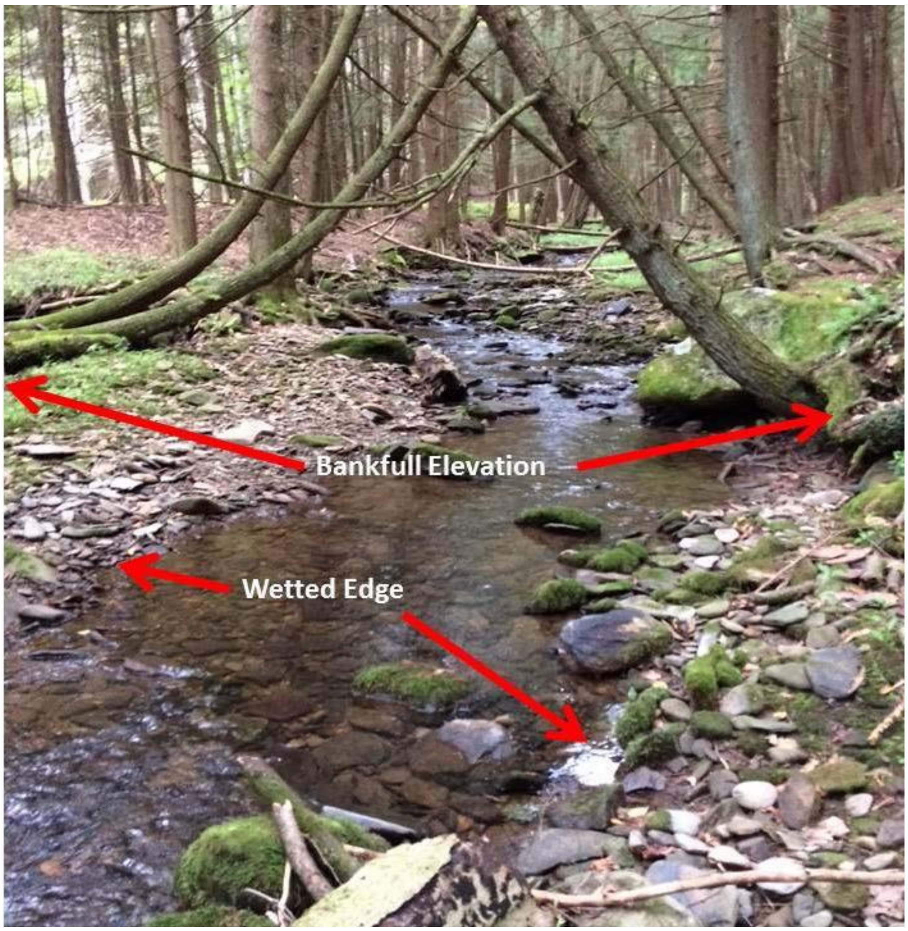
APPENDIX A

IDENTIFYING BANKFULL ELEVATION

WEST VIRGINIA RIVERS

What is Bankfull Elevation and Why is it Important?

Bankfull elevation is the point on a river bank where any further rise in stream flow would result in water leaving the channel and spilling into the floodplain. Essentially, it represents the edge of the stream channel. There may or may not be water flowing in the entire stream channel at a given time. Conversely, the stream wetted edge signifies the edge of flowing water in the stream at a particular time. The benefit of knowing bankfull elevation in conducting pebble counts is that you are able to identify a consistent sample area that encompasses the entire stream channel. The wetted channel can fluctuate on a day-to-day basis, but the bankfull channel remains fairly stable.



