THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT

TEXAS STATE UNIVERSITY

TEXAS STREAM TEAM

TEXAS STREAM TEAM ADVANCED WATER QUALITY COMMUNITY SCIENTIST MANUAL

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The Texas Stream Team encourages life-long learning about the environment and people's relationship to the environment through its multidisciplinary community science programs. We also provide hands-on opportunities for Texas State University students and inspire future careers and studies in natural resource related fields. Preparation of the Texas Stream Team Advanced Water Quality Community Scientist Manual has provided Texas Stream Team with the chance to extend additional outreach and educational opportunities to Texans. The Texas Stream Team values the staff contributions and recognizes each individual for their role.

The following staff and student workers assisted in the preparation of this report and are acknowledged for their contributions:

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1.0 INTRODUCTION

The Texas Stream Team Advanced Water Quality Community Scientist Manual (Advanced Manual) presents methods and procedures to become a certified Texas Stream Team Advanced Water Quality Community Scientist. Certification enables community scientists to collect water quality data that meet the requirements of the Texas Commission on Environmental Quality approved Texas Stream Team Quality Assurance Project Plan.

Texas Stream Team has developed this community science program with input from the Environmental Protection Agency and the Texas Commission on Environmental Quality to address the following goals and benefits:

- Standardized training and quality assurance procedures help community scientists collect accurate, consistent information and improves data quality and integrity which can be used in making environmentally sound decisions.
- As recognized by the Environmental Protection Agency and Texas Commission on Environmental Quality, community scientists collect quality assured data that serves to supplement professionally collected data.
- Collection of quality assured data helps improve understanding of environmental issues and promotes communication and positive cooperation between Texans, professional monitors, and the regulated community.

Please note that to receive certification in the Texas Stream Team Advanced Water Quality Community Scientist training, participants must be at least 14 years old (9th grade), as well as Standard Core and/or Probe Core certified with at least six months of active core monitoring.

The Advanced Manual was first developed to provide community scientists with clear instructions on how to collect advanced water quality data and to educate community scientists about the importance of the monitoring they conduct.

This manual also features information on procedures for collecting and/or analyzing streamflow, nitrate-nitrogen, phosphate, and turbidity. Texas Stream Team encourages new and veteran community scientists to develop a solid understanding of key concepts such as watersheds, stream order, and eutrophication. By raising awareness of nonpoint source pollution, Texas Stream Team educates community scientists on more effective strategies for protecting water resources and for resolving water quality problems that may originate at the community level.

1.1 WHAT IS TEXAS STREAM TEAM?

Texas Stream Team (formerly known as Texas Watch) is an environmental education and volunteer-based community scientist water quality monitoring program. Community scientists collect environmental and water quality information that may be used to promote and protect a healthy and safe environment for people and aquatic inhabitants. Texas Stream Team emphasizes communication about the environment, which is based on the premises that water issues are inextricably linked with air, biological, land, and human resource issues, and that the protection of the environment requires the active, positive, collaborative participation of all Texans.

Through Texas Stream Team, community members, students, educators, academic researchers, environmental professionals, and both public and private sector partners are brought together to conduct scientific research and to promote environmental stewardship.

Texas Stream Team encourages everyone to ask:

- What questions do we want to answer about the environment?
- What part of the environment are we most concerned with?
- What can I do to help preserve and protect the environment?

For those whose concerns are centered on water quality, Texas Stream Team helps design water quality monitoring programs to address specific concerns.

Recognizing the size and complexity of the water environment, the time and expense of monitoring water quality, and the significant role that each one of us has in protecting Texas waters, the Texas Commission on Environmental Quality, the U.S. Environmental Protection Agency, and Texas State University have formed a cooperative partnership to support Texas Stream Team. Texas Stream Team is partially funded through an Environmental Protection Agency Nonpoint Source Pollution grant under Section 319 of the Federal Clean Water Act.

1.2 NONPOINT SOURCE POLLUTION

Getting to the Point

To a large extent, water quality within a watershed is linked to the actions of the people who live, work, and play within its boundaries. Water quality issues caused by human activities can be a result of either point source or nonpoint source pollution.

A point source is a single, identifiable source of pollution such as a discharge from a municipal or industrial wastewater treatment plant. Point sources are regulated under the Federal Clean Water Act and Texas state law and are subject to permit requirements. These permits specify effluent limits, monitoring requirements, and enforcement mechanisms. Even though effluent discharges are permitted and regulated, many point sources have contributed to water quality degradation.

Nonpoint source pollution is pollution from sources which are diffuse and do not often have a single point of origin or are not introduced into a stream from a specific source. The pollutants are generally carried off the land by runoff. Nonpoint sources of pollution are largely unregulated and have not historically been evaluated in the same rigorous manner as point source pollution. Nonpoint source pollution originates from many different locations and sources. We have all seen trash in our waterways following a rainfall event. Other contaminants, not so easily seen, enter our waters in much the same way.

Nonpoint source pollution occurs when rainfall runoff transports contaminants on the surface of the land into adjacent water bodies. Contaminated stormwater can cause impairment to the beneficial uses of streams, reservoirs, estuaries, and oceans. Pollutants carried by water percolating through the soil and entering aquifer recharge features can contaminate groundwater. Land management activities associated with agriculture, forestry, and residential and urban development can increase nonpoint source pollutants.

Nonpoint Source Pollution's Effects on Aquatic Ecosystems

Dissolved oxygen is a basic requirement for a healthy aquatic ecosystem. Most fish and beneficial insects breathe oxygen dissolved in the water. Some fish and aquatic organisms, such as gar and sludge worms, are adapted to low dissolved oxygen concentrations. However, most desirable fish species, such as largemouth bass and darters, become stressed if dissolved oxygen concentrations are below 4 milligrams per liter (mg/L). Insect larvae and juvenile fish are more sensitive and require even higher concentrations of dissolved oxygen to grow and reproduce.

Oxygen concentrations in the water column fluctuate under natural conditions, but severe depletion may be the result of human activities that introduce large quantities of biodegradable organic materials into surface waters. Biodegradable organic materials which may include lawn clippings, raw and treated sewage, food processing wastes, rice field drainage, and pulp paper wastes, are some examples of oxygen depleting organic materials that enter surface waters. As these wastes decompose and break down into essential nutrient-enriched building blocks, many chemical and biological processes are directly affected. Nutrients are fundamental building blocks for healthy aquatic communities, but excess nutrients (especially nitrogen and phosphorus compounds) may over stimulate the growth of aquatic plants and algae. Excessive growth of these plants, in turn, can clog waterways and interfere with boating and swimming. In addition, these plants will out-compete native submerged aquatic vegetation, and with excessive decomposition, lead to oxygen depletion or a condition called eutrophication. Oxygen concentrations fluctuate widely, increasing during the day as aquatic plants conduct photosynthesis producing oxygen and falling at night as plants and animals respire, consuming oxygen.

Common Nonpoint Source Pollutants

Sediment from croplands, forestry activities, construction sites, and streambank erosion.

Nutrients from croplands, lawn and gardens, livestock operations, septic systems, and land waste application; sediments from erosion can reduce clarity and sun penetration in bodies of water, harming aquatic plant life and fish. Nutrients can also be carried by runoff from over-fertilized areas or decaying leaves and lawn clippings. Excessive nutrients in waterways can cause excess plant and bacteria growth, resulting in eutrophication (oxygen depletion) and fish kills.

Bacteria from livestock, seepage from improperly maintained septic systems, leaking sewer lines, wildlife, and urban runoff.

Man-made chemicals, including pesticides from roadways, croplands, lawns, gardens, and forestry operations. Toxic materials, such as improperly applied pesticides or automotive products such as motor oil, engine degreasers, and antifreeze. These toxins can wash from city streets and other areas or can result from illegal dumping.

Surface trash, such as plastic containers or cigarette butts; this trash is not only aesthetically unappealing, but residue from discarded containers can be washed into water bodies.

Fertilizers, malfunctioning septic systems, detergents, pharmaceuticals, and organic materials in treated sewage and manure in agricultural runoff are examples of nutrient sources often responsible for water quality degradation. Rural areas are susceptible to groundwater contamination from nitrates found in fertilizer and manure. Nutrients are difficult to control because they typically recycle among the water column, algae, and bottom sediments. For example, algae may temporarily but significantly reduce phosphorus from the water column, but the nutrients will return to the water column and bottom sediments when the algae die and are decomposed by bacteria. Gradual inputs of nutrients tend to accumulate over time rather than leave the system.

Detecting and Tracking Nonpoint Source Pollution

Nonpoint source pollution is episodic. This means it typically enters rivers and lakes during episodes of rainfall resulting in runoff, during isolated events such as incidences of illegal dumping, or in a random fashion, as when a sewer line overflows or breaks. It is difficult and expensive to monitor nonpoint source pollution using a fixed monitoring schedule and employing tests for only a few chemical variables. Analyzing data for trends and correlations over space and time provides an effective strategy to investigate nonpoint source pollution.

Conducting chemical tests on water quality is like taking a snapshot of the river or lake at that moment in time. Trend analysis on streamflow measurements, nitrate-nitrogen, phosphate, and turbidity concentrations provides additional clues in assessing nonpoint source pollution.

