TROUT UNLIMITED

WATER QUALITY MONITORING PROGRAM

West Virginia & Virginia

FIELD MANUAL

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TU's WV-VA Water Quality Monitoring program is based largely on the Pennsylvania TU Coldwater Conservation Corps, launched in 2010. The PATU Coldwater Conservation Corps program can be traced back to Pine Creek Waterdog program of the Pine Creek Headwaters Protection Group.

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The authors drew on a several pre-existing documents during the development of this manual. They provided much useful information and many helpful ideas and are listed below.

- *Marcellus Shale Gas Extraction: A study design and protocol for volunteer monitoring.* Alliance for Aquatic Resource Monitoring (ALLARM), Dickinson College. Carlisle, PA. June 2010.
- *Pine Creek Waterdog Log Book*. Pine Creek Headwaters Protection Group. Wellsboro, PA. 2009.
- *Designing Your Monitoring Program*: *A Technical Handbook for Community-Based Monitoring in Pennsylvania*. Prepared by River Network and Pennsylvania Department of Environmental Protection, Bureau of Watershed Management. Harrisburg, PA. 2007.
- *Volunteer Stream Monitoring: A Methods Manual*. U.S. Environmental Protection Agency, Office of Water. Washington, DC. 1997.
- *Marcellus Well Site Inspection Protocol*. Pennsylvania Fish and Boat Commission. Harrisburg, PA. 2009.
- *Stream Testing Protocols*. Delaware Riverkeeper Network, Alliance for Aquatic Resource Monitoring, and U.S. Geologic Survey. 2010.

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INTRODUCTION

There is significant potential for damage to West Virginia's and Virginia's coldwater resources as a result of land disturbances, spills, water withdrawals and wastewater discharges associated with development of the unconventional shale gas resources. Anglers and other citizens who value coldwater streams and fisheries can assist state agencies in protecting these resources through stream monitoring and field surveillance.

Protection of coldwater fisheries is an integral part of Trout Unlimited's mission, and members of the West Virginia and Virginia Trout Unlimited can contribute significantly through participation in TU's Water Quality Monitoring program. The program is designed to train a network of stream stewards who conduct stream monitoring and routine inspections of stream conditions and report problems to the appropriate agencies. In this fashion, we can promote early detection and reporting of problems that develop during oil and gas drilling and production activities. More than any other segment of society, it is we who spend considerable time on these streams, and thus we are well positioned to watch over them.

This manual provides guidance and instruction for TU volunteers in West Virginia and Virginia. It addresses topics such as: what to look for; what types of information to record; how to monitor stream water quality; how to take samples of water and soils; and whom to contact when something is thought to be amiss. It also provides information on personal conduct and safety.

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ISSUES AND CONCERNS

Oil and gas activities can affect streams and riparian areas in a number of ways. Some of these effects are discussed below.

Land Disturbances

Land disturbance for drilling pads, access roadways, pipelines, and compressor stations can cause accelerated runoff and soil erosion. This adds to the sediment loading of nearby streams and can increase stream bank erosion. Deposition of sediments into the stream adversely affects stream biota. An erosion and sedimentation control plan incorporating best management practices must be prepared and followed for all land disturbances associated with oil and gas development in West Virginia. In general, these measures do a good job of holding soil erosion in check. However, sometimes improperly installed or maintained erosion and sediment control measures can lead to accelerated erosion. Often access roadways are the problem, as they frequently are built on steep slopes, and routine maintenance is not a priority once a well is installed and producing. Recent events have shown that pipeline construction too can result in significant environmental insults.

Spills and Discharges

Discharges of polluted water to streams, whether intentional or not, can have a significant impact on water quality and stream biota. In extreme cases, fish kills can occur. Every producing gas well also produces some water, which is stored in a tank at the well site or in a nearby pit or impoundment, and periodically trucked to a treatment facility or injection well for disposal, or to another site for use in other hydraulic fracturing jobs. Unfortunately, spills do occur; and regrettably, “midnight dumping” occasionally does take place. These events can occur and important evidence can disappear before anyone takes notice, especially on more remote streams. Early detection and prompt reporting are crucial.

Water Withdrawals

Withdrawal of water from streams for use in hydraulic fracturing at gas wells can also have an adverse impact on stream biota. Between two and eight million gallons of water is needed to fracture each well. There are laws and regulations that are intended to protect aquatic life and drinking water sources from excess withdrawals. In West Virginia, natural gas operators developing horizontal wells which will use more than two hundred ten thousand (210,000) gallons of water in any month (calendar month) must submit a Water Management Plan with their Well Work Permit Application to the WV Department of Environmental Protection. However, real time monitoring is not required to make sure that there is sufficient water in stream for aquatic life. Operators intending to use water for fracking in Virginia will need to obtain permit for withdrawals from either surface or ground water sources, and routine monitoring and reporting will be required. By monitoring stream flow conditions, TU volunteers can help identify illegal water withdrawals or situations where stream flows are so low that aquatic life is stressed, and thus the water withdrawal should be suspended.

Gas Migration or Leakage

Leakage of natural gas into soil, springs, and waterways results from a pipeline break, a breech in the gas well casing, or other avenue. Since it is colorless and odorless, when gas is routed to a pipeline, mercaptan compounds are added to provide an odor for detection. When natural gas mixes with atmospheric oxygen in the right proportions, any spark or flame can ignite the mixture. This situation is particularly dangerous when someone's potable water supply is contaminated.

DECIDING WHERE TO CONDUCT MONITORING OR RECONNAISSANCE

Each chapter must decide where to deploy its volunteer resources to maximum benefit. This is a tiered process, beginning with the entire area encompassed by the chapter and funneling down to specific stream monitoring locations or areas earmarked for visual reconnaissance.

TU Conservation Success Index & Watershed Selection

The first step is to prioritize subwatersheds (HUC 12's) falling within the chapter's geographic area. This is accomplished using Trout Unlimited's Conservation Success Index (CSI). The CSI is a compilation and assessment of data and information related to a species' distribution, populations, habitat features, and threats. TU's science team has assembled spatial data from national, state, and non- profit resource management agencies into a database, analyzed the data by sub-watersheds, and assigned a categorical score of 5(High) to 1(Low), allowing for the investigation and comparison of conditions and threats across subwatersheds. The categories of spatial data are organized into three groups: trout populations (e.g., high quality streams), habitats (e.g.% of subwatershed impaired by acid mine drainage), and future security (e.g. 20 year forecasts for unconventional shale gas development).

Using local, West Virginia- and Virginia-specific data, Trout Unlimited has identified a Shale Gas Monitoring Strategy for monitoring the impacts of shale gas drilling on water quality and aquatic communities within subwatersheds in the shale formation area. See *Appendix A for TU's West Virginia-Virginia Shale Gas Monitoring Strategy.* The Shale Gas Monitoring Strategy arrays forecasts for Marcellus and Utica Shale development against existing trout population scores and produces three different monitoring strategies: immediate, long-term, and baseline. Subwatersheds containing high trout population scores and not forecasted for shale gas development are designated with a "baseline" monitoring strategy. Subwatersheds with high trout populations, containing more than five unconventional shale gas wells, and forecasted for continued development are assigned an "immediate" monitoring strategy. Subwatersheds with high trout population scores, but currently having no active drilling, but forecast for future development, are appointed a "long-term" monitoring strategy.

The first step in deciding where to monitor is to access TU's CSI Shale Gas Monitoring Strategy, prioritize the subwatersheds that are assigned a strategy within your chapter, and decide which subwatershed(s) you want to monitor. Once subwatershed(s) are chosen, the next step is to identify specific streams (main stem, tributaries) of concern, taking into account water quality and use classifications of the streams, where unconventional shale gas well pads currently exist, where unconventional shale well pads are earmarked, chapter interests, etc. It may be that a member is interested in monitoring a particular stream because he or she lives on it or fishes it frequently. Ultimately, we are interested in protecting all coldwater streams, and member interest is sufficient reason to conduct baseline monitoring of a stream within the unconventional shale gas area.

Monitoring Locations

The final step in the process is the selection of specific water quality monitoring locations and areas or stream reaches at which routine visual reconnaissance will be conducted. In basins where no unconventional shale gas development has yet occurred, you will be conducting true baseline monitoring. In other cases, you will be monitoring where shale gas development is occurring or already has occurred. When choosing monitoring sites, key considerations are manpower constraints, accessibility, locations of major tributary streams, current or future locations of unconventional shale gas wells, and locations of other development within the basin.

One important consideration is the location of major tributary streams. Tributary streams that appreciably increase flow in the main-stem waterway can alter water quality as well. Thus, it is beneficial to obtain baseline water quality data in the main stem both upstream and downstream of the tributary stream. When selecting a monitoring location downstream of a tributary, be sure to go sufficiently downstream from the mouth of the tributary so that the waters of the two streams are completely mixed. If you note a significant difference between a water quality parameter up- and downstream of a tributary, you may want to monitor the tributary itself as well.

Small headwater streams (< 10 sq. miles drainage area) can be adequately monitored via a single monitoring site located near the mouth. Any change to water quality originating in the basin can be detected there. Larger streams may require multiple monitoring locations, as any change to water quality upstream may be diluted out by the time it reaches the mouth of the stream.

Locating Unconventional Shale Gas Wells

Another consideration is the presence of drilling activity or producing wells in the watershed. Ideally, you will be aware of where a well or group of wells will be drilled. If this is the case, it is beneficial to obtain baseline data in the vicinity of the intended drilling activity prior to the initiation of access road and well pad construction. Where a well pad already exists, monitoring should be conducted both upstream and downstream of the well(s) or access roadway. Visual reconnaissance should focus on the downstream areas.

Several tools are available to help you determine where wells have been permitted and/or drilled. Both West Virginia and Virginia have online mapping systems that visually display where gas wells are located, as well as other important information about each well. One of the most user-friendly mapping tools that compiles up-to-date (weekly or monthly) unconventional shale gas well data is Fractracker.org.

To access Fractracker maps, go to www.fractracker.org and click on “Maps” tab on the top navigation bar. Scroll down to click on your state. As you zoom into the map, additional data layers will appear. For detailed instructions on how to use FracTracker.org to find wells near you, see *Appendix B*.

The West Virginia DEP Office of Oil & Gas online mapping system can be found at the following link: http://tagis.dep.wv.gov/oog/. To distinguish between unconventional shale gas (Marcellus) wells and wells drilled in other formations, click on the "Legend" tab at the bottom of the webpage. To find out specific information about each well, click on the "Zoom to Location" tab. Then move your mouse over one of the unconventional shale gas (Marcellus) well symbols and double-click on the icon to find out the following information about that specific well: American Petroleum Institute (API) number, type of well, when the permit was issued, well operator, formation name, well status, farm name and well number.

The Virginia Department of Mines, Minerals & Energy also has an online well mapping service available on the Division of Oil & Gas' website at the following link: https://maps.dmme.virginia.gov/flexviewer/DGO/. This mapping service provides only coarse scale information, does not provide latitude/longitude coordinates and does not distinguish between unconventional shale gas wells and traditional vertical wells. Information available about each well includes: well operator, county, well name, date drilled, elevation of well pad, and depth of well.

Other Considerations

The number of monitoring locations within a particular basin often comes down to manpower availability. Often it is not possible to monitor all the locations or conduct reconnaissance in all the areas chosen using the criteria discussed above. It then becomes a matter of choosing the best locations, generally those that will provide the most useful information.

Accessibility is an important consideration. Stream reaches within posted private property or a one-mile walk from the nearest road are generally not good choices. Many of our monitoring locations on both public and private property are located at bridges. Also, you should consider winter conditions when assessing accessibility.

Also important is the presence of facilities or features that could affect the conductivity or pH of the stream in question. We want to monitor in a fashion that either rules out or takes into account those features when we record changes in water quality. For example, a highway department deicing salt storage pile could affect conductivity. Thus, it would be wise to do some reconnaissance testing up- and downstream of the pile during a rainfall event prior to establishing permanent baseline monitoring locations.

If you plan to monitor a stream within a state or national forest, please inform TU's WV-VA Water Quality Monitoring Coordinator, prior to monitoring. Special procedures may need to be followed on national and state forest lands. If you must access private property to get to your monitoring location, please be sure to obtain landowner permission and submit a landowner permission form to TU's WV- VA Water Quality Monitoring Coordinator. See *Appendix C* for the private landowner permission form.