Tips for Idenifying Bankfull Elevation

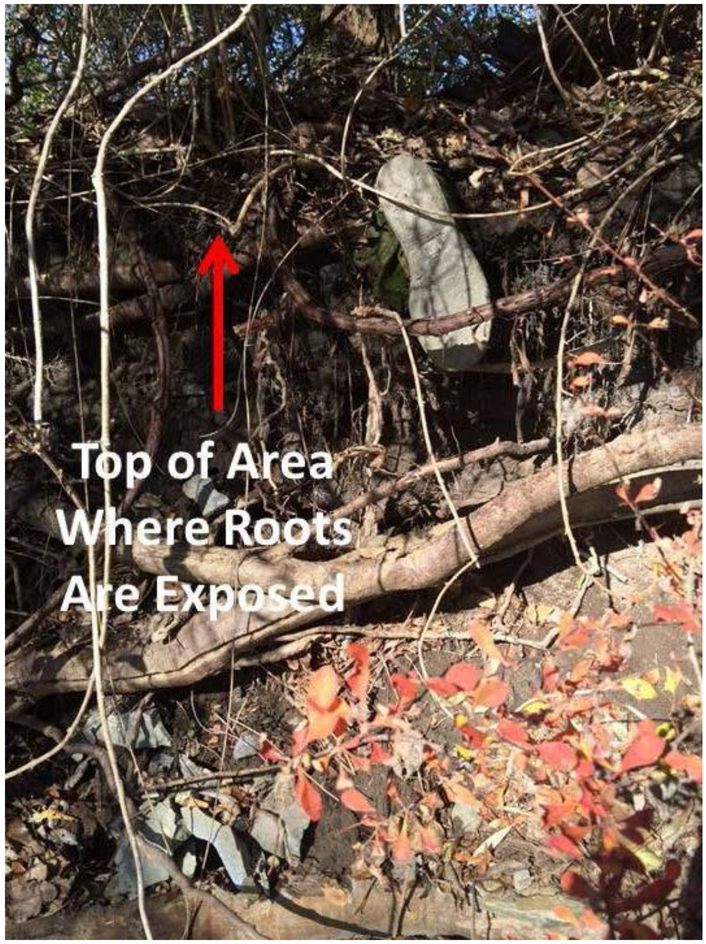
Bankfull elevation, though useful, can be tricky to determine. That said, by using some basic indicators you can approximate bankfull elevation. These indicators observed by themselves may not show the bankfull elevation. Rather, you should look at all indicators collectively and decide which best shows the edge of the stream channel. This process is somewhat subjective but use your personal judgment identify the area that sees water flow on a fairly regular basis.

1. Look for an abrupt change in the slope of the bank. If the stream bank goes from a steep slope and flattens to a more gentle slope, this can indicate the bankfull elevation.

2. Look for the lowest extent of woody vegetation. The presence of living trees in an area suggests that it is not often inundated with water.

The lower extent of woody vegetation is an indicator of bankfull elevation. Annual grasses, such as those between the black line and stream, are not.

3. Look for the top of the zone of exposed roots.



4. Look for a change in the size of substrate (from coarse material to fine material).

5. The first flat surface **above** stream point bars. Point bars are an accumulation of cobbles, gravels, sands and silts deposited on the inside edge of a stream bend/meander.

Further information on how to identify bankfull stage can be found at the following sites:

http://www.maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/stream-survey-manual/survmanv2_mainbody.pdf

http://www.vtwaterquality.org/rivers/docs/assessmenthandbooks/rv_apxkidbankfullstage.pdf

APPENDIX B

HOW TO USE THE CIT SCI ONLINE DATABASE

Make Your Data Count!

INSIDE THIS ISSUE:

Citsci.org

How to Register

Join the Project!

Educational Material

How to Enter Data

How to View Data

Using the Map

Understanding Data

Citsci.org

Citsci.org is a non-profit organization based out of Colorado State University in Fort Collins, Colorado. Citsci specializes in providing citizen science volunteer groups with tools for the entire research process including: creating new projects, managing project members, building custom data sheets, analyzing collected data, and mapping of monitoring or survey locations.

TU teamed up with Citsci in September of 2012 and released the online dataportal in January of 2013. Through Citsci, the program can now compare their conductivity and turbidity measurements to flow online, map their locations and see where others are monitoring in their area, and utilize a variety of educational materials available on the project homepage!