Living organisms in a stream or lake can provide information about what has happened there over time. For example, monitoring a stream that has healthy habitat and chemical water quality that meets local water quality standards, but no living organisms, indicates something may have happened there prior to sampling to account for the lack of biodiversity. Perhaps a heavy rainstorm scoured the site and displaced all the organisms. Perhaps some nonpoint source pollution lowered the dissolved oxygen level, causing the organisms to die or move downstream. There are many possible explanations, but by looking at the biological community of the stream over time, the community scientist knows more about the long-term conditions of the stream than if they performed only water chemical tests or field observations.

Water pollution from nonpoint sources is less obvious and more difficult to identify than those from point sources and is not as easy to control through traditional treatment strategies. The variability of rainfall events and the complexity of the landscapes and geologic features lead to nonpoint source pollution phenomena which are highly variable and intricate. The lack of a single identifiable source of pollution makes it difficult to establish specific cause-and-effect relationships but reinforces the importance of analyzing trends and correlations drawn from consistent, long-term monitoring efforts.

1.3 TEXAS STREAM TEAM ADVANCED MONITORING

Advanced monitoring involves performing tests for streamflow, nitrate-nitrogen, phosphates, and turbidity in addition to recording core parameters. These parameters are documented in an approved Group Monitoring Plan that is recommended for all groups or organizations engaged in monitoring in conjunction with Texas Stream Team.

An approved monitoring plan identifies the objectives of monitoring and specifies the sites and variables monitored and monitoring procedures. A monitoring plan is unique to the conditions and needs of a site.

The goal of these tests is to determine baseline conditions and to identify abnormal environmental events when they occur. Baseline conditions are the expected normal environmental conditions for that water body, including an expected range of values for each parameter established by long term monitoring and observations. Specialized monitoring plans may also be set up by partner groups and community scientists to target data collection for locations and/or environmental conditions.

1.4 GETTING STARTED WITH TEXAS STREAM TEAM

Please follow these steps to begin a monitoring project:

1. Schedule a training session(s) with a local Texas Stream Team trainer in your area. Texas Stream Team trainer contact information can be obtained by visiting the Texas Stream Team website. All three training phases can be completed in one training session. If training phases are split up into multiple sessions, Training Phases I and II are generally scheduled with a group.

   After completing Phases I and II, Phase III can be scheduled at a later time to complete the Advanced Training. Phase III will typically take place at the community scientist's monitoring site.

2. Select a monitoring site and request a site identification number based on the guidelines included in this manual under Section 2.1 – Choosing a Monitoring Location.

3. When establishing a monitoring group, complete a Texas Stream Team Group Monitoring Plan. The monitoring plan identifies the objectives of monitoring and specifies the sites and monitoring procedures. A copy of the Group Monitoring Plan and instructions can be obtained on the Texas Stream Team website.

4. Acquire monitoring supplies. Community scientists acquire supplies in a variety of ways. They may pay for supplies with their own money or raise money from other sources such as a civic organization. Several Texas Stream Team partners provide supplies, and the Texas Stream Team headquarters office in San Marcos periodically has supplies to loan community scientists.

5. Begin monthly monitoring for at least one year. Record data on the Advanced Environmental Monitoring Form, and send the data to your Texas Stream Team group Data Coordinator or directly to Texas Stream Team.

6. Contact Texas Stream Team for information on scheduling a training, completing a Group Monitoring Plan, acquiring monitoring supplies, or for any other questions.

Phone: (512) 245-1346

Email: TxStreamTeam@txstate.edu

Web: TexasStreamTeam.org

1.5 TRAININGS

Information describing the various levels of certifications and trainings offered by Texas Stream Team is provided here. The longevity of the program is dependent upon the participation of our dedicated community scientists, and we encourage you to continue increasing your level of involvement each year by completing the required training to become a certified Texas Stream Team Advanced Water Trainer/Quality Assurance Officer, a Texas Stream Team *E. coli* Bacteria Water Quality Community Scientist, or a Texas Stream Team E. coli Bacteria Trainer.

Texas Stream Team Community Scientist Trainings

Texas Stream Team offers a number of water quality and environmental monitoring trainings, including:

- Standard Core Water Quality Community Scientist Training
- Probe Core Water Quality Community Scientist Training
- *E. coli* Bacteria Water Quality Community Scientist Training
- Advanced Water Quality Community Scientist Training
- Macroinvertebrate Bioassessment Community Scientist Training
- Riparian Evaluation Community Scientist Training

This manual only includes information for the Advanced Water Quality Community Scientist Training.

Visit Trainings.TexasStreamTeam.org to learn more about each training.

Advanced Water Quality Monitoring Community Scientist Training

To receive certification as a Texas Stream Team Advanced community scientist, the three-phase training program described on the following pages must be completed.

Each trainee is required to fill out the online Training Enrollment Form to become an official, certified Texas Stream Team Advanced community scientist and begin monitoring activities.

PREREQUISITE

Prior to receiving certification for the advanced training, participants must:

- Be at least 14 years-of age (9th grade);
- Have completed and received certification in the Standard Core Water Quality Community Scientist Training or the Probe Core Water Quality Community Scientist Training; and
- Have completed at least six months of Core monitoring at an established monitoring site.

PHASE I TRAINING

Phase I begins with an instructional classroom session, either in-person or virtually online. This phase includes an introduction to Texas Stream Team, advanced parameters, and topics such as potential pollutant sources, parameter standards and/or screening levels, and relevant natural processes.

The Phase I training transitions to an interactive demonstration of monitoring procedures. A Texas Stream Team certified trainer explains how the monitoring equipment is used. The trainer then demonstrates the advanced water quality monitoring procedures while trainees follow along with the demonstration. The trainees perform the advanced water quality tests simultaneously and under close supervision of the trainer. Trainees record their results in the provided Advanced Training Participant Packet on the Phase I Monitoring Form.

After all parameters are evaluated and the trainee is comfortable with the advanced procedures, the trainee and trainer review the Phase I Monitoring Form. This form signifies the trainee's successful completion of Phase I for the parameters specified and indicates their under-

standing of the monitoring procedures and commitment to following all procedures.

PHASE II TRAINING

During Phase II, trainees demonstrate the monitoring procedures they learned during Phase I in the field with the assistance of the trainer. Whenever possible the water body monitored for Phase II should be similar to the sites the trainee will eventually monitor as a community scientist.

Trainee conducts advanced water quality monitoring procedures on their own, with assistance from a trainer if necessary. The trainer observes the procedures implemented by the trainee, answering any questions they may have and assisting with data quality assurance.

After all questions have been answered and the trainee completes the Phase II Monitoring Form, the trainee and the trainer discuss the strong and weak points with respect to the monitoring procedures. The Phase II Monitoring Form is retained by the trainee for reference during Phase III.

PHASE III TRAINING

Phase III training can take place at the same time and location as Phases I and II, or it can take place at the trainee's approved monitoring site within three months of completing Phase II. The trainer observes the trainee as they conduct the monitoring at the site. At this time, the trainee should be able to work through the monitoring procedures and complete the Phase III Monitoring Form without the assistance of the trainer. After the trainee completes the training, the trainer then discusses next steps and how to establish a monitoring site. The trainee then completes the online Measures of Success Survey.

Once Phase III has been completed, community scientists are required to attend one quality control field audit session every two years to comply with the Texas Stream Team Quality Assurance Project Plan. During Phase III, the trainer will conduct the trainees' first field audit session. The field audit session will include a detailed observation of the trainee's techniques to ensure monitoring is being conducted following the Texas Stream Team protocol as described in this manual without the assistance of the trainer. A field audit session checklist located on the Monitoring Form will be used to document the session and to ensure monitoring protocols are adhered to by all trainees.

Texas Stream Team Trainer

Advanced community scientists may receive an additional certification as a Texas Stream Team Advanced Water Quality Trainer after completing the requirements described below.

- **Phase I -** Trainer trainee must be a certified Texas Stream Team Advanced community scientist who has been actively monitoring for at least one year.
- **Phase II -** Trainee assists a certified trainer in planning, coordinating, and presenting at one community scientist training session.
- **Phase III -** Trainee plans, coordinates, and presents all phases of one community scientist training assisted by a certified Texas Stream Team trainer.
- **Phase IV –** Trainer trainee submits the completed Trainer Enrollment Form to Texas Stream Team. If approved, the newly certified trainer will receive a certificate as a certified Texas Stream Team trainer.

A certified trainer may request the trainer trainee repeats any of the phases if the trainer is not ready to certify the trainer trainee. Certified trainers have the authority to override prerequisites if the trainer trainee successfully completes all phases up to the certified trainer(s) standards.

The following are requirements to maintain active trainer status through the Texas Stream Team program:

- The trainer must participate in and/or lead at least one community scientist training session per year.
- Trainer must attend the Annual Texas Stream Team Trainer meeting or have an alternate attend in their place.
- Trainer should submit scheduled trainings to the Texas Steam Team online calendar.
- A Training Sign-In Sheet should be submitted to TxStreamTeam@txstate.edu after each training.
- Trainer must complete a quality control field audit session every two years. The field audit is designated to help detect and correct discrepancies in monitoring techniques. This requirement is necessary to ensure the highest quality and comparability in the community scientist data statewide.

Note that if the above is not met, the trainer may have to repeat Phase III above.

Texas Stream Team Quality Assurance Officer Training

TO PERFORM FIELD AUDIT SESSIONS:

Certified trainers concurrently become certified Quality Assurance Officers upon completion of the trainer certification. Certified community scientists can be authorized to perform field audit sessions upon approval as a Texas Stream Team Quality Assurance Officer. Community scientists must first observe a field audit session performed by a certified Quality Assurance Officer, then lead a field audit session with a Quality Assurance Officer present.