As a final note, bear in mind that the TU Water Quality Monitoring program is directed at small streams. Larger streams require a great deal more effort, equipment, and other resources. Even during normal flows, larger streams present physical challenges that we are not equipped to deal with and that the program does not address. When selecting monitoring sites, try to select locations that are manageable even at higher flows.

You can find additional information and visual tools on "Deciding Where to Monitor" under the "Resources" tab in the online data portal, located at www.citsci.org.

KEY WATER QUALITY PARAMETERS

As a TU volunteer, you will take periodic measurements of certain water quality parameters using a pocket meter. To provide some context for, and understanding of, what you are measuring, we provide a brief discussion of key water quality parameters below. To assure that the data you obtain are accurate, please be certain to carefully follow the instructions provided with the meter for its proper calibration and use.

Temperature

The rates of biological and chemical processes depend on temperature. Aquatic organisms—from microbes to fish—are dependent on certain temperature ranges for their optimal health. Optimal temperatures for fish depend upon the species: some 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 become stressed and can die. Temperature will be measured in degrees Fahrenheit (F).

To take water temperature, immerse the pocket meter (or a good stream thermometer) where there is moderate flow, allow at least one minute for it to equilibrate, then read the temperature and record it on the field data sheet or in your field notebook.

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 levels of dissolved solids, the higher the conductivity. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. For this reason, conductivity is reported as microsiemens (µS) at 25 degrees Celsius (25 C).

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 components) 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. Ground water inflows can have the same effects depending on the bedrock they flow through.

Mining, industrial and other discharges can dramatically increase the conductivity of streams through the addition of dissolved solids. In fact, conductivity is one of the key “fingerprint” parameters for

discharges associated with unconventional shale gas development. Water that contacts the shale contains high levels of dissolved salts and has a very high salinity, even higher than that of seawater. Discharges of these waters to freshwater streams can have a severe impact on aquatic organisms which are not adapted to high salinity levels.

The basic unit of measurement of conductivity is the mho or siemens. Conductivity is measured in micromhos per centimeter (µmhos/cm) or microSiemens per centimeter (µS/cm). Distilled water has a conductivity range of 0.5 to 3 µmhos/cm. The conductivity of rivers in the United States generally ranges from 50 to 1500 µmhos/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 µmhos/cm.

Turbidity

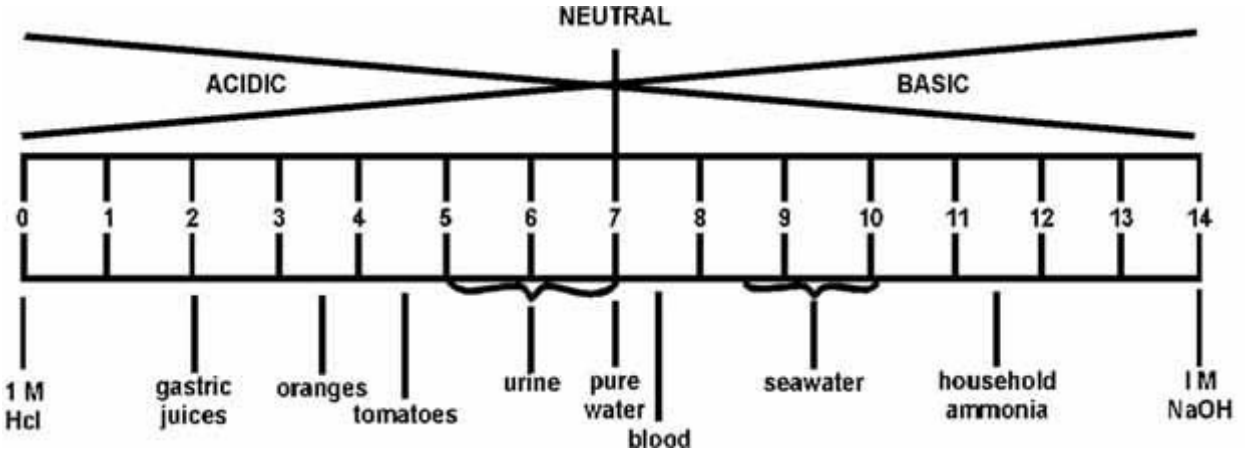
Turbidity is a measure of water clarity – how much the material suspended or dissolved in water decreases the passage of light through it. Suspended materials include soil particles (clay, silt, and sand), algae, plankton, microbes, and other substances. These materials are typically in the size range of 0.004 mm (clay) to 1.0 mm (sand).

Turbidity can affect the color of the water. Higher turbidity increases water temperatures because suspended particles absorb more heat. This in turn reduces the concentration of dissolved oxygen (DO) because warm water holds less DO than cold. Higher turbidity also reduces the amount of light penetrating the water, which reduces photosynthesis and the production of dissolved oxygen. Low DO levels can affect trout at every life phase. 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. Sources of turbidity include:

- Soil erosion
- Waste discharge
- Urban runoff
- Eroding stream banks
- Large numbers of bottom feeders (such as carp), which stir up bottom sediments
- Excessive algal growth.

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 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 rainbow trout. Changes in acidity can be caused by atmospheric deposition (acid rain), erosion and solution of surrounding rock, and certain wastewater discharges, including acid mine drainage.

Bromide

Bromides are non-toxic salt compounds derived from the element Bromine. Found naturally in a variety of sources such as seawater and underground rock formations, bromides are known to be a component of Marcellus and Utica Shale produced waste-water. Bromide itself is not harmful and is not a human-health concern, but when combined with other elements such as chlorine during the disinfectant process at a water treatment plant, bromides readily form trihalomethanes (THMs) which are a serious human-health risk. Studies have linked the ingestion and exposure to THMs with several forms of cancer and birth defects. With brine, sewage, and powerplant wastewater treatment plants discharging treated water into water-ways, elevated bromide levels are a growing concern in West Virginia and Virginia waterways, particularly when the discharge is upstream of drinking water supplies.

STREAM WATER QUALITY MONITORING

Some General Rules

Before we get into details, let's establish some general rules of conduct when conducting monitoring and/or surveillance. Stream stewards should adhere to four general rules.

1. *Always respect private property*; *do not trespass on posted property.* Please note that due to safety and liability reasons, you are prohibited from entering active drilling sites without permission. TU is not responsible for any issues that arise from anyone entering and/or trespassing on private property.

2. *Always be courteous to landowners and others* you meet on the stream; avoid confrontation.

3. *Before reporting, be certain that what you are observing is unusual or illegal.* To maintain credibility and assure that agencies take all calls seriously, we must avoid inappropriate reporting to the authorities. When in *doubt, get evidence and/or corroboration before reporting. At the very least,* contact the TU WV-VA Water Quality Monitoring Coordinator or another TU member to review the situation with you at the site.

4. *Be mindful of your personal safety at all times*. We'll address this topic in detail later.

Water Quality Monitoring

A core element of the TU program is routine monitoring of stream water quality. We discussed selection of monitoring locations in an earlier section of the manual. Here we'll discuss the monitoring activities.

The TU protocol calls for recording of the following parameters when conducting stream monitoring.

- Air temperature
- Weather conditions
- Water temperature
- Conductivity
- pH
- Water clarity
- Stream flow and water conditions
- Stream width and depths (used to calculate stream cross-sectional area)

Typically these data and information are recorded on a field data sheet, provided in *Appendix D*.

In addition, you will take water samples twice per year – once during low flow conditions and once during high flow conditions – for shipment to the National Research Center for Coal & Energy, based at West Virginia University, for measurement of bromide levels. Those same samples will be used to conduct quality assurance/quality control (QA/QC) testing to verify your field measurements.

Monitoring Kit

A limited number of monitoring kits will be provided to each chapter. Additional kits can be purchased from Trout Unlimited. The monitoring kit contains the following materials:

- A small pocket meter for measuring water conductivity, water and air temperature;
- A salt solution and a small beaker for calibrating the meter;
- pH measurement strips;
- 120cm Secchi tube;
- Squirt bottle for distilled water;
- Sample collection bottles;
- Gage staff for measuring water depth;
- Tape measure for measuring stream width;
- A hand-held GPS unit, if needed (one per chapter);
- Field notebook; and
- Clipboard.

You will need to purchase distilled water, available in the grocery store for about $1.00 per gallon. You may also want to purchase a pair or two of disposable latex gloves, in case you need to take a sample of contaminated material.

Conducting Field Monitoring

Weekly monitoring is optimal, and we encourage you to do so. We recommend that you monitor each selected site at least every two weeks. This varies somewhat, based on weather, personal constraints and other factors. In many areas, monitoring is suspended during the heart of winter due to accessibility problems and icy stream conditions. But in general, most volunteers attempt to conduct monitoring every 10 days to two weeks. We also recommend that you team up with someone in the field. Experience has shown that having someone along to record data greatly enhances efficiency and reduces the time required to complete monitoring at a site. An experienced two-person monitoring team can complete a site in 15 minutes. Finally, once you have established your monitoring site, mark it with a small rock cairn, so you can return to the exact location during each monitoring visit.

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 (first time only).
2. Note weather conditions.
3. Note stream flow and water conditions.
4. Take 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 stream width and depth readings.
10. Take turbidity measurement.
11. Secure water samples for QA/QC (if collecting, see page 18).
12. Record pH.
13. Make visual observations.
14. Take photographs (if appropriate).

pH Measurement

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 jar or 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, stream cross-section) 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. The pH of our freestone streams generally falls between 5.0 and 6.5. The pH of limestone streams is higher, above 7.0. The pH of streams in the southern coalfields of West Virginia is usually between 7.5 and 8.5 because of coal mine related water treatments.

Measuring Conductivity

The pocket meter provided in your monitoring kit will measure temperature, conductivity, total dissolved solids, and salinity. We do not use the salinity or total dissolved solids function. You will receive detailed training on how to use the meter during the TU Water Quality Monitoring Program training. Here we will discuss general procedure and tips for field use.

We recommend that you calibrate the meter at home, before heading to the stream, using the calibration beaker and solution provided in the monitoring kit. We have found that the meter reading will drift as the calibration sample cools or warms. Conducting the calibration indoors at home eliminates this problem. It is a simple process and takes less than five minutes. 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 a 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 temperature shown on the meter screen on the field data sheet in the space provided for air temperature.

You should measure conductivity near the center of the stream, at a location where there is some water movement but not a fast current. We have found 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. Using the mode button, set the meter to measure conductivity (µS). Place the meter tip in the water so that the electrodes are submersed. Often the conductivity reading will drift as the meter equilibrates to the water temperature. When the meter stabilizes, record the conductivity value on the field data sheet (see *Appendix D*). This is a good time to record the water temperature as well.

Measuring Turbidity

Turbidity in streams, particularly headwater streams, is very good indicator of stream health. Turbidity varies naturally across West Virginia and Virginia 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 Secchi tube. To begin, remove the secchi disk from the tube and rinse the tube to ensure removal of any residual materials. Facing up-stream, 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. You may have to shake some water out of the tube to ensure the water level is correct. It is also a good idea to put your hand over the opening of the tube and shake the sample to re-suspend any sediment that may have settled at the bottom of the tube. Your reading should be taken in the open, but out of the direct sunlight. You may have to turn your back to the sun to shade the sample. 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			
Centimeters	NTU	Centimeters	NTU
6	240	39	16
7	200	41	15
9	150	43	14
12	100	46	13
18	50	48	12
20	45	51	11
20	40	53	10
23	35	57	9
26	30	62	8
29	25	67	7
33	21	76	6
36	19	85	5
36	18	97	4
38	17	118	3

Stream Cross-Section or Stage

Conductivity will fluctuate with stream flow. As flow decreases, conductivity generally will increase. It is important to understand the relationship between flow and those water quality parameters in a given stream so that fluctuations in water quality can be placed in context. Before you begin to take field measurements of stream cross-section area or stage, you should identify the United States Geological Survey (USGS) stream gage that is closest to your monitoring site. On the USGS website, http://waterdata.usgs.gov/nwis/rt, click on the state where you are monitoring and identify the stream gage on the map that is nearest to your monitoring site. Each time you take a field measurement for stream flow, using either stream cross-section or stage, you should record on your Stream Monitoring Field Data Sheet (*Appendix D*), the corresponding USGS gage reading for the approximate day and time that you took your field measurements.