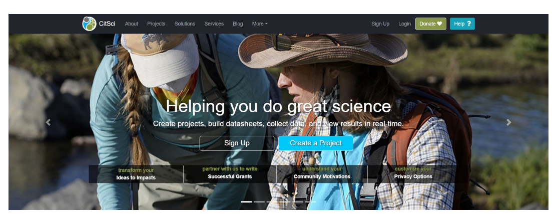
How to Register for Citsci.org

1.) Navigate to www.citsci.org

2.) Click the Sign-Up button at the top of the page, enter your information, and click 'Sign-Up'

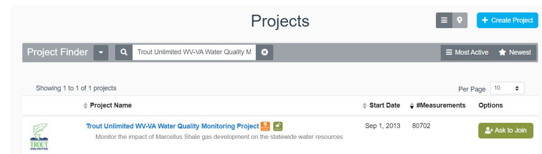
3.) Check your email and click the verification link to complete registration

4.) The link will return you to the citsci log-in page, log-in with your new account



How to Join the Project

- After you have logged in, navigate to the "**Projects**" tab at the top of your profile home page
- Search for the "**Trout Unlimited WV-VA Water Quality Monitoring Project**" and click the green "Ask to Join" button to the right of the project name



- Your membership will be approved within a day. If done on a weekend, it may take longer

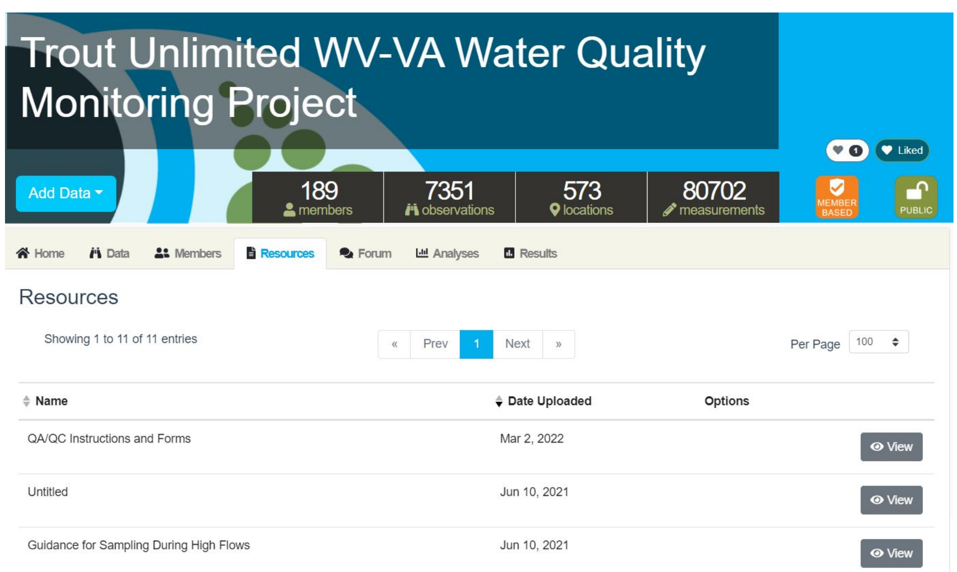
GPS Tid Bits!

- Longitude is negative! (e.g., -78.20605)
- Latitude is positive! (e.g., 40.89526)
- The Datum is WGS_84
- Your coordinates should be in decimal degrees (hddd.ddddd)

Accessing Educational Materials

Need a refresher on the correct way to collect your stream parameters or calibrate your meter? No problem, videos documenting the monitoring process are available on the Trout Unlimited WV-Va Water Quality Monitoring Project Profile page, under the **Resources** tab.

You can also find replacement data sheets and other useful documents.



Please familiarize yourself with the Project Home Page!

Make Your Data Count

How to Enter Data

Entering data using the online data portal is very simple. The data entry sheet is set-up very similar to your field data sheet and should take only a few minutes to enter your monitoring data.