Certification

Upon completion of training phases I, II, and III, the trainee must complete the online Training Enrollment Form before a certificate of completion can be issued. The trainer will then submit completed forms to the Texas Stream Team to create and distribute the certificates. The certification process serves as the record to document completion of the training and the first field audit session; therefore, it is critical that a legible form is submitted. If the trainer does not receive the completed form, a certificate of completion will not be generated and sent to the trainee. Texas Stream Team distributes certificates the beginning of each month.

1.6 QUALITY ASSURANCE

Texas Stream Team data is collected under a Texas Commission on Environmental Quality-approved Quality Assurance Project Plan. Quality assurance consists of community scientist activities that involve planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that Texas Stream Team community scientist data are of the type and quality needed and expected by the agencies that provide financial support for the program, the Texas Commission on Environmental Quality, and ultimately the Environmental Protection Agency.

The approved Quality Assurance Project Plan documents the procedures Texas Stream Team community scientists implement to ensure that the resulting data are of high quality and meet project data quality objectives. The Quality Assurance Project Plan also ensures community scientists statewide use the same methods for advanced monitoring to ensure comparable results. For these reasons, it is critical all community scientists are aware of the Quality Assurance Project Plan requirements and implement the procedures as stated in the approved document.

Quality Control

Quality control consists of the overall system of community scientist activities and compares the Texas Stream Team advanced water quality data against defined standards to verify that they meet the stated requirements approved by the Texas Commission on Environmental Quality.

There are currently three types of quality control measures implemented by Texas Stream Team advanced community scientists to achieve the data standards.

1. **Buddy system:** We strongly recommend community scientists always monitor using the buddy system for safety purposes, but also to confirm observations by conducting duplicate visual evaluations.
2. **Quality Control Sessions:** Once trained, community scientists must attend one field audit session every two years. A field audit session includes observation of a community scientist conducting evaluations by either a Texas Stream Team Trainer, Quality Assurance Officer, or Texas Stream Team staff member. Observations are documented on a Field Audit Session Checklist and results must meet the data quality objectives. Other online resources are being developed to assist with compliance of this requirement; please check the Texas Stream Team website for updates.
3. **Data Management:** Quality assurance procedures and checklists are implemented before data is entered to the Dataviewer. See Section 3.1 - Data Management for additional information.

2.0 SAFETY CONSIDERATIONS

General Precautions

1. Read all instructions to familiarize yourself with the monitoring procedures before you begin. Note any precautions in the instructions.
2. Never conduct monitoring in hazardous weather conditions. If you suspect hazardous weather conditions, do not attempt to travel to your monitoring location. Reschedule for a later time.
3. Follow the advice of all local, regional, state, and national weather agencies.
4. Follow all local, regional, state, and national laws while conducting your advanced monitoring.
5. If you need to access private property while conducting the advanced monitoring, the Private Property Access Form must be submitted to Texas Stream Team PRIOR to accessing private property.
6. Read the label on each reagent container before use. Some containers include precautionary notices.
7. Keep all equipment and chemicals out of the reach of young children.
8. In the event of an accident or suspected poisoning, immediately call the Poison Control Center at (800) 222-1222. Be prepared to give the name of the reagent in question and its manufacturer's code number. LaMotte reagents are registered with POISINDEX, a computerized poison control information system available to all local poison centers.
9. Texas Stream Team strongly suggests that you always implement a buddy system and monitor with another person for safety purposes.
10. Always wash hands and clean all surfaces before and after each sampling event.

Protecting Yourself and Your Equipment

1. Avoid contact between chemicals and skin, eyes, nose, mouth, and clothes.
2. Always wear safety goggles or glasses and rubber gloves when handling chemicals.
3. Use the test tube caps or stoppers, not your fingers, to cover test tubes during mixing.
4. Wipe up any chemical spills, liquid, or powder as soon as they occur. Rinse area with a wet sponge, then dry.
5. Thoroughly rinse sampling containers and vials twice before and after each test with deionized or distilled water (bottle drinking or tap water are acceptable if the other two are unavailable). Dry the outside of the containers.
6. Store the chemicals and equipment indoors at room temperature. Do not expose chemicals and equipment to direct sunlight for long periods of time and protect them from extremely high or low temperatures. Avoid storing your equipment in an automobile.
7. Safely dispose of all out-of-date or waste chemicals by flushing them down a sanitary sewage system drain with plenty of water. Do not dispose of chemicals into a septic waste system, waterbody, or onto the ground.
8. Once used, rinse empty bottles twice before recycling the bottle in your household recycle bin.

Site Safety

1. Park your vehicle safely away from roads and out of the way of traffic. Be cautious of traffic when unloading or loading monitoring equipment and accessing your site.
2. If necessary, sample your site from bridges with pedestrian walkways, from docks, or from stream banks. If you must enter the water, always have a buddy or partner on the shore nearby and always wear a life jacket or U.S. Coast Guard approved personal floatation device if wading is necessary.
3. Approach your site carefully! Look out for traffic on bridges and when crossing roads. Be on the lookout for snakes, fire ants, wasps, poison ivy, Africanized honeybees, wild animals, broken bottles, debris, or briars.
4. If using a boat or kayak to sample your site, learn and observe all U.S. Coast Guard and State of Texas regulations.

2.1 CHOOSING A MONITORING LOCATION

Historical water quality data is very useful in assessing impairments in water bodies. Therefore, it is preferable for community scientists conducting advanced monitoring to use existing monitoring sites with historical water quality data when possible. The Datamap can assist in determining if an established site is available in the community scientist's area of interest.

Activating an Inactive Site

Rather than establishing a new monitoring site, community scientists have the option of reactivating an inactive site. Inactive sites with historical data are useful for analyzing water quality data trends. This information can then be used by water and resource professionals to make informed decisions about the management of a waterbody. Due to these advantages, Texas Stream Team encourages community scientists to reactivate historic, inactive sites, if possible, prior to the creation of a new site. Community scientists can view all current and historic sites by referencing the Datamap, which can be used to identify an inactive site that appeals to you.

Creating a New Site

To create a new monitoring site, community scientists can submit an online New Monitoring Site Request Form to Texas Stream Team. Prior to filling out the form, community scientists should review the Site Selection Guide. The Site Selection Guide lists the necessary qualifications a site must meet to be approved as a Texas Stream Team monitoring site. These qualifications must be met at every monitoring site to increase the accuracy of the data collected and ensure the safety of the community scientist.

If the site is on private property, obtain the landowner's written permission granting access prior to any monitoring activities taking place. A Private Property Access form must be obtained and submitted to the Texas Stream Team for review before any Texas Stream Team monitoring can take place.

Once the Site Selection Guide has been reviewed and the new site has been confirmed, the New Monitoring Site Request Form is submitted with the new site information. Please note that data cannot be entered in the Waterways Dataviewer without a site identification number that includes latitude and longitude coordinates and a short description. To determine the exact location of your site, use Google Maps, a U.S. Geological Survey topographic map (scale of 1:24000), a National Oceanic and Atmospheric Administration nautical chart, one of the several Street Atlas software systems that provide latitude/longitude coordinates or street address, or a calibrated global positioning system (GPS) unit.

Following submission of the New Monitoring Site Request Form, a Texas Stream Team staff member will review the form to make sure the criteria are met and will send an email confirmation with the site identification number once the site has been created. The site identification number will be included on each monitoring form and will link the data collected to that specific site.

2.2 CHOOSING A MONITORING TIME

Advanced monitoring activities should be conducted the same day as your Standard or Probe Core monitoring. Advanced monitoring samples should also be collected once a month and at regular intervals. For example, if sampling is conducted monthly, try to sample every 30 days. If necessary, sampling can take place as early as 26 days after the last sampling event or as late as 34 days after the last sampling event.

Water quality and environmental conditions can change throughout the day, therefore monitoring at the same time and location helps to ensure the data collected on different sampling days using the same protocols are comparable. If you have questions about whether to cancel, postpone, sample early, or change your sampling location, call or email your local Training Coordinator or Texas Stream Team staff.

SAFETY CHECK: If conditions are not safe, do not sample.

2.3 EQUIPMENT AND SUPPLY LIST

Advanced Water Quality Monitoring Equipment

Advanced monitoring involves performing tests for nitrate-nitrogen, phosphate, streamflow, and turbidity in a waterbody using Texas Stream Team approved Advanced monitoring supplies.

ADVANCED MONITORING SUPPLIES

The following supplies are necessary for starting an advanced monitoring program.

- Advanced Kit (with unexpired reagents)*
- Plastic funnel
- Filtration aid solution
- Filter paper (2-3 μm, diameter 125 mm)
- Mixing bottles with caps (2 – 29 mL)
- Insta-Test Analytic Phosphate Low Range 0-2500 ppb Test Strips
- Sample bucket
- Deionized (DI) or distilled water
- Waste bin
- Insta-test Analytic Phosphate Low Range 0-2500 ppb Test Strips
- Goggles
- Gloves
- Aluminum meter stick
- Timer (stopwatch, cell phone, or wristwatch)
- Turbidity Tube (60 cm or 120 cm)
- Whiffle ball or other floating object such as a rubber duck, stick, leaf, etc.
- Tape measure
- Ice chest and ice (if sample is being transported to another location for analysis)

*Please note, the Advanced Kit must be purchased by calling LaMotte directly. Other supplies not included in the kit can be purchased separately from Hach.