Measuring flow volume requires data on both flow velocity and stream cross-section. It also requires specialized equipment (a flow meter) and multiple flow readings across the stream. Fortunately, the cross-sectional area of the stream is a reasonable surrogate for flow volume and much easier to measure.

It is important to determine the stream cross-sectional area at the exact same location each time the stream is monitored, so we must choose the location carefully. Deep pools and runs and fast

flowing riffles are difficult to measure when water levels are high. On the other hand, very shallow riffles are difficult to measure when water levels are very low. So we typically choose moderate riffles and runs where flow is more or less uniform across the width of the stream as locations for measuring stream cross-sectional area. You should avoid areas where the streambed contains mud or silt, as walking in these areas stirs up a great deal of sediment. Be sure that you are measuring cross-sectional area in the stream in the same area marked by your small rock cairn, so you can be sure that you are measuring width and average depth in the same location during each monitoring visit.

The cross-sectional area is the product of the stream width and the average depth, according to the equation: Width (ft) x Depth (ft) = Area (ft^2). Your monitoring kit contains a tape measure for measuring stream width and a staff gage stick for measuring stream depth. Both should be measured in feet and tenths of a foot. Using the tape measure, measure the stream width perpendicular to the stream and record the value in the space provided on the field data sheet. You will take multiple depth readings using the gage stick. A minimum of eight depth readings is desirable. For streams more than 10 feet wide, take a depth reading every foot. For narrower streams, take depth readings on a closer spacing, so that you get eight or 10 values. Record the depth values on the field data sheet (see *Appendix D*). Later you will compute the average depth and compute the cross-sectional area.

Stage is an alternative to measuring cross-sectional area. Measuring the rise and fall of the water table in the stream using stage is an important metric that can help us understand the fluctuations between stream flow and conductivity. One advantage of using stage over cross-sectional area is that you do not have to enter the stream each time you monitor.

There are several ways to set-up and measure stage at your monitoring location. First, an actual gage can be set-up on a permanent, non-movable structure such as a bridge, pier or a large rock, or a gage can be pounded into the streambed. This type of stage takes some additional work and expense to set- up and you must make sure it is sturdy enough to withstand high-water events and not wash away.

A second type of stage can be measured from a bridge. 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 and is not varying in size or moving, 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 come back to each time you monitor. A great example would be to choose a guard rail post that is close to the center of the stream and either mark the post or write it down in your field notebook (e.g., 7^{th} post from left, facing upstream) so you don't forget. Next, attach a small weight to the end of your measuring tape and lower the tape down until the end touches the water. Choose a spot on the guard rail or post as your reference point and record the distance. A good example would be to measure to the

top of the guard rail. Measurements should still be taken in tenths of a foot. It is important to remember when measuring from a bridge that your measurement will increase as stream flow decreases and the surface water table drops. As your stage measurement increases, so should your conductivity readings.

It is important that you stick with one method for measuring your flow surrogate. If you began monitoring cross-sectional area with a gage stick and tape measure in the stream, you should stick with this protocol. Switching to a stage will not allow you to compare conductivity readily between the two methods. If you decide that you would rather use stage as a surrogate for flow than cross-sectional area, then use both the gage stick/tape measure in stream and a stage from a bridge or other structure, until you have enough measurements to characterize high flow and low flow events using each method, and then switch to the method you prefer.

Quality Assurance

Quality assurance/quality control (QA/QC) procedures are extremely important to the success of the TU stream monitoring program. QA/QC procedures ensure that a system is operating correctly and that the system's output is correct, whether that output is manufactured goods, a service, or in our case, data. In short, those procedures lend credibility to the data we generate. That the data are credible 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.

Twice per year volunteers will send samples to the National Research Center for Coal & Energy (NRCCE) lab at West Virginia University. The samples should be sent via mail, no longer than 24 hours after collecting the sample, and do not need to be kept cold during this process. The address to send the samples is:

West Virginia University
NRCCE / Analytical Laboratory
385 Evansdale Drive – Ground Floor, Room G22
Morgantown, WV 26506-6064

One of the two samples should be taken at a time of low flow in the stream and the other should be taken at a time of high flow in the stream. When the samples are taken exactly is up to the volunteer as long as one sample is from low flow and one from high flow conditions. The samples will be tested for quality assurance/quality control for conductivity and bromide levels.

The sample should be mailed in along with a QA/QC Data Form and NRCCE's chain of custody form within 24 hours of collection. These forms can be found in *Appendix D*.

Taking Water Samples

As noted earlier, you will take water samples on two occasions and send to the National Research Center for Coal & Energy (NRCCE) at West Virginia University for QA/QC analyses and analysis of bromide levels. In addition, there may be times that you will be called upon to take a water sample from a stream for later analysis of water quality parameters. Your TU monitoring kit contains 16-ounce plastic bottles for this purpose. It is important that these water samples be taken properly, so the resulting analytical data will be valid. This is particularly critical should you take a sample during a pollution event. Proper procedure for taking a water sample follows.

1. *Put on the latex gloves, in case you determine that the water you are sampling is contaminated.*

2. Label the bottle with the sample number/location, date, and time. Number samples with your initials followed by a dash and then a number (XXX-1, XXX-2, etc.…). Be sure to record this information in your field notebook.

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's preferable to secure a sample from near the center of the stream, but conditions may dictate that you secure the sample from the bank. If you enter the stream, try to disturb as little bottom sediment as possible. In any case, be careful not to 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 plunge it (opening downward) below the water surface. Collect a water sample 8 to 12 inches beneath the surface, or mid-way between the surface and the bottom if the stream reach is shallow.

6. Turn the bottle underwater into the current and away from you. In slow-moving 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. Leave a one-inch air space. Do not fill the bottle completely (so that the sample can be shaken just before analysis). Recap the bottle carefully, remembering not to touch the inside.

8. Record the sample number, date, time, and location information in your field notebook.

9. QA/QC samples should be shipped to NRCCE within 24 hours of collection from the stream.

In cases where there is a visible layer floating on the surface of the water (e.g., an oil slick) take a sample of that surface layer as well. Follow the sampling procedure outlined above, except hold the mouth of the bottle at the water/air interface to capture the floating material. Be sure to record in your field notebook that it is a surface sample.

Taking Soil and Sludge Samples

Unlike materials discharged to a stream, liquid or solid material that has been dumped on the ground surface, roadway, or in a drainage ditch is not likely to migrate. These materials are best sampled by staff of state agency personnel. The best course of action when encountering sludge or contaminated soil is to record your visual observations and the GPS coordinates in your field notebook and await arrival of appropriate agency personnel. However, there may be situations when it is imperative to obtain a sample immediately (during a heavy rainstorm, for instance). You will need latex gloves, a plastic or metal trowel, and a zip-lock bag for this purpose. Follow the procedure below when taking a soil or sludge sample.

1. Put on the latex gloves.

2. Label the bag with the sample number/location, date, and time. Number your samples as given in Water Samples section above.

3. Prior to sampling open the zip-lock bag, being careful to avoid touching the inside of the bag. If you do, use another.

4. Using the plastic trowel, scoop up a sample of the material and place it in the bag. One cupful should be adequate.

5. Push excess air out of the bag and zip it closed.

6. Record the sample number, date, time, and location information in your field notebook.

7. As soon as you return home, place the sample in the refrigerator. Keep the sample cool until you turn it over to appropriate agency officials.

To avoid cross contamination, the trowel should be thoroughly cleaned between samples. If you take a second sample, clean the trowel as best you can before securing it. Upon returning home, wash the trowel in detergent, rinse thoroughly with tap water, and allow to air dry.

Chain of Custody

If you take a sample during a pollution event, the custody of that sample should be carefully tracked. This process is termed *Chain of Custody*. It means that custody and care of the sample can be tracked from its initial taking through analysis at a laboratory. Each time the sample changes hands, the event is recorded on a chain of custody form. Copies of the form are provided along with your field data sheet in *Appendix D*. Multiple samples can be transferred using a single form. Before turning the sample(s) over to someone else, record the information about the sample(s) on two copies of the form. For each sample, enter into the table the sample number you assigned, the date and time the sample was taken, the location, and the type of sample (i.e., water, soil, or sludge). When you relinquish the sample(s) to another party, sign and date both copies of the form and make sure the person accepting the sample does the same. You keep one copy and the person accepting the sample from you keeps the other.

Reporting Your Data Online

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

CONDUCTING VISUAL RECONNAISSANCE

In addition to water quality monitoring, TU volunteers conduct periodic visual observations of streams, riparian areas, and areas of earth disturbances for unconventional shale gas wells, access roads, and pipelines. 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 resulting from gas development activities). The table below provides some more specific guidance. More detailed guidance is provided in the form of a checklist, which can be found in *Appendix F.*

Table 2. Observations that may indicate a threat to streams or other resources

Observation	Possible Indication
Muddy, sediment-laden water in ditches or streams	Accelerated erosion from access road or other land disturbance
Erosion rills or washouts on access roads or other disturbed areas	Failure of erosion and sedimentation control measures; accelerated erosion
Any change in water color or appearance, especially an oily film on the water surface	Discharge of waste or contaminated water to the stream
Discolored water or streambed where a tributary or spring enters the stream	Possible indication of contamination in the tributary or spring
Sediment or turbidity in a water body in the absence of recent precipitation, or abnormal, persistent foam or bubbles	Accidental or illegal discharge from a pond, tank or other source
Unusual, usually organic odors	May indicate presence of waste or contaminated materials nearby
Changes in conductivity, pH, or other water quality parameter	Possible spill or other discharge reaching the stream
Dead fish or other organisms in the water or along the bank	Discharge of waste or contaminated water
Water hoses in or adjacent to stream	Possible unauthorized water withdrawal
Black or unusually colored sludge on the land surface, especially in a ditch or depression	Possible illegal dumping of liquid or solid waste material
Tanker trucks in unusual or unexpected locations	Possible unauthorized water withdrawal
Gas bubbling from a pool, puddle, or stream, or a strong sulfur odor	Escape of free natural gas from a well or pipeline (Be very cautious!)

When conducting visual reconnaissance, you should adhere to the same general rules discussed above under STREAM WATER QUALITY MONITORING. In addition to the checklist (see Appendix F), it is helpful to have a pocket camera, GPS unit, binoculars, and of course, your field notebook along. The GPS unit can be used to record the coordinates of anything of interest. Should you observe any of the conditions noted in Table 1 or the checklist, photographs are invaluable.

Participants in the TU Water Quality Monitoring Project are provided a variety of materials and equipment, including a sturdy field notebook for recording notes. Whether you are doing routine monitoring or observing a pollution incident, you should always record your observations and other important information in the field notebook. Place the day, date, and time at the top of the page, followed by a physical description of the location (for example, Atkins Road bridge over Fishing Creek, one mile downstream of the Methodist Church). This helps anyone conducting follow-up investigations to find the exact location. In addition, recording the latitude and longitude using a GPS unit is very helpful. The final piece of general information to record in the notebook is the current weather conditions, along with the weather conditions during the past 12 hours (if you know). Since materials are often washed into streams via runoff, tracking recent rain events is very important.

Following this general information, write a detailed physical description of what you observed. This typically involves visual observations, but also could include smells and sounds. Describe any vehicles or equipment you observe. It will be helpful to record the license number, company name, and any other ID number on vehicles.

Photographs are extremely helpful when documenting a pollution event or other incident. Although participants are not provided with a camera, we hope that you will have your personal digital camera along. Make sure that the date/time stamp on your camera is accurate. Record the number and subject of each photograph in your field notebook (for example, Photograph 4 – Fishing Creek looking downstream from Atkins Road bridge).

If you observe a pollution incident, it is extremely important to investigate further, both upstream and downstream. This information can be extremely helpful in identifying the origin of any contaminants. For example, if you record specific conductivity much higher than normal, it may be due to an influx of briny water from drilling or other oil/gas activity. Moving upstream to the next bridge and finding normal, low specific conductivity indicates that the source is somewhere between the two bridges. In like manner, if you observe a fish kill, attempt to trace it upstream until there is no longer evidence of fish mortality.