From the Project Home Page:

- Locate the “Add Data” Tab at the top left of the page and select the appropriate data sheet

Date of the Observation:

- Please enter the date of observation, which is the date the data was collected
- For Observer, select your name from the drop-down box
- Enter any comments related to the data collected

Location Information:

- Select your naming convention for your site from the drop down box
- If you do not have a naming convention please send the stream name and the GPS coordinates for your site to Jake Lemon at jlemon@tu.org

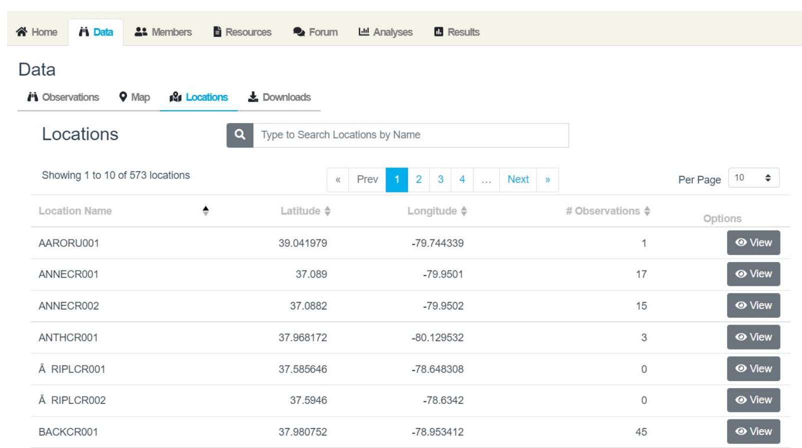
Site Characteristics:

- Fill out the data sheet with your collected parameters
- Upload any photos you have taken
- Click Submit!

How to View and Edit Data

From the Project Home Page:

- Locate the “Data” tab next to the "Home" tab
- Choose the “Locations” option underneath the “Data” heading
- Search for your location by typing it in the search box
- Click "View" beside your sites to see your data observations and trends
- Click "View" beside your observation to see data for that submission
- Click "Edit" on the top right to edit the observation



Mapping Application

From the Project Home Page:

- Locate the “Data” tab
- Choose the “Map” option underneath the “Data” heading
- Use the plus/minus controls to zoom in/out on the map and view your sites

APPENDIX C

PROPERTY ACCESS PERMISSION FORM

LANDOWNER ACCESS AUTHORIZATION

West Virginia Rivers Coalition (WVRC) has developed a stream surveillance program, called the *WV/VA Highway Monitoring Program.* This program is designed to help WVRC volunteers collect baseline water quality data on West Virginia and Virginia's streams and to monitor the potential impacts of highway development. While WVRC volunteers make every effort possible to monitor streams from publicly accessible locations, on occasion, the most effective monitoring locations can only be accessed from private lands. In those cases, volunteers should seek written permission from the private landowner, using this form.

I,________________________________, owner of_________________________, do hereby
(name of property owner) (address of property)

authorize and agree to permit ______________________________
(Volunteer name)

to enter my property for the purpose of conducting stream surveillance, including visual assessments

and water quality monitoring, on____________________________________, accessible from my property,
(stream name)

beginning_________________.
(specific date)

This permission allows the above-named individual to carry out weekly, bi-weekly, or monthly water quality tests and visual assessments, while exercising due diligence in protecting the above-referenced property and personal safety and health.

____ __________________
Property Owner signature Date

____ __________________
Volunteer Monitor signature Date

Please submit this form via email to:
Jenna Dodson
Staff Scientist
jdodson@wvrivers.org

APPENDIX D

SITE DOCUMENTATION INSTRUCTIONS AND FORM

Site Documentation Instructions

1. Enter stream name and date of documentation on the Site Documentation Form.

2. Identify access to stream. If access is on private property, please contact the property owner to ask if you can access the stream to conduct water quality monitoring from their land. If they approve, please have them fill out the landowner permission form. If stream is located on public land, no permission form is needed but it will be important for Jake Lemon to know your latitude/longitude coordinates.