ADVANCED MONITORING REPLACEMENT REAGENTS

- Filtration Aid Solution
- Nitrate #1 Tablets
- Nitrate #2 CTA Tablets
- Insta-test Analytic Phosphate Low Range 0-2500 ppb Test Strips

ADVANCED MONITORING REPLACEMENT EQUIPMENT AND SUPPLIES

- Filter Paper (2-3 µm, diameter 125 mm)
- Mixing Bottles with caps (2 – 29 mL) Plastic Analytical Funnel
- Nitrate-Nitrogen Octa-Slide, 0-15 ppm
- Octa-Slide Viewer
- Protective Sleeves for Test Tube
- Long Path Viewing Adapter
- Color Comparator Box
- Test Tube, 2.5-10 mL, plastic, with caps

Vendor and pricing information for ordering supplies and equipment can be found on the Texas Stream Team website. All equipment must be inspected upon receipt from the manufacturer and prior to each sampling event. Equipment should be inspected for completeness, breakage, and to ensure it is operating properly.

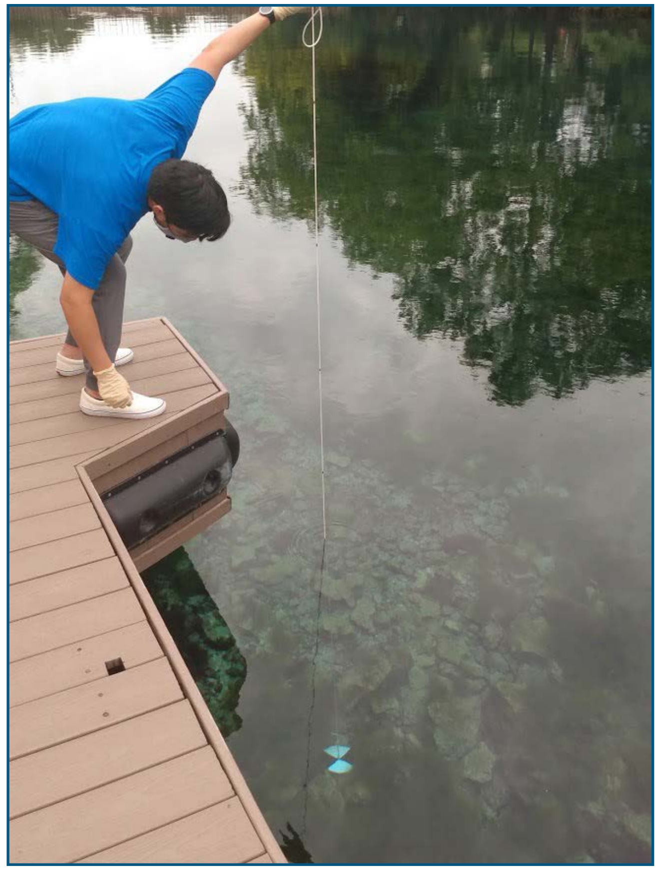
Reagents and Supplies

Texas Stream Team requires all reagent and supply expiration dates be inspected before each monitoring event. When reagents and supplies are received, the production date (if known) or arrival date and the expiration date will be written on the box of media. All items should be stored at room temperature, around 77°F, away from heat, humidity, moisture, direct sunlight, and the cold. Storage temperature should be kept as constant as possible. Be careful to avoid large fluctuations in temperature.

2.4 SAMPLING SEQUENCE

A typical sampling sequence for a certified community scientist would include the following steps:

1. Print the Monitoring Form or enter your data directly into the Dataviewer using your account credentials.
2. Before sampling, review the field audit checklist on the second page of the Monitoring Form. Use this list as a guideline throughout the sampling event to ensure all protocols are adhered to.
3. Check reagent and supply expiration dates.
4. Conduct advanced monitoring after Core monitoring.
5. At the monitoring site, document field observations on the Monitoring Form about the condition of the water, weather, and other pertinent facts. The following can be included in the Comments section:
    - Number of recreational swimmers, fishers, boaters, etc.
    - Any unusual water conditions, such as color or smell
    - The presence or evidence of wildlife
    - The presence of litter or trash
6. Collect the streamflow method (if the monitoring site is not near a gauge).
7. Collect the turbidity method.
8. Collect the water sample.
9. If transporting the water sample to another location, immediately place the sample in ice chest on ice. If transportation is not necessary, be sure to store your water sample in the shade out of the sunlight.
10. Measure and record nitrate-nitrogen and phosphate.
11. Clean and store equipment.



12. Legibly record all applicable data on the Monitoring Form. Remember to double-check for accuracy and readability.
13. Review and check-off the field quality control checklist on the second page of the Monitoring Form to confirm all procedures were followed.
14. Make sure the Monitoring Form is completed, then sign and date.
15. Submit the form to your local Texas Stream Team Data Coordinator, or to Texas Stream Team by emailing a pdf or high-quality picture to TxStreamTeam@txstate.edu

2.5 MONITORING PROCEDURES

Texas Stream Team community scientists perform advanced monitoring on a wide variety of lakes, rivers, streams, and estuaries. The primary reason for advanced testing is the determination of baseline conditions and to identify abnormal environmental events when they occur.

Field Observations

Conducting field observations adds important background information to your advanced water quality monitoring results. This background information allows watershed managers to better understand and predict trends in advanced water quality data. For this reason, it is important to adhere to the procedures described in the Core Water Quality Community Scientist Manual and to collect and report field observation data on your Monitoring Form.

If you have any questions regarding field observation procedures, please contact your Texas Stream Team trainer and/or Data Coordinator.

Comments

Record any explanatory information about the advanced measurements in the Comments section. For example, if you needed to transfer the water sample you can document it here. This is also the best place to describe:

- The biological conditions such as a plankton bloom, fish kill, presence and abundance of fish, aquatic insects, aquatic plants, and wildlife.
- The lake and stream uses like swimming, wading, boating, fishing, irrigation pumps, and navigation.
- In stream or drainage basin activities and events that are impacting water quality – bridge construction, soil washouts, herbicide or pesticide use, livestock watering, dredging, or changes in stream bottom.
- Type of floating debris found at the site.

Streamflow

OVERVIEW

Streamflow is the volume of water that moves over a designated point over a fixed period of time. Streamflow is an important measurement regarding water quality and nonpoint source pollution. Streamflow is measured with the Texas Stream Team program in cubic feet per second (cfs or ft3/sec).

Factors that affect streamflow:

- Rain
- Drought
- Development
- Pumping of groundwater

During high flow, higher levels of contaminants might exist in the waterbody due to contaminants being carried with sediments in stormwater during runoff events. Some organisms depend on streamflow for food and oxygen. Additionally, substantial streamflow dilutes the effect of pollution on aquatic organisms. When streamflow is limited, the effect of pollution is increased due to decreased dilution. Therefore, less flow may lead to concentrated contaminants. Also, lower flows may cause changes in water temperature and other parameters such as dissolved oxygen. Higher streamflow can increase dissolved oxygen. When water bodies contain a high streamflow, pollutants can be transferred, degraded, and diluted, having little effect on the waterbody. Higher levels of contaminants might exist in a waterbody due to contaminants being carried with sediments in stormwater during runoff events. Flow levels can impact water quality negatively during high runoff events. Additionally, a waterbody with low streamflow is unable to transfer and dilute pollutants making it more susceptible to poor water quality.

MEASURING STREAMFLOW

FLOW GAUGE STATION METHOD

Flow gauges are operated by varies state and federal agencies to document high level and consistent flow measurements. These agencies include river authorities and the United States Geological Survey. If a Texas Stream Team monitoring site is near a flow gauge, that data can be reported under the advanced monitoring.

STEP 1: Check if the monitoring site is ≤0.25 river miles of a stream gauge. You can check the United States Geological Survey, International Boundary and Water Commission's, or your local river authority to see a list of flow gauging stations.

STEP 2: Measure the distance from the monitoring station using free software such as Google Earth, implementing the measurement tool.

STEP 3: If the monitoring site is ≤0.25 mile of a gauge, record the *Discharge* from the gauge for the same day and approximate time the monitoring event was conducted. Record the *Flow Measurement Method* on the Monitoring Form.

- If the nearest gauge is >0.25 mile of the monitoring site, proceed with the protocols below to estimate streamflow discharge.

STREAMFLOW ESTIMATE METHOD

This method was chosen because it is a practical and affordable method to record cfs measurements using community science. Other options involve flow meters (devices that measures and records discharge), which are more expensive and less user-friendly. Also, more measurements could be taken and coupled with more complicated calculations to achieve greater accuracy, but this is not included so that this process can be performed by all willing community scientists.

Never measure streamflow in swiftly moving, deep water, or in hazardous weather conditions. Take a buddy with you for safety purposes. If you are concerned for your safety, **do not** proceed.

STEP 1: Select a cross section of the waterbody with laminar flow to measure, avoiding pools, ripples, backflows, etc., that would impact the waterbody's true flow. Choose a section between 5 – 20 feet wide if possible.

STEP 2: Measure the width of the waterbody in feet. Measure only the water from the edge of the left bank to the edge of the right bank. Round to the nearest 0.25 inch and document on Monitoring Form.

STEP 3: Measure the depth of the waterbody at the midpoint of 2 feet wide increments along the entire width of the waterbody. Average the depth measurements and document on Monitoring Form.

STEP 4: Measure 10 feet downstream (following the current) from the centroid of flow.