As a final notation, when you leave the site, record the time in the field notebook. When you move to a new location, record all of the same types of information in your field notebook.

If there is an imminent threat to human life or property (such as free gas bubbling from the ground or water), contact the local Emergency Management Agency (dial 911). If you observe conditions that are of concern but do not constitute an imminent, severe threat to human health or the environment, your first call, if you are a West Virginia volunteer, should be to the West Virginia Department of Environmental Protection Office of the Environmental Advocate's toll free hotline: 1-800-654-5227. They will then assist you in contacting the proper agencies/offices. For additional information about contacting the Office of the Environmental Advocate please see *Appendix G*.

If you are volunteer in Virginia your first call should be to the owner/operator of the well or other facility in question. Hopefully, they will then respond appropriately and repair or correct the situation. The owner/operator's name and telephone number are often posted on a sign at drilled or completed wells, or on the side of a storage tank.

It is important to immediately contact the appropriate agencies when you have observed a pollution event or firmly believe that something illegal has taken place. There are several primary agencies— such as the West Virginia Department of Environmental Protection (Office of Oil and Gas), West Virginia Department of Environmental Protection (Office of Water and Waste), Virginia Department of Mines, Minerals and Energy (Division of Oil and Gas) and the U.S. Environmental Protection Agency (USEPA) —and several secondary agencies that may need to be contacted. The decision diagram on the following page will assist you in deciding when to act and whom to contact.

For potential pollution incidents occurring in West Virginia, it should be noted that the West Virginia Department of Environmental Protection Oil & Gas Inspectors should only be notified if the issue is on a well pad. For all other issues, such as pipelines, the West Virginia Department of Environmental Protection Office of Water & Waste Environmental Enforcement Inspectors should be notified. Contact information for Oil & Gas Inspectors and Environmental Enforcement Inspectors can be found in *Appendix G.* If you are unsure of which office to contact in West Virginia, you should contact the

If the incident occurs within the Monongahela National Forest or George Washington-Jefferson National Forests, you should contact the forest service district office for the area that you are in. See *Appendix G* for contact information.

If you observe a pollution event or illegal activity on state forest, state park or wildlife management area lands, you should also contact the individual state forest district, state park office or wild management area office. See *Appendix G* for contact information.

If you observe a fish kill, you should contact the West Virginia Division of Natural Resources or the Virginia Department of Game & Inland Fisheries, as well as the primary agencies described above.

There are additional, second-tier organizations that you may want to inform. If there is evidence that erosion and sedimentation control practices are not being implemented or maintained

properly, contact the local county Conservation District. See *Appendix G* for a listing of telephone numbers by county.

After contacting the appropriate government offices, please inform TU's WV-VA Water Quality Monitoring Coordinator and your local chapter President. TU's WV-VA Water Quality Monitoring Coordinator is Jaimie Holmes, and she can be reached at 304-614-6699 or at jholmes@tu.org.

To assist you in making decisions regarding which agencies and organizations to contact, a decision flow chart is provided on the following page. Simply begin at the top left of the flow chart. As you answer the questions, you will be directed to a listing of contacts. A master listing of agencies, along with telephone numbers, is provided in *Appendix G*. The exact office you will call depends upon your location. For this reason, you should list the appropriate offices and their telephone numbers on the last page of your field notebook. They will then be handy when you need them.

We stress again that you should contact these agencies only when you are certain that you have witnessed a pollution event or illegal activity. If you are not certain, further inquiry may be appropriate. Collect all the information and data you possibly can at the site, and then consult with Trout Unlimited's WV-VA Water Quality Monitoring Coordinator and your chapter president to decide what subsequent action is appropriate.

After contacting the appropriate agencies regarding a pollution or other incident, a courtesy call should be made to the owner/operator of the well or facility.

TU West Virginia-Virginia Water Quality Monitoring Project DECISION DIAGRAM

IS THE CONCERN OCCURRING ON THE WELL PAD?

YES

Notify:
1. WV DEP Office of Environmental Advocate
2. WV DEP Oil & Gas Hotline *OR* VA DMME Oil & Gas
3. EPA Gas Drilling Tip Line
4. Facility Owner/Operator
5. TU WV-VA Water Quality Monitoring Coordinator
6. Chapter President

NO

IS THE CONCERN OCCURRING OFF OF THE WELL PAD?

YES

Have you observed a fish kill?

YES

Notify:
1. WV DEP Office of Environmental Advocate
2. WV Division of Natural Resources OR VA Dept. of Game & Inland Fisheries & VA DMME Oil & Gas

YES

Is conductivity 3x baseline conductivity at comparable flow, or 2x upstream conductivity?
OR
Have you observed a discharge to a stream or other threat to water quality?
OR
Have you observed accelerated erosion not yet directly affecting a stream?

YES

Notify:
1. WV DEP Office of Environmental Advocate
2. WV DEP Office of Water & Waste *OR* VA DMME Oil & Gas
3. EPA Gas Drilling Tip Line
4. County Conservation District (*for local erosion or sedimentation issues)*
5. Facility Owner/Operator
6. TU WV-VA Water Quality Monitoring Coordinator
7. Chapter President

Have you reported an incident or conditions within the Monongahela or George Washington-Jefferson National Forest?

YES

Notify:
Appropriate US Forest District Office

Have you reported an incident or conditions that occurred on state park, state forest, or wildlife management area lands?

YES

Notify:
WV Div. of Natural Resources State Forest District Office, State Park Office, or WMA office
OR
VA Dept. of Forestry regional office, VA Dept. of Conservation & Recreation State Park Office (for that park), or VA Dept. of Game & Inland Fisheries District Offices

PERSONAL SAFETY CONSIDERATIONS

As important as documentation of a pollution event is, it should not be pursued at the risk of your personal safety. Some important safety suggestions are enumerated below.

1. *Do not touch, walk, or wade in water or soils that may be contaminated.* If you suspect that water/soils are contaminated, take pictures and document what you visually see, then contact the appropriate authorities. Avoid contact with contaminated water/soils.

2. *To avoid contacting contaminated material, always wear gloves when taking samples of materials that you suspect are contaminated.* Latex gloves are available from Wal-Mart or any drugstore for about 50 cents per pair.

3. *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.

4. *Avoid confrontation.* If someone becomes confrontational, or if you are physically threatened, leave the scene.

5. *Be very cautious if you suspect that free gas is bubbling from the ground or water.* It could be ignited by any spark or flame. Immediately contact the local Emergency Management Agency.

TU is not responsible for injury to persons or property resulting from volunteer monitoring activities associated with the TU Water Quality Monitoring Program.

APPENDIX A

TROUT UNLIMITED

CONSERVATION SUCCESS INDEX

WEST VIRGINIA-VIRGINIA

MONITORING STRATEGY

[Reserved]

APPENDIX B

Locating Oil and Gas Wells Using Fracmapper

Presented by FracTracker.org

June 2013

TROUT UNLIMITED

FRACTRACKER Alliance

Exploring data, sharing perspectives, and mapping impacts of the oil and gas industry