3. Describe how to find and access the stream in the "Travel/Access Directions" box. Also take photographs of the access. For example: *Drive west on state highway 38, after 8.5 miles turn right onto Mill Run Road. Park at first bridge over Mill Run. Best access is on right side of the bridge facing upstream. See picture 1 and 2 for reference.*

4. Take GPS coordinates of the sampling location in decimal degrees and record these coordinates on your Site Documentation Form. You can find the GPS coordinates by marking a point in Google Maps at your site location.

5. Provide any relevant information on the stream, referring to the appropriate pictures, in the "Station Description and Comments" box. This can include sample site suggestions, directions from landowners, observations on flow and safety, etc. For example: *There is a deep pool directly upstream of the bridge. It is necessary to walk upstream about 10 meters to locate riffles that would work well for sampling. Stream was dry at time of site documentation suggesting that flow in this section of stream is seasonal. See picture 3 and 4 for reference.*

6. Provide a description and photos of the location of the bankfull elevation. For example: *Facing upstream, bankfull elevation on the left side of the stream is indicated by a line of woody vegetation shown in picture 5. On the right side of the stream, bankfull elevation is indicated by an abrupt change in slope of the bank shown in picture 6.*

7. Provide a description and photos of the study reach. For example: *Due to lack of access to private property, the study reach runs from the bridge upstream 30 meters. The upstream and downstream boundary of the study reach are show in picture 7 and 8.*

8. Email your site documentation form and pictures to Jake Lemon, Monitoring and Community Science Manager at Trout Unlimited, at Jacob.Lemon@tu.org. In this email, also cc Jenna Dodson, Staff Scientist at WV Rivers, at jdodson@wvrivers.org.

Highway Monitoring Sampling Site Documentation

Stream Name:		Date:
Coordinates		
Decimal Degrees Latitude	Decimal Degrees Longitude	
Estimated Coordinate Accuracy (if available):_________________ ☐ feet ☐ meters		
Travel/Access Directions:		
Station Description and Comments:		
Bankfull Elevation Description:		
Study Reach Description		

Site Documentation by:
Station Pictures (provide filename, date, description)

APPENDIX E

VISUAL RECONNAISSANCE CHECKLIST

Highway Construction Visual Assessment Checklist

In the Stream

- Sediment plume
- Stream water discolored
- Increased sediment deposition on the stream bottom
- Dead fish or other organisms
- Increased bank erosion
- Oil film on water surface

Stream Crossings

- Streamflow not diverted away from disturbed ground
- Downstream of crossing is muddier than upstream

Highway Construction Work Site

- Earth disturbance to edge of water body with no erosion controls
- Erosion gullies
- Bare soil: no mulch
- Failing slopes
- Failed BMPs (erosion controls)
- Sign of sediment discharge outside of construction area

Access Roads

- Lack of gravel
- Mud or sediment on main road
- Erosion gullies

Restoration and Revegetation

- Vegetation in disturbed areas is not taking
- Failing slopes
- Erosion gullies
- Stream banks are undercut and eroding
- Stream substrate materials differs from upstream and downstream reaches

Note: If you see any of the above issues, submit an observation using the Stream Watch App (*Appendix F*), and WV Rivers will follow up with you within 24-48 hours.

APPENDIX F

REPORTING INCIDENTS: STREAM WATCH APP

WEST VIRGINIA RIVERS

WV Stream Watch: Get Started

Overview:

The West Virginia Stream Watch app is a smartphone-enabled form designed to document and share water quality and habitat issues on West Virginia streams and rivers. This basic information is stored online and is viewable by WV Rivers, TU, partner organizations and agency staff. The information collected is intended to be a broad description of the disturbance with photographic evidence that is geo-located (GPS location). This information will inform follow up inspections and/or identification of potential restoration projects.

Downloading WV Stream Watch:

WV Stream Watch is not a mobile app itself, but rather is a ‘Survey’ within the mobile app called **Survey123 for ArcGIS**

Step 1: Download the Survey123 for ArcGIS mobile app to your phone:

a. Use the App Store with an iPhone, or Google Play with an Android phone
b. Or, scan the QR code below to be prompted to download Survey123 for ArcGIS from your respective app store

Survey123 app icon

NOTE: If you open the Survey123 app at this point, it will ask you to Sign In; instead, you must first download the WV Stream Watch survey form, as described below.

