Conducting a Watershed Survey

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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Conducting a Watershed Survey

Prepared by

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MC 234

Texas Commission on Environmental Quality

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Texas Commission on Environmental Quality

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Contents

Contents *(cont'd)*

Contents *(cont'd)*

Contents *(cont'd)*

Highlight Boxes

Introduction

Why Do a Survey?

One of the major environmental issues that remains to be fully addressed is the problem of water pollution coming in ***small amounts*** from a ***large number of sources*** carried by rainfall runoff into streams, lakes, or bays. This is called "**nonpoint source (NPS) pollution**." For example, fertilizer may wash off a lawn during a heavy rain, and be carried by the storm drain system to pollute a nearby creek.

By contrast, pollution that comes in ***large amounts*** from a ***single source***, called "**point source pollution**," has been extensively addressed over the past three decades, largely though the process of issuing permits to sources such as industrial plants and wastewater treatment facilities.

Nonpoint source pollution is difficult to control through regulation, because it results from our everyday activities, like fertilizing our lawns or maintaining our cars. Consequently, the voluntary and preventive efforts of citizens, businesses, service organizations, and other groups are an essential part of the effort to address NPS pollution.

Raising awareness of the issue of NPS pollution is an important step in addressing the problem. One of the most effective ways that a citizen group can help a community take this step is to undertake a survey of conditions in and around a local stream, lake, or reservoir. Called a "watershed survey," these projects can be carried out by people with little previous scientific or technical training.

What This Manual Covers

This booklet will equip your group to survey your watershed and make a record of its history and geography, land and water uses, and potential and actual pollution sources. The information gathered can be tailored to your group's goals. For example, the survey could help teachers explain how land uses affect water quality and instill in students a sense of stewardship of the watershed. The survey could also be a more in-depth community project of a science club or scout troop, with the preparation of detailed maps, thorough land use documentation, historical and current aerial photographs, and potential land uses based on current zoning.