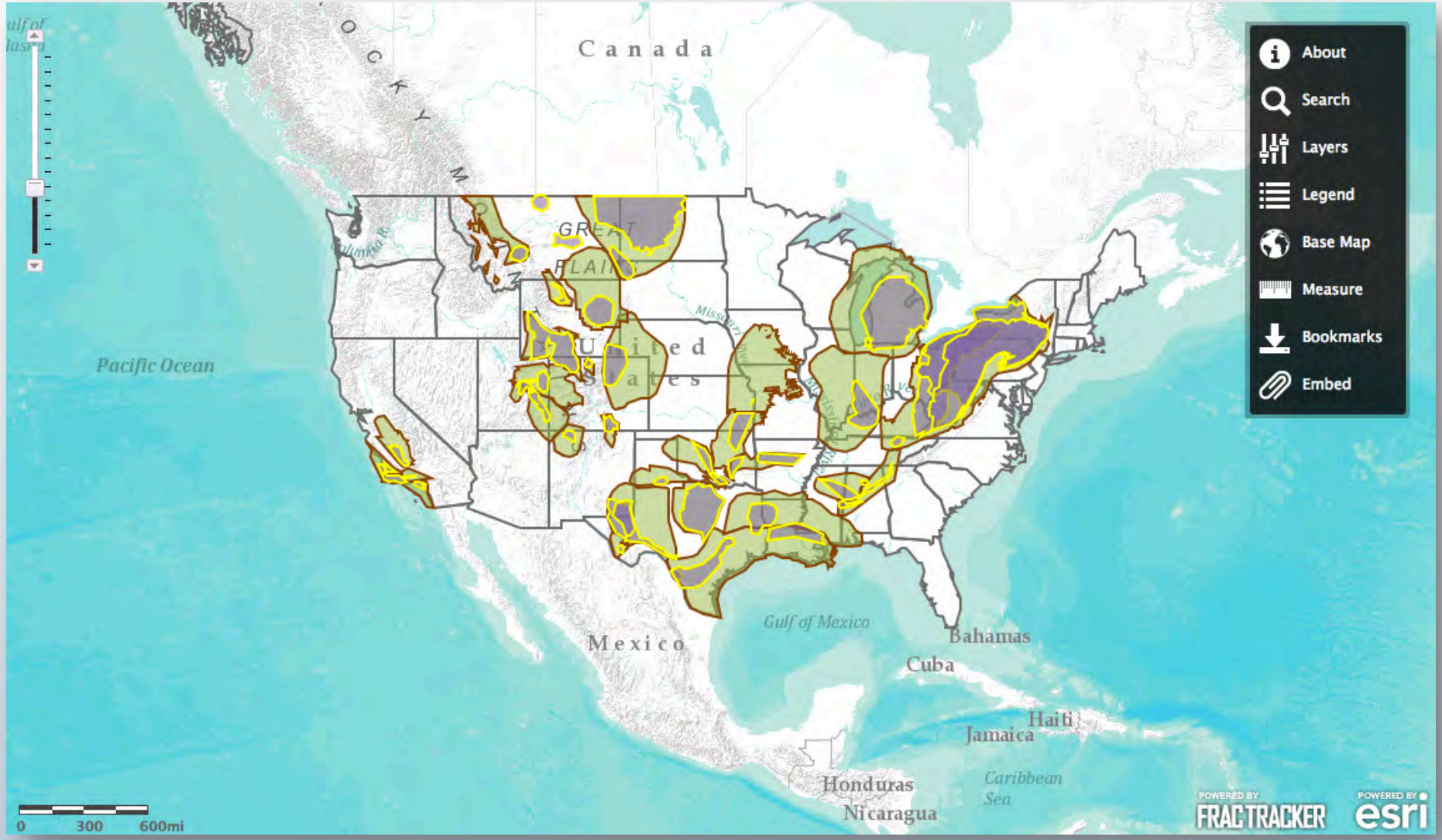
Getting the Most Out of FracTracker.org

A Focus on Using FracMapper

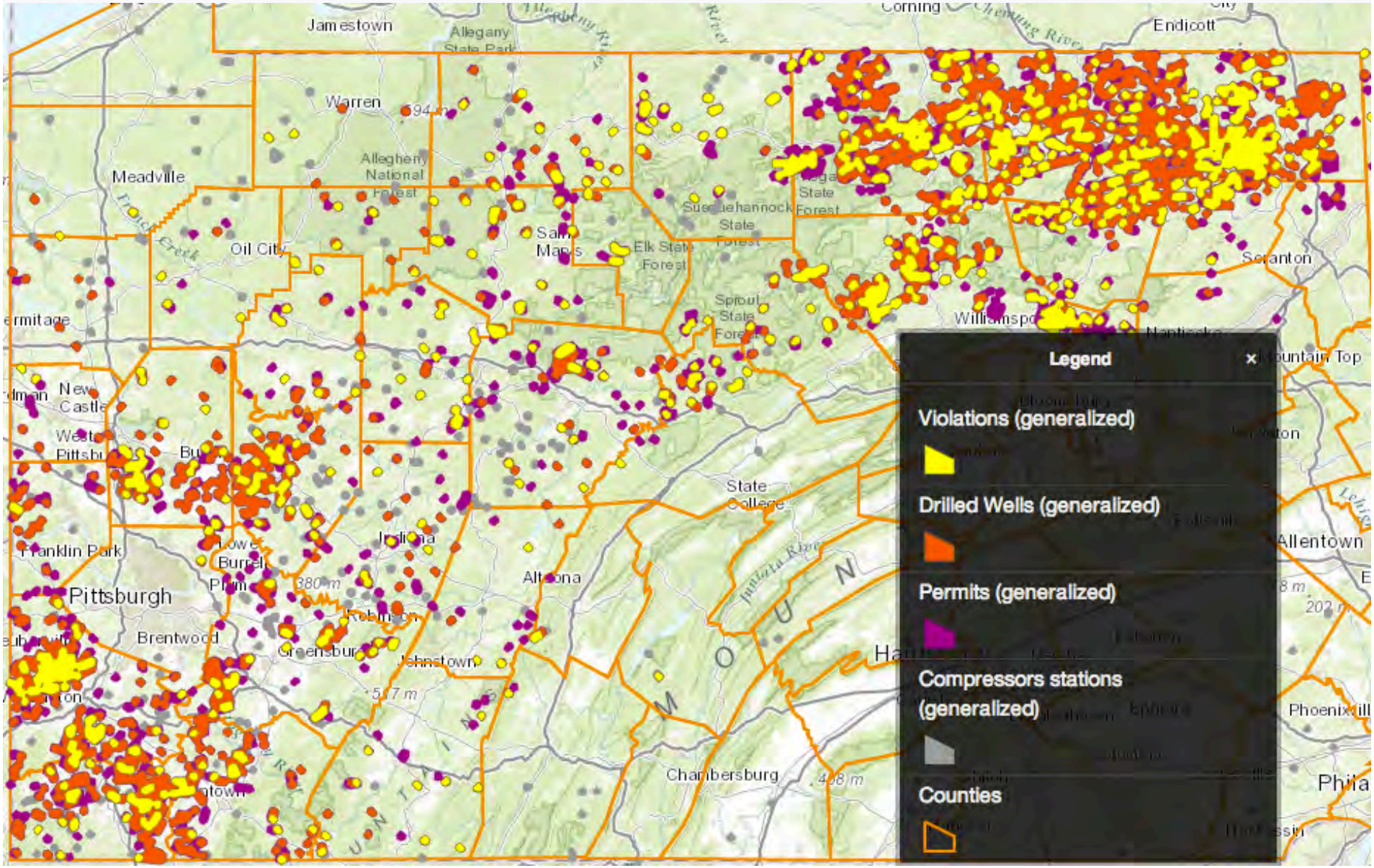
FracTracker Alliance

- FracTracker.org launched in 2010 as a CHEC project at the University of Pittsburgh
- Became independent non-profit organization, The FracTracker Alliance," in 2012
- Featuring new data mapping tool: FracMapper
- FracMapper can be used to pinpoint and assess gas and oil activities. Free. Registration not required
- Currently have maps for 15 states and counting

FracMapper: New FracTracker Mapping Platform



For Example:
PA Permits, Wells, Violations, & Compressor Stations



What can you do with FracMapper?

- Find a well or permit near your home or place of interest
- Learn more about the nature of a violation issued (depending on the data's availability)
- Measure how close a well is to a waterway, road, or residence
- Share your geo-located data with the world on a FracTracker map
- Volunteer water monitors with the Mountain Watershed Association have been using FracMapper to decide when and where to conduct water monitoring
- Export a map to take to your next municipality's or organization's meeting
- And more!

Working w/FracMapper

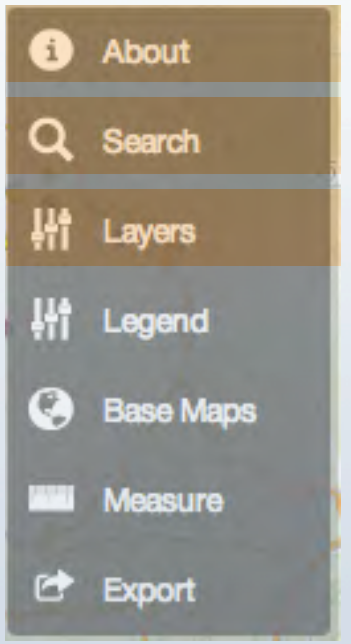
- Navigate to fractracker.org/maps. Select state.
- Manipulating the Map:
  - **Zoom**:
    - Using the scale bar in the upper left corner of screen
    - Or by double-clicking mouse or rolling mouse's scroll wheel forward (not on all mice)
    - Currently there are 2 different versions of the scale bar, depending on the state (shown right)
    - Zoom in until points appear instead of generalized area
  - **Pan**: Click and hold down your mouse to pan
  - **Click** on a point or area for more information:
    - Will show data layer details (e.g. well's API number, company, county name, watershed (HUC), and violation specs)

V1

V2

Toolbar Buttons

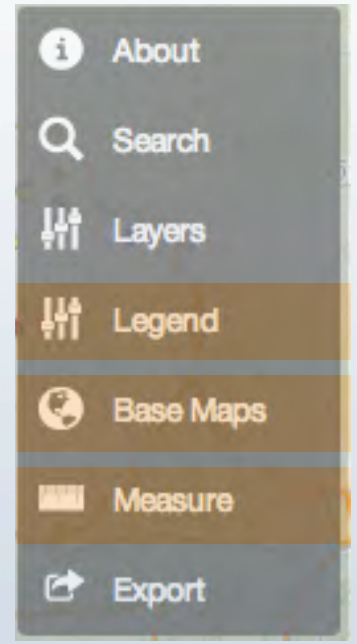
- Toolbar Buttons:
  - **About**: Provides metadata for the data displayed on the maps. Key for seeing data sources!
  - **Search**: Runs off of Google Maps. Can enter address, area, or landmark
    Coming soon: Search by API number (well identification code)
  - **Layers**:
    - Shows you which datasets are being shown on the map.
    - Can be toggled on and off.
    - Will vary by map and state.
    - When zoomed out too far, will see generalized (not point-based) well locations. This improves map's loading time.

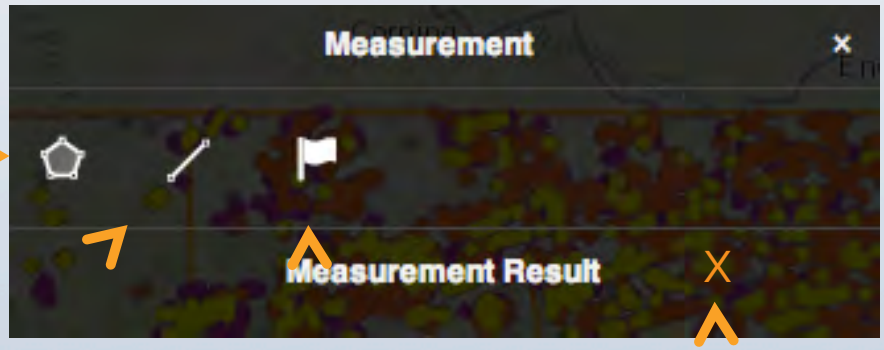


Continued...

Toolbar Buttons (cont.)

- **Legend**: Identifies what points/areas mean using colors and shapes
- **Base Maps**: Background of the map. Can be changed depending on viewing preference. 9 options
- **Measure**: Tool used to determine distance, area, or geo-location of features on the map. Double click to end.





Area

Distance

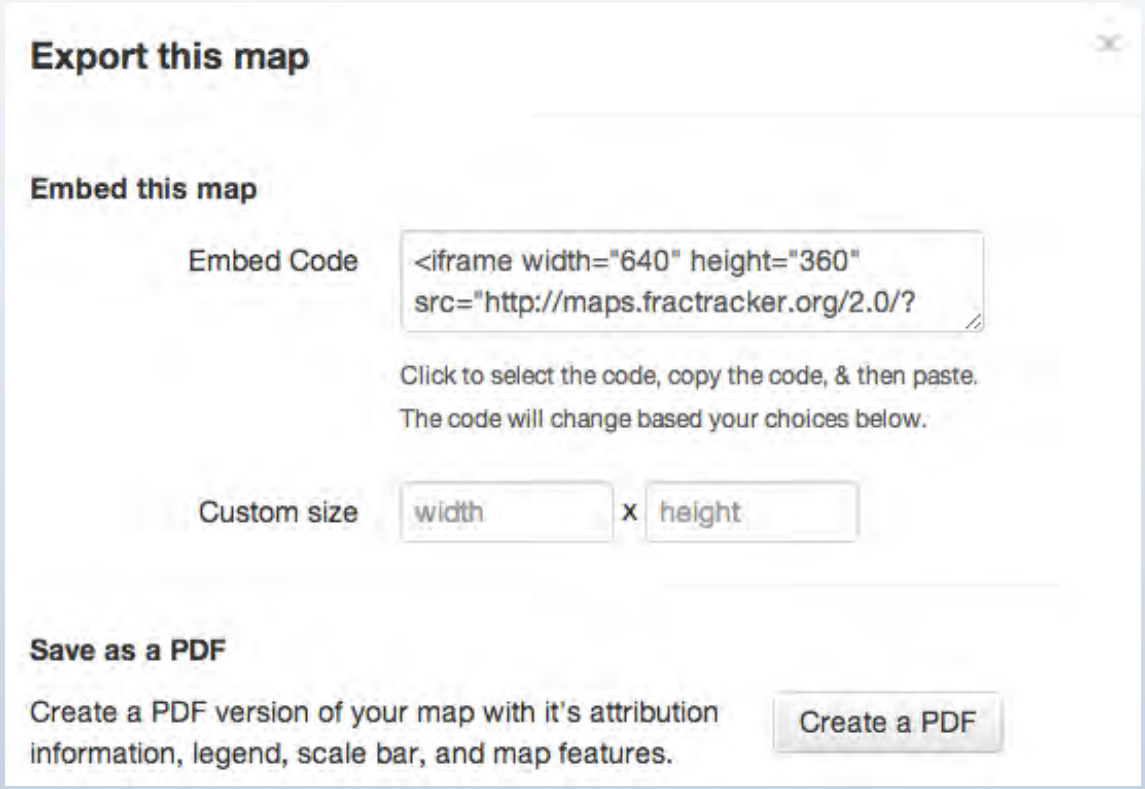
Identify Lat/ Long

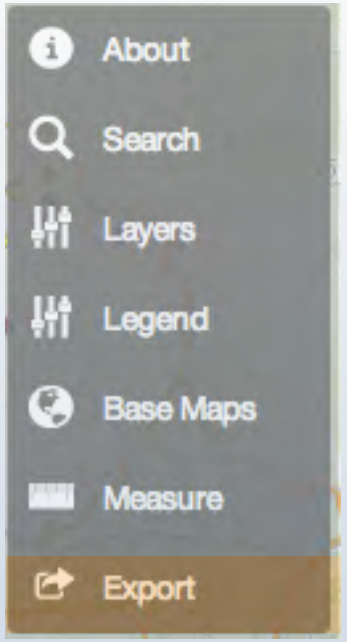
Result Appears Here

Continued...

Toolbar Buttons (cont.)

- **Export**
  - **Two options**: Export (in development) or take a screen shot. Export shown below:





Additions & Coming Soon

Data Downloads:

- Now available!
- File types: Shape file (polygon/lines) and CSV (points)
- Can be found here: www.fractracker.org/data
- If you have data you would like to share, just let us know.