STEP 5: Calculate the time it takes for an object to travel downstream. There are two ways to do this:

- Buddy method is used if you have a buddy.
  1. Have one person stand upstream at the beginning of the 10-foot measurement, and the other downstream.
  2. The person upstream drops the whiffle ball/floating object into the current.
  3. The person downstream times how long it takes the object to travel 10 feet using the timer, then retrieves and returns the object to the starting point. Record the time on the Monitoring Form.
  4. Repeat the process 3X and average the recorded times.
- Sampling alone is used if you do not have a buddy.
  1. Mark where the 10-foot measurement is downstream. You can insert a stick into the sediment so that it is visible above the water surface, or stack rocks. Be sure to remove any sticks/rocks after completing the measurement.
  2. Stand upstream (at the beginning of the 10- foot measurement). Instead of a whif-

fle ball, use a dry stick or a natural object that can float to prevent littering.

3. Drop the floating object into the current.
4. Use the timer to time how long it takes the object to travel 10 feet. Record the time on the Monitoring Form.
5. Repeat the process 3X and average the recorded times.

STEP 6: Divide the distance (10 ft) by the average time to calculate the *Velocity*.

- Velocity (ft/sec) = 10 (ft) ÷ Average Time (sec).

STEP 7: Calculate and record the *Discharge* in cubic feet per second (cfs).

- Discharge (cfs) = Width of Waterbody (ft) x Average Depth (ft) x Average Velocity (ft/sec).

Turbidity

OVERVIEW

Turbidity is the cloudiness or haziness of a fluid, caused by dissolved or suspended solids that scatter light, making the water appear cloudy or murky. These suspended solids can include soil, algae, plankton, microbes, and other substances. These solids are often invisible to the naked eye due to their small size but can wreak havoc on plants and animals. Turbidity is measured with the Texas Stream Team program in Nephelometric Turbidity Units or mg/L.

Highly turbid waters are mostly a result of stormwater runoff carrying exposed soils. Sources can include:

- Soils exposed from tilling, mining, construction, or drought
- Excessive algal growth
- Bottom feeders disturbing sediment
- Recreational swimming
- Eroding stream banks

High turbidity increases the water temperature because suspended particles absorb more heat. Higher temperatures then reduce the dissolved oxygen because warm water holds less dissolved oxygen than cold water. This process is intensified because turbid water limits sunlight penetration, which limits photosynthesis and therefore reduces the amount of dissolved oxygen in the waterbody. Highly turbid water also poses a risk to wildlife by clogging gills, reducing resistance to disease, lowering growth rates, and affecting egg and larval development. As suspended particles settle, they can blanket the stream bottom and smother fish eggs and any organisms living on or near the bottom of the waterbody. Contaminants tend to attach to sediment, so highly turbid waters serve as an indicator of other problems as well.

MEASURING TURBIDITY

The turbidity method used by Texas Stream Team involves using a turbidity tube (60 cm or 120 cm). This method was chosen because it is a practical and affordable method to achieve quantitative turbidity measurements using community science. Other options involve using spectrometers, which are very expensive.

STEP 1: Collect the turbidity water sample by selecting a method most applicable to your monitoring site:

- Bucket Grab is used if the centroid of flow is not accessible, or it is not safe to get in the water.
    1. Rinse bucket and tube 2X with sample water.
    2. Use a bucket to collect sample water. Do not disturb the streambed or kick up any sediment. Carefully pour the water collected in the bucket into the tube immediately after collection to prevent settling of suspended materials.
- Sample Directly from Waterbody if the centroid of flow is accessible and safe.
    1. Standing in the centroid of flow of the waterbody and downstream of the tube, rinse the tube 2X then dip the tube into the water facing upstream to fill. Do not disturb the streambed or kick up any sediment.

STEP 2: Holding the tube vertically, look down the tube from the top to see if the disk at the bottom is visible. If disc is not visible, release water until visible and record the water level in meters on Monitoring Form. If the tube is filled to the top and the disk is completely visible, record the measurement as > the maximum tube length (i.e., >1.2m or >0.6m depending on the length of the tube used).

STEP 3: Use the table below to convert the measurement from meters to nephelometric turbidity units (NTUs). Record the value on the Monitoring Form.

Distance from bottom of tube (m)	NTU	Distance from bottom of tube (m)	NTU
<0.0625	>240	>0.2875 to 0.3125	24
0.0625 to 0.07	240	>0.3125 to 0.3375	21
>0.07 to 0.08	185	>0.3375 to 0.3625	19
>0.08 to 0.095	150	>0.3625 to 0.3875	17
>0.095 to 0.105	120	>0.3875 to 0.4125	15
>0.105 to 0.12	100	>0.4125 to 0.4375	14
>0.12 to 0.1375	90	>0.4375 to 0.4625	13
>0.1375 to 0.1625	65	>0.4625 to 0.4875	12
>0.1625 to 0.1875	50	>0.4875 to 0.5125	11
>0.1875 to 0.2125	40	>0.5125 to 0.5375	10
>0.2125 to 0.2375	35	>0.5375 to 0.575	9
>0.2375 to 0.2625	30	>0.575 to 0.6	8
>0.2625 to 0.2875	27	> 0.6	6

Source: Utah Water Watch, Turbidity Tube Conversion Chart

*1 meter = 100 centimeters

DATA RANGE

Turbidity measurement results are recorded in nephelometric turbidity units (NTU) and can be read from 6 to 240 NTUs. Turbidity is a measure of water transparency and is used by the Texas Commission on Environmental Quality as a secondary parameter for assessing eutrophication in reservoirs and lakes. Turbidity is also an important parameter used in the drinking water treatment process to ensure safe drinking water.

Collecting a Water Sample

If advanced monitoring is conducted the same day as Core monitoring, a fresh bucket sample should be collected. Rinse the sample bucket twice with water to be sampled at the same depth as the sampling depth. See the Sample Depth section below for guidance.

Try to get your bucket grab as close to the center of the waterbody as possible. If there is a current, be sure you are standing downstream of your container. Do not drag the container on the bottom of the lake or stream, or kick sediment up into your sample.

Sample Depth

If the water depth at the sampling point is less than 0.5 m, collect samples at a depth equal to one-third of the water depth measured from the water surface. If the water depth is greater than 0.5 m, collect samples at a depth of 0.3 m (1 foot) below the surface. This is the depth at which most water quality measurements are made by Texas Commission on Environmental Quality's professional monitors.

When submerging the sample container, be sure to avoid contamination by material on the surface. The surface of the water is enriched with particles and bacteria is not representative of the waterbody as a whole.

> **QC CHECK:** Always throw the bucket rinse water downstream or on the bank so the rinse water does not contaminate the sample.

Sample Preservation & Holding Times

Test water sample as soon as possible following sample collection. If transporting a sample is necessary due to weather or other extreme conditions, samples should be placed on ice during transport and analyzed as soon as possible. Please record in the comments field if the sample was transported.

Nitrate-Nitrogen and Turbidity: Samples can be stored for up to 48 hours at 4°C. Check the temperature of your refrigerator with a thermometer and adjust to 4°C. Be sure to transport samples to the refrigerator on ice.

Phosphate: Samples can be preserved by freezing at or below -10°C for up to 48 hours, but this is not recommended. Check the temperature of your freezer with a thermometer and adjust to -10°C. Be sure to transport samples to the freezer on ice. Samples should be filtered prior to transport in most cases. Note that highly turbid water may take up to thirty minutes to filter. If a community scientist is sampling highly turbid water in unfavorable conditions, it is permitted but not recommended that community scientists transport samples prior to filtration.

Filtration

Filtration must be performed for both nitrate-nitrogen and phosphate if you recorded either "cloudy" or "turbid" on the *Field Observations* section of the Monitoring Form under Water Clarity. If the sample is clear, proceed to the Testing Procedures section without filtering.

STEP 1: Rinse 1 mixing bottle 2X with sample water; rinse the other mixing bottle 2X with DI water.

STEP 2: Fill the bottle rinsed with sample water to the shoulder with more sample water.

STEP 3: Add 0.5 mL of Filtration Aid Solution. Swirl to mix.

STEP 4: Place the funnel inside the bottle rinsed with DI water and insert a filter into the funnel. Pour the water sample from the first bottle into the funnel. Use the filtered water sample or filtrate in the testing procedures below.

STEP 5: Rinse funnel and mixing bottles 2X with DI water before storing.

Nitrate-Nitrogen

OVERVIEW

Nitrogen is a nutrient necessary for the growth of most organisms. Nitrogen is present in terrestrial or aquatic environments as nitrates, nitrites, and ammonia. Nitrate-Nitrogen is a compound containing nitrogen which can exist as a dissolved solid in water. Nitrates are produced as a result of the decomposition of animal and human waste and can often be an indication of pollution levels of the water. Nitrate-nitrogen is measured with the Texas Stream Team program in mg/L.

Nitrate-Nitrogen Sources:

- Wastewater treatment plants
- Fertilized lawns and cropland
- Failing septic systems
- Animal waste
- Industrial discharges

Excessive amounts of nitrogen can have a detrimental effect on aquatic life by lowering the concentration of dissolved oxygen. Nitrogen affects dissolved oxygen when excessive algae growth on the water surface starves subsurface vegetation of sunlight, which limits the input of oxygen into a waterbody due to decreased photosynthesis. This process is enhanced when subsurface vegetation dies and decomposes, undergoing a process during which oxygen is consumed from the water (the bacteria breaking down the vegetation uses up a lot of the oxygen in the water).