Step 2: Download the WV Stream Watch survey form within the Survey123 for ArcGIS app:

a. Open this link on your phone using Safari or Google Chrome: arcg.is/1jDC9G
   OR, Scan the QR code using your smartphone camera
   - This will prompt you to open the link in a browser, such as Safari
b. Click ‘Open in the Survey123 field app’. Ignore the ‘Sign in to ArcGIS online’ message if it appears. Click continue without signing in. Allow Survey123 to access your location and camera

Scan QR code to download WV Stream Watch

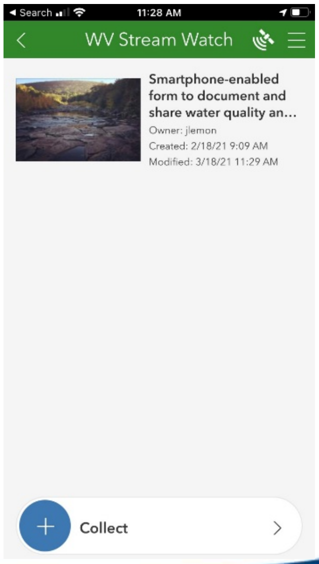
Opening WV Stream Watch within the Survey123 app:

Step 1: Open the Survey123 app (if not already open)

Step 2: Select the WV Stream Watch survey from My Surveys

Step 3: Tap the Collect icon at the bottom of your screen to begin collecting data

*Tap **Collect** at bottom to start a survey.*



The West Virginia Stream Watch app is a smartphone-enabled form designed to document and share water quality and habitat issues on West Virginia streams and rivers.

(updated: 5/14/2021)

WV Stream Watch: Get Started

Begin a WV Stream Watch survey:

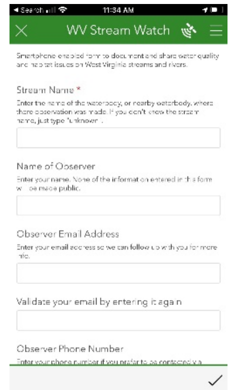
A new survey is used to collect data on each individual disturbance

Step 1: Enter the stream name and your contact information.

a. Enter the name of the waterbody, or nearby waterbody, where the observation was made.

b. Enter your contact info. This is optional but it may be necessary to follow up for more info.

c. ***Note**: Save your contact information as 'Favorites' using upper right menu so that you can simply paste in this information for every new survey



Start a Survey using WV Stream Watch

Step 2: Complete disturbance information for the survey

a. Mark the location by tapping on the marker location at top left 

- You must tap the marker location to update your GPS location
- You can tap the map to open it and move your location pin or tap the marker location button within the map to update location. Tap the check mark to capture the updated location

b. Select the general disturbance type

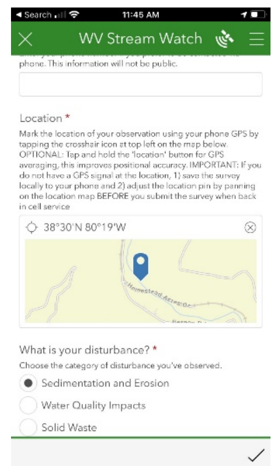
- You have to select a general disturbance to see options for specific disturbances
- ***Tip**: tap the thumbnail to enlarge photos
- See the *WV Stream Watch: Disturbances* document for more information on disturbance types

Document a sediment plume using WV Stream Watch

c. Select the specific disturbance type, which is available after you select a general disturbance type

d. Take 1-3 high quality photos of the disturbance. Use a person for scale if possible