Coming Soon:

- Additional states and layers are continually being added.
- Request one today: info@fractracker.org

Keep Up To Date:

- Sign up for our monthly e-newsletter: www.fractracker.org/resources/e-newsletters/

Final Notes

A list of upcoming in-person trainings is maintained here:

- www.fractracker.org/2013/06/2013ftmwatraining/
- Contact us if interested in participating: info@fractracker.org

Feedback Requested:

- Please check out the website and provide us with some feedback about what you think of FracMapper: www.fractracker.org/2012/09/fracmapper/

Contact Information:

- Samantha Malone, MPH, CPH
  Manager of Science and Communications
  FracTracker Alliance
  malone@fractracker.org
  412-802-0273

APPENDIX C

LANDOWNER ACCESS PERMISSION FORM

LANDOWNER ACCESS AUTHORIZATION

Trout Unlimited has developed a stream surveillance program, called the *Coldwater Conservation Corps (CCC).* The CCC program is designed to help TU volunteers collect baseline water quality data on West Virginia and Virginia's coldwater streams and to monitor the impacts of Marcellus Shale gas development. While TU 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, TU members 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 _____ of the _____
(Volunteer name) (TU Chapter)

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

To find out where to submit this form, please contact:

Jaimie Holmes
WV-VA Water Quality Monitoring Coordinator
jholmes@tu.org

APPENDIX D

WATER QUALITY QA/QC & CHAIN OF CUSTODY DATA SHEETS

TROUT UNLIMITED

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STREAM MONITORING FIELD DATA SHEET

MONITOR: _____ **DATE:** _____ **TIME:** _____

STREAM NAME: _____

NAMING CONVENTION:_____

LOCATION DESCRIPTION: _____

WEATHER & PRECIPITATION: **Clear** **Cloudy** **Partly Cloudy** **Fog/Haze** **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**

STREAM DEPTHS:									

STREAM WIDTH: _____ **Feet** **AVERAGE DEPTH:** _____ **Feet**

CROSS-SECTIONAL AREA = _____ **X** _____ **=** _____ **FT^2**
Width **Avg. Depth**

STAGE:_____ **FEET (OPTIONAL)**

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STREAM MONITORING FIELD DATA SHEET

MONITOR: _____ **DATE:** _____ **TIME:** _____

STREAM NAME: _____

NAMING CONVENTION:_____

LOCATION DESCRIPTION: _____

WEATHER & PRECIPITATION: **Clear** **Cloudy** **Partly Cloudy** **Fog/Haze** **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**

STREAM DEPTHS:									

STREAM WIDTH: _____ **Feet** **AVERAGE DEPTH:** _____ **Feet**

CROSS-SECTIONAL AREA = _____ **X** _____ **=** _____ **FT^2**
Width **Avg. Depth**

STAGE:_____ **FEET (OPTIONAL)**

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WV-VA Water Quality Monitoring Program

QA/QC Instructions and Data Form

Directions for collecting and sending water samples for QA/QC:

1. You should collect one sample from each site you are monitoring. **Each sample should be accompanied by a copy of this form.**
2. Label the sample collection bottle with your name, sampling site name, and date of collection.
3. Enter the stream and stand downstream of your sampling site and face upstream. Rinse the bottle a total of 3 times, emptying the bottle behind you (downstream).
4. Lower the bottle into the water with the opening facing upstream. Fill the bottle completely with stream water and screw the cap on tightly.
5. Record the information and data in the tables below.
6. Pack a small box with your water samples and copies of this sheet and a chain of custody form. Be sure that the sample bottle is secure within the box and cannot move around.
7. Mail the box containing your water samples and copies of this sheet to NRCCE for processing. **Samples should be mailed *within 24 hours* of collection.**

West Virginia University
NRCCE / Analytical Laboratory
385 Evansdale Drive – Ground Floor, Room G22
Morgantown, WV 26506-6064

Your Name		**Stream Name**	
Email Address		**Coordinates**	**N** **W**
Mailing Address		**County**	
Organization		**Sample Date**	

Parameter	Units	Result
Conductivity	µS/cm	
pH	pH units	
Cross-Sectional Area	Sq. feet	

NRCCE Analytical Laboratory

Trout Unlimited WV-VA Water Quality Monitoring Project

CHAIN OF CUSTODY RECORD

PROJECT NO

SITE NAME

SAMPLERS (SIGNATURE)

STATION NO.	**DATE**	TIME	TEMP. WHEN REC.	PRES.	STATION LOCATION	**NO. OF CON TAINERS**	Bromide	Conductivity	pH				REMARKS
							X	X	X				

RELINQUISHED BY (SIGNATURE)	**DATE/TIME**	RECEIVED BY (SIGNATURE)	RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED BY (SIGNATURE)

RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED FOR LABORATORY BY (SIGNATURE)	DATE/TIME	REMARKS

APPENDIX E

MAKE YOUR DATA COUNT

Make Your Data Count!

INSIDE THIS ISSUE:

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 Log-in button at the top of the page and create a Log-in

3.) Log-in and navigate to your profile page

4.) In the top left-hand corner, beside your email address, please click the "validate your email" tab.

5.) *Check your email for a message from CitSci and follow the instructions in the email.*

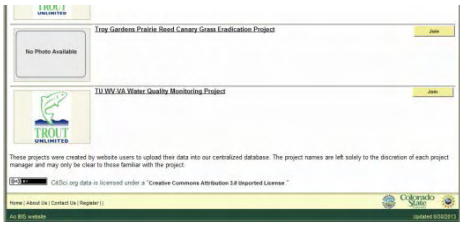
For a video on how to register and use Citsci.org, please follow this link

www.youtube.com/watch?v=asPzO9MtF_s

or go to www.youtube.com and search for "Trout Unlimited's CCC Dataportal User's Guide 1"

How to Join the Project

- After you have created a log-in and validated your email address, navigate to the "**Projects**" tab at the top of the CitSci home page.
- Find the "**TU WV-VA Water Quality Monitoring Project**" and click the "join" button to the right of the project



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

Accessing Educational Materials

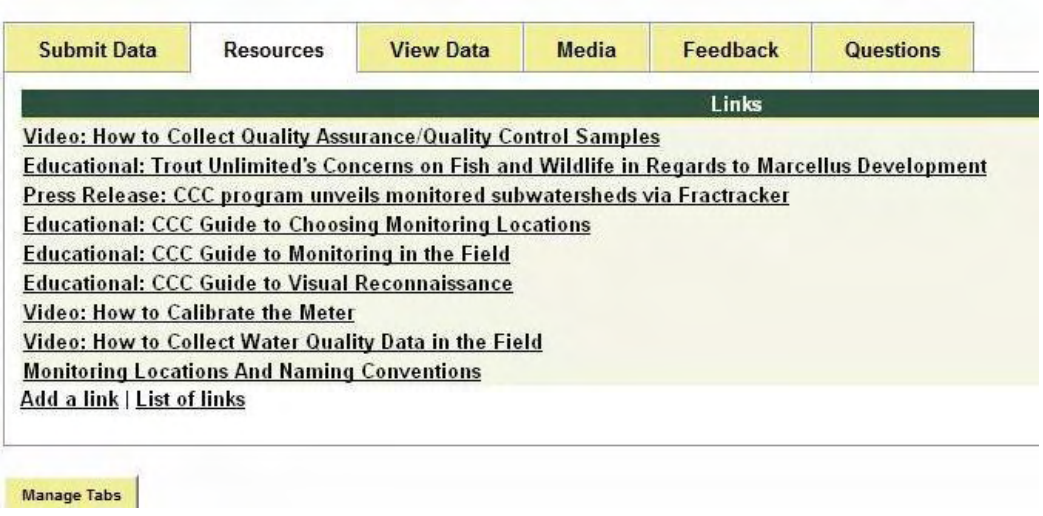
Need a refresher on the correct way to collect your stream parameters or calibrate your meter? No problem, videos documenting the monitoring process are available on your **Project Profile** page, under the **Resources** tab.

You can also find the latest press the program has received, prezi presentations used during trainings, and most importantly your naming conventions needed for data entry.

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)

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 "Submit Data" Tab at the bottom of the page and choose "enter data".

Date of the Observation:

- Please fill out the logistics of your monitoring sheet with the correct date.
- Select "Jaimie Holmes" as the **Authority**
- Search time is a rough estimate of how long it took you to conduct your monitoring

Location Information:

- Enter your naming convention for your stream in the "Name" space. If you do not have one, please contact Jaimie Holmes.
- Enter your lat/long correctly!
  Latitude is positive
  Longitude is negative
- Coordinates should be in decimal degrees
- Datum is WGS_84
- Accuracy is 25m

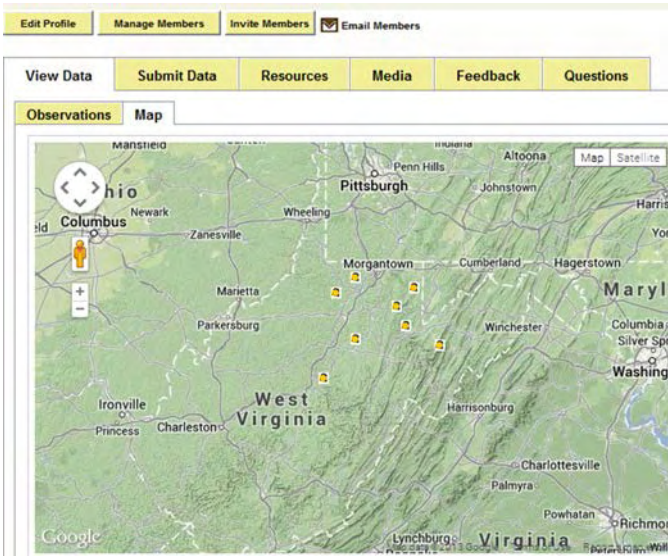
Site Characteristics:

- Fill out the data sheet with your collected parameters
- Only report on one surrogate for flow measurement (i.e., gage, cross-sectional area, or discharge)
- Click Submit!

How to View and Edit Data

From the Project Home Page:

- Locate the "View Data" tab at the bottom of the page.
- Choose the "Observation" option underneath the "View Data" tab.
- Observations are listed by date and by naming convention.
- A data entry can be edited by clicking the entry and selecting edit
- ***Lat/Long coordinates can not be edited.***
- If you have entered the wrong coordinates, the entire entry must be deleted and re-entered.



Mapping Application

From the Project Home Page:

- Locate the "View Data" tab.
- Choose the "Map" option underneath the "View Data" tab
- Use the plus/minus controls to zoom

For more detailed instruction on how to view and map data, please follow this link...www.youtube.com/watch?v=lYbFY8aPjqg or go to www.youtube.com and search for "Trout Unlimited's CCC Dataportal User's Guide 2"

Volunteers will be responsible for correcting incorrect data entries within two weeks of notification.

TROUT UNLIMITED
571 Douglas Rd.
Thomas, WV
26292
Phone:
304-614-6699
E-Mail:
jholmes@tu.org
See us at:
www.citsci.org
www.tu.org

What happens to conductivity when the water level decreases?

What may be causing conductivity to increase in the winter?

Would a few more samples for comparison be a bad thing?

Is there a reportable event?

Making Sense of Your Data

Understanding your data is an integral part of the program, especially if monitoring around shale gas development. Currently, an analysis tool is being created to aid volunteers in understanding what is going on in their stream. For now, it is up to you to keep track and identify a reportable event.

3X Baseline Measurement at Similar Flow

In order to identify an event, conductivity must be 3x a previous conductivity reading at a comparable flow. Stream conductivity can fluctuate with the amount of water in the stream due to concentration/dilution effects. It is important for volunteers to collect a body of baseline data, preferably from different times of year, in order to have a diversity of comparison options.

Can you Identify a Reportable Event…?

Date	Conductivity	Cross Sectional Area
12/5/2012	152 µS	10 ft²
12/17/2012	164 µS	9.2 ft²
1/15/2013	138 µS	13.4 ft²
2/25/2013	205 µS	18.1 ft²
3/5/2013	47 µS	25.3 ft²
3/16/2013	72 µS	29 ft²
3/25/2013	469 µS	14.2 ft²
4/2/2013	59 µS	21 ft²
4/13/2013	96 µS	13 ft²
4/21/2013	164 µS	19 ft²
5/19/2013	85 µS	14.9 ft²
5/23/2013	243 µS	9.6 ft²
6/1/2013	74 µS	13.4
6/9/2013	182 µS	8.5 ft²
6/14/2013	423 µS	7 ft²
6/28/2013	556 µS	6.2 ft²
7/1/2013	281 µS	7.5 ft²

ANWSER: 3/25/2013

APPENDIX F

VISUAL OBSERVATION CHECKLIST

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TU Water Quality Monitoring Program
Checklist for Visual Observations

Location: _____

Latitude: _____ ° _____ min. _____ sec.

Longitude: _____ ° _____ min. _____ sec.

Earth Disturbance

Access Road:

☐ Mud/sediment on Township / State Road that access road enters

☐ Mud/sediment entering public road ditch from site

☐ Access road to site not stabilized with clean gravel

☐ Access road crosses stream with access road drainage directly emptying into stream

☐ Access road carrying drainage from site directly to road ditch or stream

☐ Road banks not stabilized with mulch, seeding, vegetation, etc.