Nitrates dissolve more readily (easily) than phosphates, which tend to be attached to sediment, and therefore can serve as a better indicator of the possibility of sewage or manure pollution during dry weather.

MEASURING NITRATE-NITROGEN

The LaMotte Nitrate-Nitrogen Kit (Zinc Reduction Octa-Slide 2 Method) enables the user to reduce nitrate-nitrogen to nitrite with zinc, which then undergoes diazotization (coupling) to form a pink color in a test tube. The test tube is then inserted in an Octa-Slide 2 Viewer and compared to a color standard. The value of the closest color to the sample is recorded in milligrams per liter (mg/L).

Aside from the accuracy described above, the LaMotte Nitrate-Nitrogen Zinc Reduction Method is employed because it is a practical test available for community science programs due to the lack of hazardous waste and the low cost of supplies. It has been used by the Colorado River Watch Network for many years, and the need for cross-program consistency is very important for Texas Stream Team since it is the hub for a network of partners, including the Colorado River Watch Network.

STEP 1: Rinse test tube 2X with sample water or filtrate if water sample was filtered.

STEP 2: Using a pipette, fill test tube with 5 mL of sample water or filtrate as appropriate.

STEP 3: Add 1 Nitrate #1 Tablet to test tube without touching the tablet with your hands/fingers. See instructions and diagram on tablet box, if needed.

STEP 4: Cap test tube and invert until tablet dissolves.

STEP 5: Add 1 Nitrate #2 Tablet to test tube the same way as step 3 above. Immediately slide the tube into the Protective Sleeve if testing outdoors.

STEP 6: Cap and invert for 2 minutes until tablet dissolves.

STEP 7: Wait 8 minutes. While you wait, insert the Nitrate-Nitrogen Octa-Slide 2 Bar into the Octa-Slide 2 Viewer.

STEP 8: After 8 minutes remove the test tube from the protective sleeve. Insert tube into the Octa-Slide 2 Viewer.

STEP 9: Match the resulting sample color to a color standard on the Octa-Slide 2 Bar and record as ppm or mg/L on Monitoring Form.

STEP 10: If test result is < 2.00 ppm or mg/L, record on Monitoring Form and proceed to step 12.

STEP 11: If test result is ≥ 2.00 ppm or mg/L, run test again to confirm.

- If the same/similar result occurs, average the values and record on Monitoring Form.
- If the same/similar result does not occur, rerun the test until the same/similar result occurs and record the average on Monitoring Form.

STEP 12: Dispose sample water in waste bin and rinse test tube and cap 2X with DI water before storing.

QC CHECK:

1. To properly mix your sample in the test tube, the test tube should be constantly inverted, or turned upside down. Be sure the cap is secured.
2. Nitrate #2 Tablets are sensitive to UV light. The Protective Sleeve will protect the reaction from UV light. If testing indoors, there is no need to use the Protective Sleeve in this procedure.

DATA RANGE AND SCREENING LEVEL

Nitrate-nitrogen measurements can be read from 0 to 15 mg/L nitrate-nitrogen. Measurements are accurate to +/- 0.5 mg/L. Values which appear to be below 1 mg/L are recorded as <1 because it is the lowest readable quantity of the color comparator.

Texas Commission on Environmental Quality conducts nutrient assessments using the water quality standard for chlorophyll *a* in reservoirs. Water Quality Standards have not been established for freshwater streams, rivers, or bays/estuaries. Therefore, Texas Commission on Environmental Quality uses a freshwater screening level for nitrate-nitrogen of 1.95 mg/L. Texas Stream Team analyzes data collected by certified community scientists and prepares quarterly data summary reports to document data trends within a specific watershed.

Phosphate

OVERVIEW

Phosphorus almost always exists in the natural environment as phosphate, which continually cycles through the ecosystem as a nutrient necessary for the growth of most organisms. Testing for phosphate detects the amount of readily available phosphate in the water itself, excluding the phosphate bound up in plant and animal tissue.

Phosphate is normally in short supply in fresh water. Often times the concentration of phosphate in freshwater is below the lab's detection limit, indicating low levels. Testing for phosphate gives us an idea of the degree of phosphate in a waterbody. It can be used as a screening tool for problem identification, which can be followed up with more detailed professional monitoring if necessary. Phosphate can have the same detrimental effect as nitrate-nitrogen.

Phosphate sources:

- Soil
- Rocks
- Wastewater treatment plants
- Fertilized lawns and croplands
- Failing septic systems
- Animal waste
- Disturbed land areas
- Drained wetlands
- Commercial cleaning preparations

Excessive amounts of phosphorus can stimulate plant and algae growth, which can provide food for fish, but excessive amounts of phosphorus can have harmful effects on water quality:

- Low dissolved oxygen levels
- Respiration efficacy of fish and aquatic invertebrates
- Eutrophication

WHAT IS EUTROPHICATION?

Eutrophication can occur as a result of excessive nutrients; the process of eutrophication occurs when the nutrients stimulate excessive plant and algae growth, then those plants and algae die and sink to the bottom of the waterbody. There, the plants and algae are decomposed by bacteria and the oxygen is consumed resulting in low or anoxic conditions which can lead to fish kills or displacement of mobile organisms. This is what takes place in the Gulf of Mexico every year in what is called the "dead zone," but it can also occur in lakes, streams, rivers, and estuaries

MEASURING PHOSPHATE

The LaMotte Insta-test Analytic Phosphate Low Range 0-2500 ppb Test Strips enables the user to conduct the test in a short amount of time using a visual color standard located on the bottle. The value of the closest color to the sample is recorded in ppm or mg/L.

The LaMotte Insta-test Analytic Phosphate Low Range 0-2500 ppb Test Strips was chosen because it enables the user to detect values as low as 0.00 to 2.50 mg/L. Most water bodies in the state of Texas will exhibit very low values for phosphate, so community scientists need the ability to detect at low detection limits.

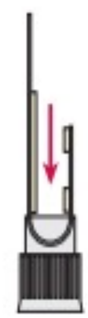
STEP 1: Rinse test tube and cap 2X with sample water or filtrate if water sample was filtered.

STEP 2: Fill test tube with 10 mL of sample water or filtrate as appropriate.

STEP 3: Remove one test strip from the vial and immediately cap vial to prevent UV light contamination.

STEP 4: Gently bend the strip – DO NOT FOLD – beneath the long rectangular test pad with pads facing inwards. The test strip should now be in the shape of the letter "J".

STEP 5: Place the bend of the strip inside the test tube cap. Cap test tube with strip inside.



STEP 6: Slowly invert the test tube 5X, making sure air bubble moves from one end of the tube to the other each time the tube is inverted.

STEP 7: Remove the cap and test strip.

STEP 8: Place the bottom of the test tube on the white boxed area of the color chart located on the vial with the test strips.

STEP 9: Look down through the OPEN test tube and compare to the color chart.

Note: For accurate results, read in natural light.

STEP 10: If test result is < 700 ppb (< 0.7 ppm or mg/L), record the result on Monitoring Form as ppm or mg/L (see unit conversion table below) and proceed to step 12.

- If the value falls between two colors on the chart, record the value halfway between the two.

STEP 11: If test result is ≥ 700 ppb (≥ 0.7 ppm or mg/L), run test again to confirm.

- If the same/similar result occurs, average the values and record on Monitoring Form as ppm or mg/L.
- If the same/similar result does not occur, rerun the test until the same/similar result occurs and record the average on Monitoring Form as ppm or mg/L.

STEP 12: Dispose sample water in waste bin and rinse test tube and cap 2X with DI water before storing.

Unit conversion: ppm or mg/L = ppb ÷ 1,000

Parts per billion (ppb)	0	100	200	300	500	1000	2500
Parts per million (ppm or mg/L)	0	0.1	0.2	0.3	0.5	1.0	2.5

DATA RANGE AND SCREENING LEVEL

Screening level is the terminology Texas Commission on Environmental Quality uses when a water quality standard is not promulgated in the Texas Water Code. The states screening level for total phosphorus in freshwater streams is 0.69 mg/L, but Texas Stream Team only measures phosphate, or the phosphorus portion in water, not the organic portion bound up in plant and animal tissue. Measuring total phosphorus is cost prohibitive, therefore phosphate is measured as an indicator of potential phosphorus contamination.

3.0 FOLLOW-UP AND CLEAN-UP

Clean-Up

WASTE DISPOSAL

All advanced monitoring reagents and supplies are non-hazardous. To dispose of the sample water waste generated during the monitoring event, run cold tap water and slowly pour waste material down a sanitary sewage system drain. While pouring the waste into the drain, turn on the tap and keep it running throughout the process. This will dilute the waste chemicals. Place the used phosphate strips in household garbage for disposal.

Do not dispose of chemicals into a septic waste system, waterbody, or onto the ground.

KIT STORAGE

Kits should be sealed and stored in a cool, dark place, and should not be stored in direct sunlight or high temperatures. Ensure that your kit is stored in a safe location, where it cannot be accessed by children or animals. All chemicals should be stored inside the kit.

Follow-Up

SUBMITTING A TRAINING ENROLLMENT FORM

The Training Enrollment Form must be submitted to participate in the Texas Stream Team program. Note that Texas Stream Team cannot certify individuals who do not submit the Training Enrollment Form.

The trainer will send training documentation to Texas Stream Team to be processed by staff. Certificates will be emailed to community scientists within the first week of the month following the training.