- See the *WV Stream Watch: Photos* document for more information



Mark each disturbance location in WV Stream Watch

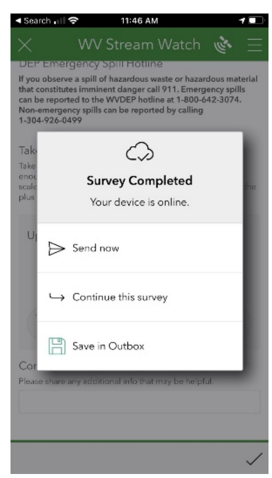
Step 3: Enter survey notes

a. Enter notes for each survey or disturbance to give context to collected data

Step 4: Complete survey by tapping the check mark at bottom right

a. If you have cellular service, tap Send **Now** when prompted.

b. If you do not have service, it will be stored in our Outbox and can be sent at a later time when you have service



Surveys will be stored in your Outbox until you have cell service

The West Virginia Stream Watch app is a smartphone-enabled form designed to document and share water quality and habitat issues on West Virginia streams and rivers.

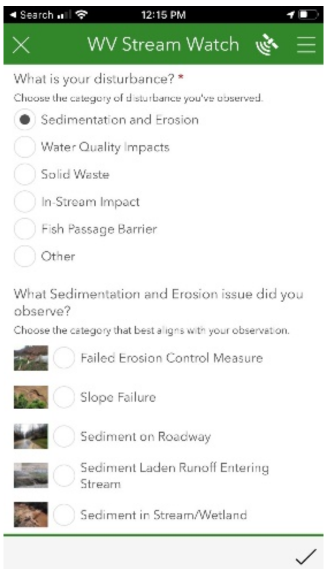
(updated: 5/14/2021)

Overview: Disturbances

The WV Stream Watch mobile application is a convenient way for citizen observers to collect data on and map disturbances on their home waters. Disturbance data are collected at two levels: general disturbances, and specific disturbances.

Type of general disturbances:

WV Stream Watch can document general (blue box) and specific disturbances. Here are the general categories:



WV Stream Watch can document both general and specific disturbances. Specific disturbance options show after the general disturbance is selected

Sedimentation and Erosion

Failed Erosion Control

Slope Failure

Sediment on Roadway

Sediment Laden Water Entering Stream

Sediment in Stream/Wetland

Water Quality Impact

Acid Mine Drainage

Algal Bloom

Pipe Discharging into Stream

Petroleum Spill and/or Fish Kill

WV Stream Watch: Disturbances

Solid Waste

Litter in Stream

Tire Dump

Open Dump

Fish Passage Barrier

Perched Culvert

Dam

In Stream Impacts

Equipment in Stream

Livestock in Stream

Additional Disturbances:

WV Stream Watch has the ability to incorporate 'Other' disturbances, so if you see other disturbance types please document them. WV Stream Watch is periodically updated, and additional disturbance types that are commonly documented will be built into future updates.

The West Virginia Stream Watch app is a smartphone-enabled form designed to document and share water quality and habitat issues on West Virginia streams and rivers.

(updated: 4/16/2021)

APPENDIX G

WATER QUALITY MONITORING FORMS

WEST VIRGINIA RIVERS

HIGHWAY MONITORING FIELD DATA SHEET

MONITOR: ______________________________ **DATE:**______________**TIME:** _____________

STREAM NAME: ____

NAMING CONVENTION:____

(Circle one for each category)

WEATHER: Clear Cloudy Partly Cloudy Fog/Haze

PRECIPITATION: Rain Drizzle Intermittent Rain Snow

PRECIPITATION LAST 48 HOURS: None Trace Light Moderate Heavy

STREAM FLOW: Low Normal High

WATER CONDITION: Clear Cloudy/Off Color Muddy

Parameter	Units	Replicate 1	Replicate 2	Average
Conductivity	**µS/cm**			
pH	**units**			

TURBIDITY:_________**cm converts to**_________**NTU**

AIR TEMPERATURE:_______**°F WATER TEMPERATURE:**_______**°F**

STAGE:_________**FEET**

CROSS SECTIONAL AREA:_________**FEET**

You will collect either stage or cross-sectional area, not both.