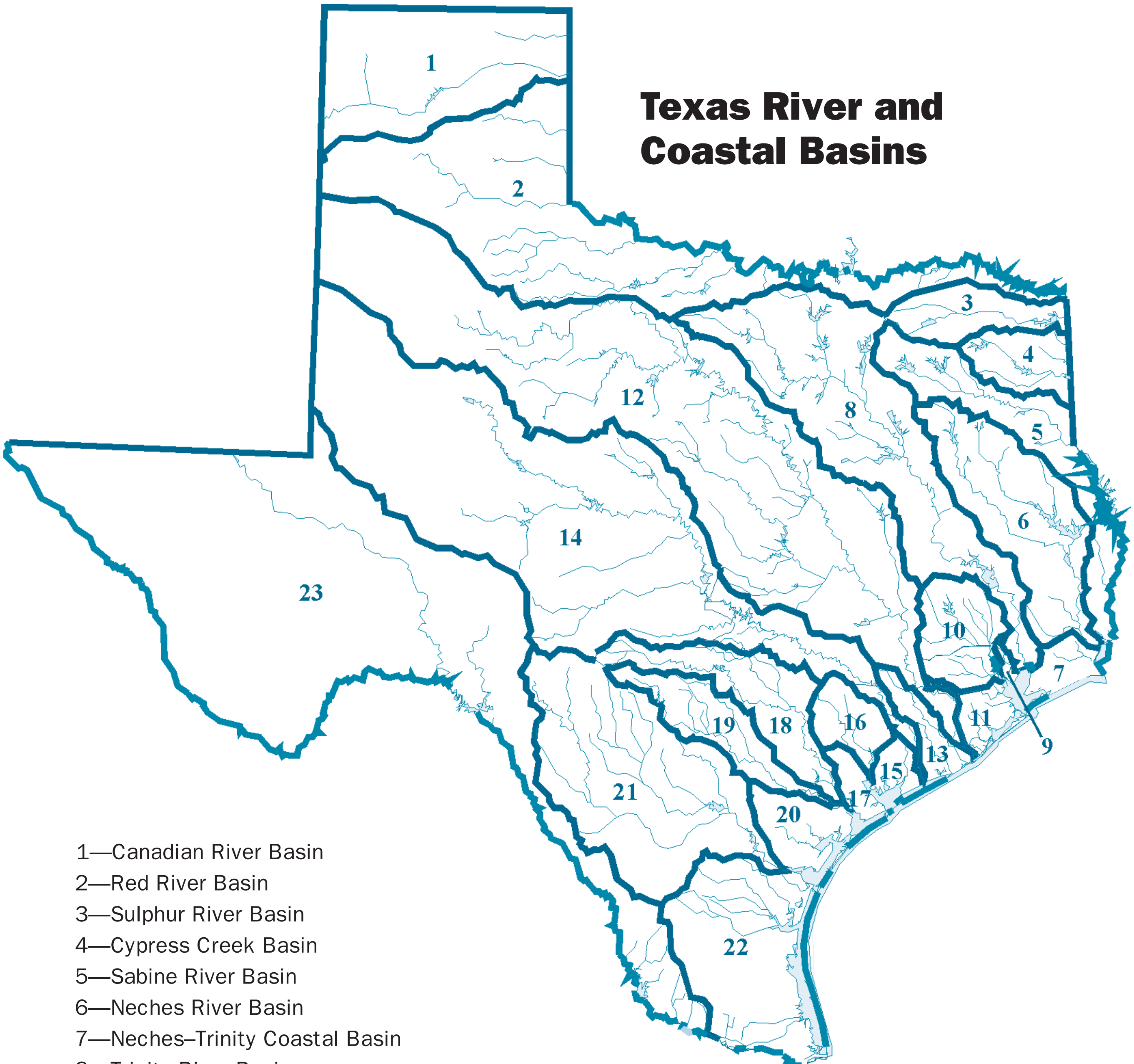
In conducting a survey, you will learn to read a topographic map, mark a watershed's boundaries, and observe and evaluate the effects of land development. You will also gain an understanding of city planning, zoning, municipal waste treatment, and environmental practices that lessen the impact of urban growth and development. This manual's appendixes contain information resources that will help you to develop your survey, such as a glossary of scientific and technical terms and Web sites of interest.

This is a voluntary project, so remember to have fun while you're at it! Determine your group's objectives, and tailor your exploration accordingly using the information provided here.

To waste, to destroy our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the days of our children the very prosperity which we ought by right to hand down to them amplified and developed.

— Theodore Roosevelt

Texas River and Coastal Basins



1—Canadian River Basin
2—Red River Basin
3—Sulphur River Basin
4—Cypress Creek Basin
5—Sabine River Basin
6—Neches River Basin
7—Neches–Trinity Coastal Basin
8—Trinity River Basin
9—Trinity–San Jacinto Coastal Basin
10—San Jacinto River Basin
11—San Jacinto–Brazos Coastal Basin
12—Brazos River Basin
13—Brazos–Colorado Coastal Basin
14—Colorado River Basin
15—Colorado–Lavaca Coastal Basin
16—Lavaca River Basin
17—Lavaca–Guadalupe Coastal Basin
18—Guadalupe River Basin
19—San Antonio River Basin
20—San Antonio–Nueces Coastal Basin
21—Nueces River Basin
22—Nueces–Rio Grande Coastal Basin
23—Rio Grande Basin

What Is a Watershed?

A watershed is a geographic area in which water, sediments, and dissolved materials drain into a common outlet. This outlet could be a stream, lake, playa, estuary, aquifer, or ocean. Watersheds are also commonly called drainage basins or drainage areas.

A watershed can be as large or as small as you want to define it. The gutters that run along the curb on your street are the drainage outlets for your street's watershed. The gutters, which drain a small watershed, would flow into the storm drain system and empty into a nearby stream, which drains several streets in a larger watershed. That stream, in turn, flows into a larger stream or river.