Upon completion of the training, Texas Stream Team Advanced community scientists can begin monitoring. To get started, certified community scientists need to obtain monitoring supplies, select a site, and create a monitoring schedule.

MONITORING EQUIPMENT

To obtain equipment and supplies for the Advanced training, go to the Texas Stream

Team Monitoring Equipment Form. **Please note**, Texas Stream Team is a federally recognized statewide monitoring program with an approved Quality Assurance Project Plan, therefore all monitoring must be conducted using approved methods and with the equipment listed, unless prior approval has been granted by Texas Stream Team staff. Texas Stream Team is entirely grant funded, and, therefore, unable to provide funding assistance to all community scientists and partners across the state. Texas Stream Team highly encourages community scientists and partners to seek alternate funding sources. Please refer to the Funding Sources Document for assistance.

MONITORING SITE

To select a site, community scientists can begin by referencing the Datamap. The Datamap includes all historic and current water quality monitoring sites. Community scientists can choose to reactivate an inactive site, or they can create a new site using the New Monitoring Site Request Form. For more information on site selection, go to Section 2.1- Choosing A Monitoring Location.

MONITORING SCHEDULE

Community scientists must create a monitoring schedule that allows time to travel to the monitoring site and conduct the sampling following their Core monitoring. To ensure data quality, the Texas Stream Team requests community scientists conduct *E. coli* bacteria water quality monitoring at least once a month, at the same time. For more information on scheduling your sampling time, see Section 2.2 - Choosing a Monitoring Time.

3.1 DATA MANAGEMENT

Community scientists are required to use the Advanced Environmental Monitoring Form to record measurements at their monitoring site(s). Test results are always recorded on the form as they are completed while in the field at the monitoring site. All applicable sections of the Monitoring Form should be completed. For example, if information is not collected for a parameter, the space on the form remains blank.

Recording Data

To ensure compliance with the approved Quality Assurance Project Plan, community scientists should observe the following rules when completing the Monitoring Form:

1. Write legibly in ink or pencil if using the hard copy version of the Monitoring Form.
2. Correct errors with a single line strike-through followed by initials of the individual making the correction and date the correction was made.
3. Complete the Field Quality Control Checklist on the form to confirm protocols were followed.
4. Sign and date the form once complete for validation.

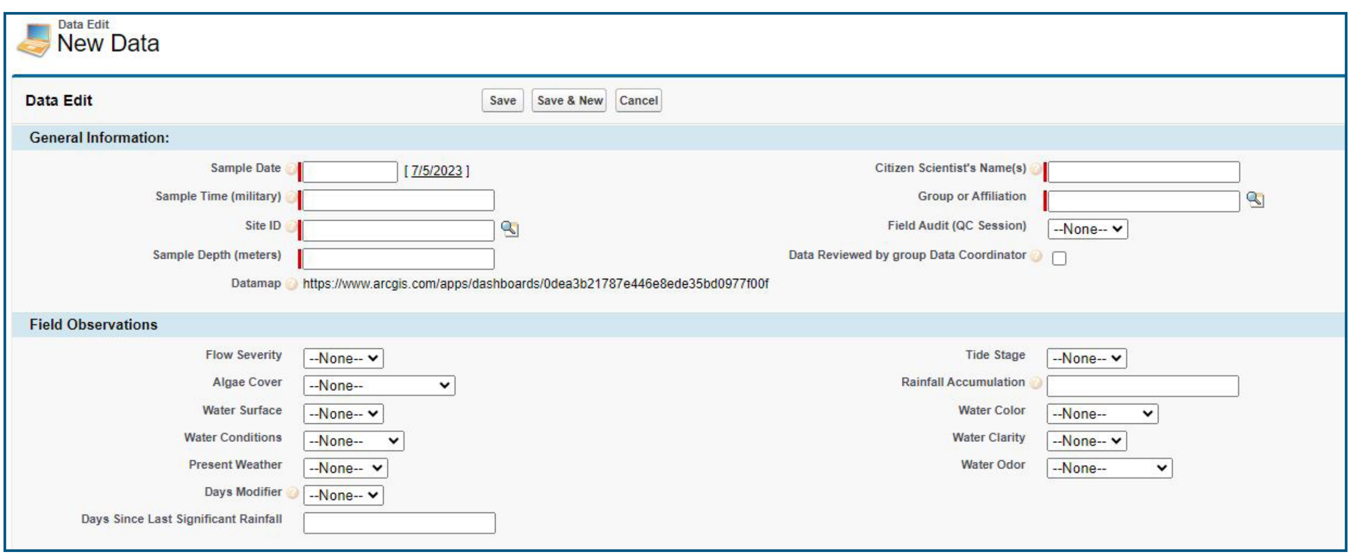
Before monitoring data can be entered into the Dataviewer, it must undergo a quality control check to ensure the data are of the highest quality and meet the following conditions:

1. It is collected by a certified community scientist that has met all training requirements as described in this manual.
2. It is collected using the protocols, equipment, and the Field Quality Control Checklist provided on the form described in this manual.
3. All data entries are legible if using the hard copy version of the Monitoring Form.
4. The Monitoring Form is complete and includes a signature by the community scientist that conducted the monitoring.
5. All quality assurance and quality control protocols described in this manual have been implemented and met to the best of the community scientist's ability.

Entering Data into Waterways Dataviewer

Once the Monitoring Form is complete and meets the quality control checks, the next step is to enter the data into the Dataviewer. There are two ways to enter the data:

1. Monitoring Forms get forwarded to the group Data Coordinator (if available). The group Data Coordinator conducts a quality


Data Edit
New Data

Data Edit [Save] [Save & New] [Cancel]

General Information:

Sample Date [7/5/2023]
Sample Time (military)
Site ID
Sample Depth (meters)
Datamap https://www.arcgis.com/apps/dashboards/0dea3b21787e446e8ede35bd0977f00f
Citizen Scientist's Name(s)
Group or Affiliation
Field Audit (QC Session) --None--
Data Reviewed by group Data Coordinator

Field Observations

Flow Severity --None--
Algae Cover --None--
Water Surface --None--
Water Conditions --None--
Present Weather --None--
Days Modifier --None--
Days Since Last Significant Rainfall
Tide Stage --None--
Rainfall Accumulation
Water Color --None--
Water Clarity --None--
Water Odor --None--

control check and enters the data into the Dataviewer. If your group does not have a Data Coordinator, skip to the second option.

2. Monitoring Forms are submitted to Texas Stream Team by emailing scanned or high-quality photocopies to TxStreamTeam@txstate.edu for entry by Texas Stream Team staff. Texas Stream Team staff conducts a quality control check and enters the data into the Dataviewer.

Before group Data Coordinators can access the Dataviewer to enter data, they must first request an account and receive assigned login credentials. A request for an account can be made by filling out the Dataviewer Account Request Form.

Once the data from the Monitoring Forms are entered into the Dataviewer, the group Data Coordinator, Texas Stream Team staff, and/or designee verifies the data entry and the data becomes publicly available.

If the data does not meet the checks described above, the data is flagged upon entry to the Dataviewer for further review by Texas Stream Team staff or designee. The purpose of flagged data is to note inconsistencies or identify data that may have excessive variability. The Dataviewer is designed to recognize and flag data that do not meet requirements in the checklist. Therefore, it is critical for community scientists to comply with the protocols described in this manual to ensure data measurements are of the highest quality and can be used to promote and protect a healthy and safe environment for people and the aquatic inhabitants.

3.3 EQUIPMENT MAINTENANCE AND STORAGE

The importance of proper maintenance and storage of all monitoring equipment cannot be overstated. The accuracy of the measurements depends on proper maintenance and storage. The time, effort, and expense that goes into conducting Texas Stream Team water quality monitoring is highly valued, therefore do not dismiss this very important step that will add value to the quality of data produced and increase the longevity of the equipment.

QC CHECK: Do not use soap when cleaning your equipment. This can leave a residue, which can alter your results.

Rinse all bottles, tubes, caps, and equipment used for the monitoring event with distilled water. Dry and sore in protective kit.

Images acquired from the official government website of Knox County, Tennessee.

3.4 REPORTING UNUSUAL ACTIVITY AND UNLAWFUL EVENTS

Illicit discharge

An illicit discharge can have different meanings across different regulatory agencies. For the purposes of Texas Stream Team monitoring activities, an illicit discharge is defined as any event wherein a storm drain has a measurable flow during dry weather conditions (Brown, et. al, 2004). Illicit discharges are usually produced from a singular source or operation and can be further broken down into categories based on their frequency, flow-type, and mode of entry (Brown, et. al, 2004).

Illicit discharges can be either direct or indirect. An illicit discharge has a direct mode of entry when the discharge is directly connected to a storm drain through a sewage pipe, shop drain, or other kind of pipe (Brown, et. al, 2004). An indirect discharge occurs when flows generated outside of the storm drain enter the system, either through inlets, or by infiltrating the joints of a pipe (Brown, et. al, 2004).

Illicit discharges include any instances wherein chemicals or waste are discarded into a sanitary sewer drain. Examples of illicit discharges include improperly discarded oil and grease, runoff from excessive fertilizers and pesticides, and illegal dumping of hazardous chemicals (Brown, et. al, 2004). Other examples include septic tank seepage, laundry wastewater, or illegal sanitary sewer connections (Brown, et. al, 2004). For information about illicit discharge, and additional examples of illicit discharges that might be expected corresponding to land use, visit page 12, table 2 of the Environmental Protection Agency's Illicit Discharge Detection and Elimination Guidance Manual for Program Development and Technical Assessments (see Section 4.0- References).