Comments:

PEBBLE COUNT DATA SHEET

Site Name: **Date:**

Monitor Names: **Study Reach Length (meters):**

Size Categories	Size Ranges (mm) or Description	Tallies (counts)
Silt/Clay	very small, smooth feel	
Sandy	very small, grainy feel	
Very Fine Gravel	2-4	
Fine Gravel	5-8	
Medium Gravel	9-16	
Coarse Gravel	17-32	
Very Coarse Gravel	33-64	
Small Cobble	65-90	
Medium Cobble	91-128	
Large Cobble	129-180	
Very Large Cobble	181-255	
Small Boulder	256-512	
Medium Boulder	513-1024	
Large Boulder	1025-2048	
Very Large Boulder	>2048	
Bedrock	Large Unbroken Rock Surface	
Woody Debris	Leaves, sticks etc.	

Study reach should be at least 50 feet if possible. 100 feet is ideal. Upon completion you should have 100 tallies.

APPENDIX H

QA/QC INSTRUCTIONS AND FORM

WEST VIRGINIA RIVERS

VOLUNTEER WATER QUALITY MONITORING

Quality Control Instructions – Collecting a Duplicate Sample

Alliance for Aquatic Resource Monitoring (ALLARM) is pleased to provide quality control (QC) assistance to volunteers who monitor streams within the Chesapeake Bay Watershed – a service partially funded by the Chesapeake Monitoring Cooperative (CMC).

Quality assurance and quality control (QA/QC) procedures are an important part of a stream monitoring program, and should be followed consistently to help ensure the credibility and quality of the data being collected. ALLARM helps volunteers implement QA/QC procedures in a variety of ways, including duplicate sample analysis, where volunteers collect and send a water sample to the ALLARM laboratory for analysis.

Here's how the ALLARM Quality Control Program works:

Volunteer:

1. Conducts stream monitoring as usual
2. Collects a water sample and records the results on the QC Form
3. Sends the water sample and the QC Form to ALLARM

ALLARM:

1. Analyzes the water sample using the same and other equipment
2. Compares the results between the volunteer and ALLARM
3. Sends the analysis and comparison results to the volunteer

For specific directions, please see the Quality Control Form on the back of this page. Remember to:

- Label the QC bottle with your name, site name, and the collection date.
- Fill the QC bottle completely with stream water and close the lid tightly to avoid leaks.
- Pack a small box with your water sample and Quality Control Form and mail it to ALLARM.

If you have questions, please contact:

Jinnie Monismith, ALLARM Assistant Director
monismij@dickinson.edu
717.245.1021

ALLARM will notify you with the analysis and comparison results within one month of processing your water sample. Thank you for collecting information about the health of streams in the Chesapeake Bay Watershed and participating in the ALLARM Quality Control Program!

For more information on ALLARM, please visit www.dickinson.edu/ALLARM.

VOLUNTEER WATER QUALITY MONITORING
Quality Control Form

1. Fill out the label on your QC bottle. Record your bottle # here: ________________________________

2. Enter the stream and face upstream. Rinse your QC bottle and cap *three* times by filling the bottle with stream water, then pour the rinse water out downstream. Next, fill your QC bottle completely with stream water and close it tightly with the cap.

3. Record your results in the boxes below.

Parameter	Units	Equipment	Result
Conductivity	µS/cm	Hanna EC Tester (0-2000)	
pH	pH units	ColorpHast pH strips (2 – 9)	
Stage	ft	Gage stick	
Transparency	cm	Transparency tube (120 cm)	

4. Fill out the information in the boxes below.

Volunteer Information		Sample Information	
Name		Site Name	
Mailing Address		Stream Name	
		Latitude Coordinate	
Email Address		Longitude Coordinate	
County Monitored		Collection Date	
TU Chapter or other affiliation		Collection Time	

5. Pack a small box with your QC bottle and this QC Form and mail it to: Dickinson College/ALLARM
28 N College Street
P.O. Box 1773
Carlisle, PA 17013-2896