Pad/Storage Pond/Staging Areas:

☐ Earth disturbance to edge of water body with no controls to stop or filter

☐ Clean water entering site from uphill (no diversion ditch)

☐ Outlets of sediment control structures go directly to water body without filtering/cleaning

☐ Diversion ditch

☐ Sediment pond

☐ Road drainage

☐ Silt barrier (fence, hay bales, tubes, etc.)

☐ Soil stockpile areas not stabilized if open longer than 20 days

☐ Outlets of ditches, sediment control structures, etc. are not stabilized and are causing erosion

Receiving Streams:

☐ Visual evidence of sediment entering stream, pond, wetland or other body of water

☐ Sediment plume

☐ Discolored water

☐ Increased sediment deposition on the stream bottom

Spills and Discharges

☐ Unusual odor in water
☐ Persistent foam or bubbles in absence of high level of agitation
☐ Dead fish or other organisms in the water or along the bank
☐ Discolored water, especially an oily film on the water surface
☐ Increased bank erosion (may indicate a high water event)

Water Withdrawal

☐ Water hoses in or adjacent to stream
☐ Unusually low flow in the stream not related to drought conditions
☐ Trucks parked beside streams where there are no signs posted that it is a withdrawal area.

Gas Migration or Leakage

☐ Gas bubbling from a pool, puddle, or stream
☐ Odor due to mercaptan compounds

APPENDIX G

AGENCY CONTACT INFORMATION

CONTACTING WV DEP OFFICE OF ENVIRONMENTAL ADVOCATE

West Virginia DEP's Office of Environmental Advocate is designed to assist the public with various requests/complaints, including reporting incidents related to unconventional shale gas development to the appropriate agencies/offices.

If there is a threat to human health or safety, you should first call the local Emergency Management Agency (call 911).

Then place a call to Office of Environmental Advocate Hotline—which accepts phone calls during normal business hours on their hotline 1-800-654-5227 or faxes at 304-926-0474.

If you have something to report outside of regular business hours you can call the 24/7 DEP Emergency Hotline, 1-800-642-3074.

Make sure you have the following information ready when you call the Office of Environmental Advocate or the 24/7 DEP Emergency Hotline:

- Type of complaint (ex. Chemical spill into water or to the land; toxic or hazardous substance released in the air, very foul odor, natural gas leak, etc.).
- The town or closest town, the county, and directions to the site, including the name of the street or Route number.
- The name of the responsible party (company name or individual's name).
- The date and time the incident occurred, or was found.
- Your name and contact information, in case they need additional information about the complaint.

WEST VIRGINIA Department of Environmental Protection | Office of Oil & Gas Inspectors:

CONTACT INFO FOR INCIDENTS THAT OCCUR ON THE WELL PAD | For Pollution and Emergency Spills: 1-800-642-3074

WV DEP Office of Oil & Gas Inspectors (All Inspectors' telephones have 24 hour voice mail)

Inspector	District	Counties	Address	Cell Phone	Fax/Telephone	E-Mail Address
David Cowan	9	Ritchie(085)	1597 Devil Hole Road Harrisville WV 26362-7543	304-389-3509	304-628-4016	David.W.Cowan@wv.gov
Ross Eller	9	Boone(005), Wyoming(109)	121 Brierhill Drive Beckley WV 25801	304-932-6844	--	Ross.E.Eller@wv.gov
Ed Gainer	9	Calhoun(013), Roane(087), Clay(015), Nicholas(067)	P.O. Box 821 Spencer WV 25276	304-389-7582	304-927-5572	Edward.N.Gainer@wv.gov
Bryan Harris	9	Braxton(007), Gilmer(021), Pocahontas(075), Webster(101), Barbour(001), Taylor(091), Tucker(093)	P.O Box 157 Volga WV 26238	304-553-6087	304-472-1732	Bryan.O.Harris@wv.gov
Bill Hatfield	9	Berkeley(003), Grant(23), Hamp.(027), Hardy(031), Jeff.(037), Mineral(057), Morgan(065), Pend.(071), Rand.(083), Upshur(097)	P. O. Box 522 Buckhannon WV 26201	304-767-1828	304-473-4202	Billie.G.Hatfield@wv.gov
Derek Haught	9	Wetzel(103)	P.O. Box 85 Smithville WV 26178	304-206-7613	304-477-4148	Derek.M.Haught@wv.gov
Bill Hendershot	9	Marion(049), Marshall(051)	403 James Street Mannington WV 26582	304-206-7750	304-986-3732	William.R.Hendershot@wv.gov

Inspector	District	Counties	Address	Cell phone	Fax/telephone	Email
Jeremy James	9	Cabell(011), Mingo(059), Wayne(099)	P.O. Box 147 Ona WV 25545	304-951-2596	--	Jeremy.E.James@wv.gov
Gary Kennedy	9	Mercer(055), Raleigh(081), Monroe(063), Summers(089), McDowell(047), Greenbrier(025)	P.O. Box 268 Nimitz WV 25978	304-382-8402	304-466-9868	Gary.L.Kennedy@wv.gov
Gayne J Knitowski	9	Brooke(009), Hancock(029), Ohio(069)	P.O. Box #2 Moundsville WV 26041	304-546-8171	- -	Gayne.J.Knitowski@wv.gov
Douglas Newlon	9	Doddridge(017)	4060 Dutchman Road Macfarlan WV 26148	304-932-8049	304-477-3116	Douglas.C.Newlon@wv.gov
Jamie Stevens	9	Jackson(035), Mason(053), Putnam(079), Wood(107)	105 Kentuck Road Kenna WV 25248	304-206-7775	304-372-7140	James.S.Stevens@wv.gov
Barry Stollings	9	Lewis(041)	28 Conifer Drive Bridgeport WV 26330	304-552-4194	304-855-5401	Barry.W.Stollings@wv.gov
Joe Taylor	9	Pleasants(073), Tyler(095), Wirt(105)	1478 Claylick Road Ripley WV 25271	304-380-7469	304-372-2032	Joseph.D.Taylor@wv.gov
Ralph Triplett	9	Lincoln(043), Logan(045),	5539 McClellan Hwy Branchland, WV 25506	304-389-0350	304-824-5111	Ralph.D.Triplett@wv.gov
Terry Urban	9	Fayette(019), Kanawha(039)	P.O. Box 1207 Clendenin, WV 25045	304-549-5915	304-558-8489	Terry.W.Urban@wv.gov
Sam Ward	9	Preston(077), Monongalia(061), Harrison (033)	P.O. Box 2327 Buckhannon WV 26201	304-389-7583	304-472-9742	Samuel.D.Ward@wv.gov

WEST VIRGINIA Department of Environmental Protection | Office of Water & Waste, Environmental Enforcement Inspectors

CONTACT INFO FOR INCIDENTS THAT OCCUR OFF OF THE WELL PAD | For Pollution and Emergency Spills: 1-800-642-3074

County	Name	Title	Work Group	Phone Number
Barbour/Lewis/Upshur	Stanley Wolfe	Environmental Inspector	Water & Waste	304-368-2000 ext 3726
Barbour/Doddridge/Lewis/Tyler/Upshur	Tim Hodge	Environmental Inspector – Construction Stormwater	Water & Waste	304-368-2000 ext 3724
Berkeley	Mike Kanehl	Environmental Inspector	Water & Waste	304-822-7266 ext 3602
Berkeley/Morgan	Gerald Crispino	Environmental Inspector	Water & Waste	304-822-7266 ext 3618
Berkeley/Grant/Hampshire/ Hardy/Jefferson/Mineral/Morgan/ Pendleton/Pocahontas/Preston/ Randolph/Tucker	Matthew Alt	Environmental Inspector – Construction Stormwater	Water & Waste	304-822-7266 ext 3603
Boone/Kanawha	Brad Wright	Environmental Inspector	Water & Waste	304-757-1693 ext 3812
Boone/Cabell/Calhoun/Gilmer/Jackson/ Kanawha/Lincoln/Logan/Mason/Mingo/ Putnam/Roane/Wayne/Wirt/Wood	Matthew Collier	Environmental Inspector – Construction Stormwater	Water & Waste	304-757-1693 ext 3810
Braxton/Clay/Webster	Gregory Morris	Environmental Inspector	Water & Waste	304-465-1919 ext 3127
Braxton/Clay/Fayette/Greenbrier/ McDowell/Mercer/Monroe/Nicholas/ Raleigh/Summers/Webster/Wyoming	John Hendley	Environmental Inspector – Construction Stormwater	Water & Waste	304-465-1919 ext 3050
Brooke/Hancock/Ohio	Gregory Paetzold	Environmental Inspector	Water & Waste	304-238-1220 ext 3513

County	Name	Title	Work Group	Phone Number
Brooke/Hancock/Harrison/Marion/ Marshall/Monongalia/Ohio/Pleasants/ Ritchie/Taylor/Wetzel	Tim Hodge	Environmental Inspector – Construction Stormwater	Water & Waste	304-368-2000 ext 3724
Cabell/Wayne	Ryan Harbison	Environmental Inspector	Water & Waste	304-757-1693 ext 3811
Doddridge/Harrison	Melisa Powers	Environmental Inspector	Water & Waste	304-368-2000 ext 3720
Fayette/Nicholas	Bryan Vandigo	Environmental Inspector	Water & Waste	304-465-1919 ext 3046
Grant/Preston/Tucker	Mary Sanders	Environmental Inspector	Water & Waste	304-822-7266 ext 3607
Greenbrier/Monroe/Summers	Susan Kershner	Environmental Inspector	Water & Waste	304-465-1919 ext 3047
Hampshire/Hardy/Mineral	Rhod Mills	Environmental Inspector	Water & Waste	304-822-7266 ext 3604
Jackson/Wood	Sara Miller	Environmental Inspector	Water & Waste	304-420-4635
Jefferson	Mike Kanehl	Environmental Inspector	Water & Waste	304-822-7266 ext 3602
Kanawha	Richard Hackney	Environmental Inspector	Water & Water	304-757-1693 ext 3807
Lincoln/Logan/Mingo	Carolyn Napier	Environmental Inspector	Water & Waste	304-757-1693 ext 3801
Marion/Ritchie	Jason Ely	Environmental Inspector	Water & Waste	304-368-2000 ext 3718

County	Name	Title	Work Group	Phone Number
Marshall/Pleasants/Tyler/Wetzel	Scott Buchanan	Environmental Inspector	Water & Waste	304-238-1220 ext 3528
Mason/Putnam	Kevin Saunders	Environmental Inspector	Water & Waste	304-757-1693 ext 3806
McDowell/Mercer	Michael Puckett	Environmental Inspector	Water & Waste	304-465-1919 ext 3051
Monongalia/Taylor	Chuck Joseph	Environmental Inspector	Water & Waste	304-368-2000 ext 3723
Pendleton/Pocahontas/Randolph	Thomas Ditty	Environmental Inspector	Water & Waste	304-822-7266 ext 3601
Raleigh/Wyoming	Lily Kay	Environmental Inspector	Water & Waste	304-465-1919 ext 3044

Other Environmental Inspection Staff

Headquarters	Name	Title	Work Group	Phone Number
Charleston	Mark Bolling	Environmental Inspector	Water & Waste	304-465-1919 ext 3011
Fairmont	Tim Andrew	Environmental Inspector	Water & Waste	304-368-2000 ext 3722
Teays	Newt Harman	Environmental Inspector	Water & Waste	304-757-1693 ext 3808
Teays	Alan Kee	Environmental Inspector Specialist	Water & Waste	304-757-1693 ext 3802

Teays	Phil Carper	Environmental Inspector	Water & Waste	304-757-1693 ext 3805
Fairmont	Kirk Powroznik	Environmental Inspector Specialist	Water & Waste	304-368-2000 ext 3721
Teays	Eric Philyaw	Environmental Inspector Specialist	Water & Waste	304-757-1693 ext 3815
Fairmont	Brad Swiger	Environmental Inspector Supervisor	Water & Waste	304-368-2000 ext 3719
Oak Hill	Kevin Lilly	Environmental Inspector Supervisor	Water & Waste	304-465-1919 ext 3048
Romney	Robin Dolly	Environmental Inspector Supervisor	Water & Waste	304-822-7266 ext 3606
Teays	Debbie Keener	Environmental Inspector Supervisor	Water & Waste	304-757-1693 ext 3809
Teays	Cynthia Musser	Environmental Inspector Supervisor	Water & Waste	304-757-1693 ext 3804

MONONGAHELA NATIONAL FOREST | District Offices

Supervisor's Office - Forest Headquarters
200 Sycamore Street
Elkins, WV 26241
304-636-1800 (Voice & TDD)
One block east of Rt 219 at the Iron Horse statue in downtown Elkins.