HOW TO REPORT AN ILLICIT DISCHARGE

To report an illicit discharge, please contact your city office. Many cities allow community members to anonymously report illicit discharges online.

Check your city's Department of Water or Department of Public Works for an online form, or, alternatively, you can contact your city office at their main office phone line.

For assistance with reporting illicit discharges, you can also contact Texas Stream Team at TxStreamTeam@txstate.edu or by calling (512) 245-1346.

Wildlife Kills and Pollution Events

The Texas Parks and Wildlife Department's Kills and Spills Team (KAST) is comprised of a group of biologists who investigate fish and wildlife kills. Kills and Spills Team biologists evaluate both unnatural and natural events to assess the impacts to fish and wildlife resources and to determine the causes of the events.

Kills and Spills Team biologists work to:

1. Determine the causes of wildlife kills and/or pollution events

2. Attempt to minimize environmental damage resulting from wildlife kills and/or pollution events
3. Obtain compensation for environmental damage and restore the affected environment resulting in Kill or Spill

   (Kills and Spills Team, n.d.)

REPORTING A KILL OR SPILL

Prompt notification is essential to a successful investigation, and the sooner that Kills and Spills Team biologists are notified of a potential wildlife kill or pollution event, the better the chances are that useful evidence can be collected, and conclusive actions can be taken.

When reporting a Kill or Spill, make a note of the:

1. Location, date, and time
2. Water color, clarity, and odor
3. Number, size, and species of affected organisms
4. Recent weather
5. Condition and behavior of animals or organisms
6. Condition of plants/other organisms

   (Kills and Spills Team, n.d.)

Image acquired from the TPWD KAST webpage.

To contact the Kills and Spills Team, call (512) 389-4848 or contact your regional Kills and Spills Team biologist.

You can find the regional KAST biologist at www.tpwd.gov/landcover/water/environconcers/kills_and_spills/regions.

Texas Commission on Environmental Quality Compliance and Enforcement

The Texas Commission on Environmental Quality Office of Compliance and Enforcement is responsible for enforcing compliance with state environmental law, responding to emergencies and natural disasters, overseeing dam safety, and monitoring air quality (Office of Compliance and Enforcement, 2020).

Texas Commission on Environmental Quality divides the state of Texas into four areas, with further regional divisions. Within their defined administrative region, each regional office is responsible for:

- Investigating compliance at permitted air, water and waste facilities
- Investigating complaints at facilities and operations- permitted or not- from community members, businesses, and other concerned parties
- Developing enforcement actions and referrals for violations
- Environmental education and technical assistance for communities
- Monitoring the quality of ambient air, surface water, and public drinking water

  (Office of Compliance and Enforcement, 2020)

REPORTING AN ENVIRONMENTAL PROBLEM

Concerned community members can file an Environmental Complaint with the Texas Commission on Environmental Quality. In general, the Texas Commission on Environmental Quality can assist with any complaint, provided that you have:

- Seen water that may be polluted
- Seen or smelled something unpleasant in the air
- Seen land that may be contaminated
- Are having problems with your drinking water
- Have information or evidence about an environmental problem
- Are having problems with an individual or company licensed or registered by the Texas Commission on Environmental Quality
- Need assistance or information regarding environmental laws, possible pollution sources, or other questions relating to Texas Commission on Environmental Quality Compliance and Enforcement

  (Office of Compliance and Enforcement, 2020)

For more information on what Texas Commission on Environmental Quality can and cannot help with, please visit the Texas Commission on Environmental Quality website.

To report an Environmental Problem, please contact the Texas Commission on Environmental Quality Office of Compliance and Enforcement at their 24-hour line 888-777-3186 or fill out their online form.

If you would prefer to contact your regional Texas Commission on Environmental Quality Field Office, you can find applicable contact information on the Texas Commission on Environmental Quality website.

4.0 REFERENCES, ONLINE RESOURCES, AND GLOSSARY

References

Brown, E., Caraco, D., Pitt, R. (2004). Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessment. Retrieved from: https://www3.epa.gov/npdes/pubs/idde_manualwithappendices.pdf

Kills and Spills Team. (n.d.). Texas Parks and Wildlife. Retrieved from: https://tpwd.texas.gov/landwater/water/environconcerns/kills_and_spills/

Office of Compliance and Enforcement. (2020). Texas Commission on Environmental Quality. Retrieved from: https://www.tceq.texas.gov/agency/organization/oce.html#8

Stormwater Management staff. (n.d.). Examples of Illicit Discharge. Government of Knox County, Tennessee. Retrieved from: https://www.knoxcounty.org/stormwater/illicit_discharge.php

Utah Water Watch. (n.d.). Turbidity Tube Conversion Chart. Extension Utah State University. Retrieved from: https://extension.usu.edu/utahwaterwatch/monitoring/field-instructions/turbidity/turbiditytube/turbiditytubeconversionchart

Online Resources

- Advanced Environmental Monitoring Form
- Dataviewer Account Request Form
- Equipment Form
- Funding Guidance
- Group Monitoring Plan
- Measures of Success Survey
- New Monitoring Site Request Form
- Private Property Access Form
- Site Selection Guide
- Supply Order Form
- Texas Stream Team Calendar
- Texas Stream Team Dataviewer and Datamap
- Texas Stream Team Online Store
- Texas Stream Team Partners List
- Texas Stream Team Quality Assurance Project Plan (QAPP)
- Texas Stream Team Trainers List
- Texas Stream Team Trainings and Programs
- YouTube Quality Control and Parameter Videos

For additional forms and resources please visit the Texas Stream Team Forms and Resources page.

Glossary

Algae - Plants that lack true roots, stems, and leaves. For the physical assessment described herein, algae consist of nonvascular plants that attach to rocks and debris or are free floating in the water. Such plants may be green, blue-green, or olive in color, slimy to the touch, and usually have a coarse filamentous structure.

Ammonia-Nitrogen (NH3-N) - Ammonia, naturally occurring in surface and wastewaters, is produced by the breakdown of compounds containing organic nitrogen.

Bank - The portion of the channel that tends to restrict lateral movement of water. It often has a slope less than 90° and exhibits a distinct break in slope from the stream bottom. Also, a distinct change in the substrate materials or vegetation may delineate the bank.

Channel - That portion of the landscape which contains the bank and the stream bottom. It is distinct from the surrounding area due to breaks in the general slope of the land, lack of terrestrial vegetation, and changes in the composition of substrate materials.

Estuary - Regions of interaction between rivers and near shore ocean waters, where tidal action and river flow create a mixing of fresh and salt water.

Eutrophic - Refers to shallow, murky bodies of water that have excessive concentrations of plant nutrients resulting in increased algal production.

Eutrophication - The slow, aging process during which a lake, estuary or bay evolves into a bog or marsh and eventually disappears.

Habitat - The area in which an organism lives.

Nitrate-Nitrogen (NO3-N) - A compound containing nitrogen which can exist as a dissolved solid in water. Excessive amounts can have harmful effects on humans and animals >10 mg/L).

Nonpoint Source - Pollution sources which are diffuse and do not have a single 38 point of origin or are not introduced into a receiving stream from a specific outfall. The pollutants are generally carried off the land by stormwater runoff. The commonly used categories for nonpoint sources are: agriculture, forestry, urban, mining, construction, dams and channels, land disposal and saltwater intrusion.

Nutrient - Any substance used by living things to promote growth. The term is generally applied to nitrogen and phosphorus in water and wastewater but is also applied to other essential and trace elements.

Phosphate - Phosphate is a measure of phosphate molecules in water. Testing for phosphate detects the amount of readily available phosphate in the water itself, excluding the phosphate bound up in plant andanimal tissue.

Outfall - A designated point of effluent discharge.

Phosphorus - Essential nutrient to the growth of organisms and can be the nutrient that limits the primary productivity of water. In excessive amounts, from wastewater, agricultural drainage and certain industrial wastes, it also contributes to the eutrophication of lakes and other water bodies.

Photosynthesis - The manufacture by plants of carbohydrates and oxygen from carbon dioxide and water in the presence of chlorophyll using sunlight as an energy source.

Point Source - A specific location from which pollutants are discharged. It can also be defined as a single identifiable source of pollution (e.g., pipe or ship).

Pollution - The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of water (EPA CWA definition).

Reservoir - Any natural or artificial holding area used to store, regulate or control water.

Runoff - The part of precipitation or irrigation water that runs-off land into streams and other surface water.

Streamflow - Streamflow is the volume of water that moves over a designated point over a fixed period of time. Streamflow is measured with the Texas Stream Team in cubic feet per second (cfs). Some organisms depend on streamflow for food and oxygen.

Sediment - Particles and/or clumps of particle of sand, clay, silt, and plant or animal matter carried in water and are deposited in reservoirs and slow-moving areas of streams and rivers.

Turbidity - Turbidity is the cloudiness or haziness of a fluid, caused by dissolved or suspended solids that scatter light, making the water appear cloudy or murky. These suspended solids can include soil, algae, plankton, microbes, and other substances.

Water Quality Standards - Established limits of certain chemical, physical, and biological parameters in a waterbody; water quality standards are established for the different designated uses of a waterbody (e.g., aquatic life use, contact recreation, public water supply).

Watershed - The area of land from which precipitation drains to a single point. Watersheds are sometimes referred to as drainage basins or drainage areas.