Cheat Ranger District
PO Box 368
Parsons, WV 26287
304-478-3251 (Voice & TDD)
On US Route 219 just east of Parsons

Gauley Ranger District
932 North Fork Cherry Road
Richwood, WV 26261
304-846-2695 (Voice & TDD)
One mile east of Richwood on Rt 39/55

Greenbrier Ranger District
Box 67
Bartow, WV 24920
304-456-3335 (Voice & TDD)
On Rt 92/250 just east of Bartow

Marlinton Ranger District
PO Box 210
Marlinton, WV 24954-0210
304-799-4334 (Voice & TDD)
On Cemetery Road off Rt 39 at the eastern edge of Marlinton.

Potomac Ranger District
HC 59, Box 240
Petersburg, WV 26847
304-257-4488 (Voice & TDD)
1.5 miles south of Petersburg off Rt. 28/55

White Sulphur Springs District
410 E. Main Street
White Sulphur Springs, WV 24986
304-536-2144 (Voice & TDD)
On Rt 60 in White Sulphur Springs

Cranberry Mountain Nature Center
304-653-4826 (Voice & TDD)
At the intersection of Rt 39/55 and Rt 150

Seneca Rocks Discovery Center
304-567-2827 (Voice & TDD)
At the intersection of Rt 28 and Rt 33 at Seneca Rocks

GEORGE WASHINGTON-JEFFERSON NATIONAL FOREST | District Offices

To be added, after consultation with the Forest Supervisor for the George Washington-Jefferson National Forest

WEST VIRGINIA STATE FORESTS, PARKS & WILDLIFE MANAGEMENT AREAS

AUDRA SP
RR 4, Box 564
Buckhannon WV 26201
304-457-1162
www.audrastatepark.com

BABCOCK SP
486 Babcock State Park Rd.
Clifftop WV 25831
304-438-3004
www.babcocksp.com

BEARTOWN SP
See Droop Mountain Battlefield
www.beartownstatepark.com

BEECH FORK SP
5601 Long Branch Rd.
Barboursville WV 25504
304-528-5794
www.beechforksp.com

BERKELEY SPRINGS SP
2 South Washington St.
Berkeley Springs WV 25411
304-258-2711
www.berkeleyspringssp.com

BERWIND LAKE WMA
RR 16, PO Box 38
Warriormine WV 24894
304-875-2577
www.berwindlake.com

***BLACKWATER FALLS SP**
1584 Blackwater Lodge Road
PO Box 490
Davis WV 26260
304-259-5216
www.blackwaterfalls.com

BLENNERHASSETT ISLAND HISTORICAL SP
137 Juliana St.
Parkersburg 26101
304-420-4800
blennerhassettislandstatepark.com

BLUESTONE SP
HC 78, Box 3
Hinton WV 25951
304-466-2805
www.bluestonesp.com

BLUESTONE WMA
HC 65, Box 91,
Indian Mills WV 24935
304-466-3398
www.bluestonewma.com

CABWAYLINGO SF
4279 Cabwaylingo Park Road
Dunlow WV 25511
304-385-4255
www.cabwaylingo.com

CACAPON RESORT SP
818 Cacapon Lodge Dr.
Berkeley Springs WV 25411
304-258-1022
www.cacaponresort.com

CALVIN PRICE SF
(See Watoga State Park)

CAMP CREEK SP
2390 Camp Creek Rd
Camp Creek WV 25820
304-425-9481
www.campcreekstatepark.com

CANAAN VALLEY SP
134 Headquarters Road
Davis WV 26260
304-866-4111

CANAAN VALLEY RESORT*
230 Main Lodge Drive
Davis WV 26260
304-866-4121
www.cannaanresort.com

CARNIFEX FERRY BATTLEFIELD
1194 Carnifex Ferry Rd.
Summersville WV 26651
304-872-0825
carnifexferrybattlefieldstatepark.com

CASS SCENIC RAILROAD
242 Main Street, Cass WV
PO Box 130
Green Bank 24944
304-456-4300
www.cassrailroad.com

CATHEDRAL SP
12 Cathedral Park Drive
Aurora WV 26705
304-735-3771
www.cathedralstatepark.com

CEDAR CREEK SP
2947 Cedar Creek Rd.
Glenville WV 26351
304-462-8517
www.cedarcreeksp.com

CHIEF LOGAN SP
376 Little Buffalo Creek Rd
Logan WV 25601
304-792-7125
www.chiefloganstatepark.com

CHIEF LOGAN LODGE*
1000 Conference Center Dr.
PO Box 898
Logan WV 25601
304-855-6100
www.chiefloganlodge.com

COOPERS ROCK SF
61 County Line Road
Bruceton Mills 26525
304-594-1561
www.coopersrockstateforest.com

DROOP MOUNTAIN BATTLEFIELD
683 Droop Park Road
Hillsboro WV 24946
304-653-4254
www.droopmountainbattlefield.com

FAIRFAX STONE SP
(See Blackwater Falls)

GREENBRIER RIVER TRAIL
426 Gum Cove Road
Buckeye WV 24924
304-799-7416
greenbrierrailtrailstatepark.com

GREENBRIER SF
HC 30, Box 154
Caldwell WV 24925
304-536-1944
www.greenbriersf.com

HAWKS NEST SP*
49 Hawks Nest Park Road
PO Box 857
Ansted WV 25812
304-658-5212
www.hawksnestsp.com

HOLLY RIVER SP
680 State Park Road
Hacker Valley WV 26222
304-493-6353
www.hollyriver.com

KANAWHA SF
7500 Kanawha State Forest Dr.
Charleston WV 25314
304-558-3500
www.kanawhastateforest.com

KUMBRABOW SF
RR 219/16, PO Box 65
Huttonsville WV 26273
304-335-2219
www.kumbrabow.com

LAUREL LAKE WMA
HC 70, Box 626
Lenore WV 25676
304-475-2823
www.laurellakewma.com

LITTLE BEAVER SP
1402 Grandview Rd.
Beaver WV 25813
304-763-2494
www.littlebeaverstatepark.com

LOST RIVER SP
321 Park Dr.
Mathias WV 26812
304-897-5372
www.lostriversp.com

MONCOVE LAKE SP
HC 83, Box 73-A
Gap Mills WV 24941
304-772-3450
www.moncovelakestatepark.com

NORTH BEND RAIL TRAIL
northbendrailtrailstatepark.com

NORTH BEND SP*
202 North Bend Park Road
RR 1, Box 221
Cairo WV 26337
304-643-2931
www.northbendsp.com

PANTHER WMA
HC 63, Box 923
Panther Creek Rd.
Panther 24872
304-938-2252
www.pantherstateforest.com

PINNACLE ROCK SP
RR 52, PO Box 1
Bramwell WV 24715
304-248-8565
www.pinnaclerockstatepark.com

PIPESTEM RESORT SP*
3405 Pipestem Drive
RR 20, Box 150
Pipestem WV 25979
304-466-1800
www.pipestemresort.com

PLUM ORCHARD WMA
1156 Plum Orchard Lake Road
Scarbro WV 25917
304-469-9905
www.plumorchardlakewma.com

PRICKETT'S FORT SP
106 Overfort Lane
Fairmont WV 26554
FORT 304-363-3030
www.prickettsfortstatepark.com

SENECA SF
10135 Browns Creek Rd.
Dunmore WV 24934
304-799-6213
www.senecastateforest.com

STONEWALL LAKE SP
149 State Park Trail
Roanoke WV 26447
304-269-0524

STONEWALL RESORT *
940 Resort Dr.
Roanoke 26447
304-269-7400
www.stonewallresort.com

TOMLINSON RUN SP
84 Osage Rd., PO Box 97
New Manchester WV 26056
304-564-3651
www.tomlinsonrunsp.com

TU-ENDIE-WEI SP
Point Pleasant Battlefield
First St., PO Box 486
Pt. Pleasant WV 25550
304-675-0869
www.tu-endie-weistatepark.com

TWIN FALLS RESORT SP
RR 97, PO Box 667
Mullens WV 25882
304-294-4000
www.twinfallsresort.com

TYGART LAKE SP*
RR 1, Box 260
Grafton WV 26354
304-265-6144
www.tygartlake.com

VALLEY FALLS SP
720 Valley Falls Road
RR 6, Box 244,
Fairmont WV 26554
304-367-2719
www.valleyfallsstatepark.com

WATOGA SP
4800 Watoga Park Road
Marlinton 24954
304-799-4087
www.watoga.com

WATTERS SMITH SP
831 RR 3, PO Box 296
Lost Creek WV 26385
304-745-3081
www.watterssmithstatepark.com

* Phone numbers for 24-hr reservation info; other phone listings reflect office/business hour contact 7/17/2013

SP = state park; SF = state forest; WMA = wildlife management area

ALL WEST VIRGINIA WILDLIFE MANAGEMENT AREAS

DISTRICT I **PO Box 99** **Farmington, WV 26571** **(304)-825-6787** Bear Rocks Lake Burches Run Castlemans Run Lake Cecil H. Underwood Center Branch Cross Creek Dunkard Fork Hillcrest Lantz Farm & Nature Preserve Lewis Wetzel Little Indian Creek Pedlar Pleasant Creek Pruntytown State Farm Snake Hill Teter Creek Upper Deckers Creek	**DISTRICT II** **#1 Depot St.** **Romney, WV 26757** **(304)-822-3551** Allegheny Edwards Run Fort Mill Ridge Nathaniel Mountain Shannondale Springs Short Mountain Sleepy Creek South Branch Thorn Creek Warden Lake Widmeyer	**DISTRICT IV** **2006 Robert C Byrd Drive** **Beckley, WV 25801** **(304)-256-6945** Anawalt Lake Berwind Lake Beury Mountain Bluestone Lake Horse Creek Lake Meadow River Moncove Lake Plum Orchard Lake R.D. Bailey Lake Tate Lohr Tug Fork
DISTRICT III **Box 38** **French Creek, WV 26218** **(304)-924-6211** Becky Creek Big Ditch Burnsville Lake Elk River Handley Huttonsville Slaty Fork Smoke Camp Stonecoal Lake Stonewall Jackson Lake Summersville Lake Valley Bend Wallback	**DISTRICT V** **4300 First Avenue, Suite 100** **Nitro, WV 25143** **(304)-759-0703** Amherst/Plymouth Beech Fork Lake Big Ugly Chief Cornstalk East Lynn Lake Elk Creek Green Bottom Hilbert Laurel Lake McClintic Mill Creek Morris Creek Upper Mud River	**DISTRICT VI** **2311 Ohio Avenue** **Parkersburg, WV 26101** **(304)-420-4550** Buffalo Run Conaway Run Lake Frozen Camp Hughes River O'Brien Lake Ritchie Mines Rollins Lake Sand Hill Stumptown The Jug Turkey Run Woodrum Lake

VIRGINIA Division of Forestry

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FAX: 434.296.2369

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FAX: 434.220.9189
Regional Forester: Ed Zimmer. Cell: 434.981.0479
Deputy Regional Forester: Robbie Talbert. Cell: 434.981.0556

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P.O. Box 100
Salem, Virginia 24153-0100
Phone: 540.387.5461
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Tappahannock Office
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Phone: 804.443.2211
FAX: 804.443.3164
Deputy Regional Forester: David Milby

State Forest Office
Cumberland State Forest
751 Oak Hill Road
Cumberland, Virginia 23040

Forestry Center Locations

Augusta Forestry Center
PO Box 160 Crimora, Virginia 24431
90 Forestry Center Lane
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Phone: 540.363.5732
FAX: 540.363.5055

Garland Gray Forestry Center
19127 Sandy Hill Road
Courtland, Virginia 23837
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FAX: 804.834.3141