Another example is the watershed of the Mississippi, which is the largest watershed in the United States and contains thousands of smaller watersheds. All of these smaller watersheds and their corresponding streams flow downhill and converge with each other, forming a tree-like network with the Mississippi as the trunk. All of the streams, from the smallest branches down to the largest river, constitute the Mississippi watershed.

The state of Texas has 23 major watersheds, or basins, and approximately 191,228 miles of streams and rivers (see the map "Texas River Basins"). All of these streams drain into the Gulf of Mexico. Of the total stream mileage, 144,603 miles (76 percent) have intermittent flow during some part of the year, which means these streams have portions that are completely dry some of the time. Texas also has approximately 5,700 reservoirs with a surface area of 10 acres or larger, for a total coverage estimated at 3,065,600 acres.

Nonpoint Source Pollution— an Important Reason to Survey Your Watershed

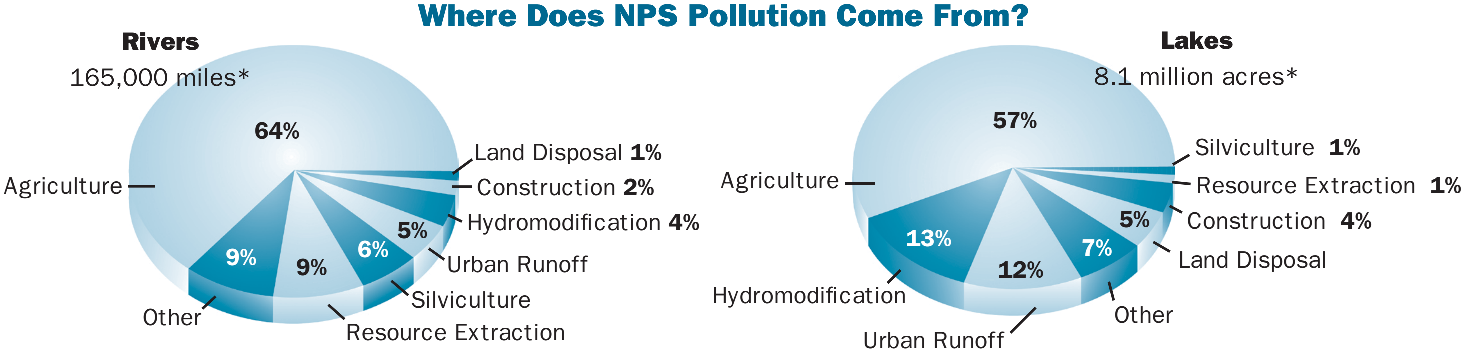
When rain falls onto a watershed and flows into a stream, the stream acts as a water collection area for the entire watershed. The activities and land uses in the watershed can directly affect the water quality and quantity in the stream. For example, in highly developed areas a much larger percentage of the rain becomes runoff because of the large amount of impervious cover found in urban areas, such as parking lots, roads, sidewalks, and rooftops. Where there is impervious cover, the water flows quickly into streams or other receiving areas instead of soaking into the ground, causing an increase in flooding due to urbanization. In natural areas, such as forests, roughly half of the rainfall is absorbed into the ground, becoming groundwater, while in urban areas less than a third usually becomes groundwater, depending on the amount of impervious cover.

The pollutants that are washed off these impervious surfaces contribute to nonpoint source (NPS) pollution. These pollutants are sporadic, difficult to control, hard to detect using traditional water chemistry techniques, and harmful to aquatic life. NPS pollution occurs when rainfall or snowmelt runs over and through the ground, picking up pollutants and depositing them into lakes, streams, wetlands, and underground water supplies. NPS pollutants include:

- excess fertilizers, herbicides, and insecticides from residential areas and agricultural land;
- oil, grease, and toxic chemicals from runoff and energy production;
- sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks;
- motor oil, car batteries, and home chemical containers that have been improperly disposed of; and
- bacteria and nutrients from livestock, pet wastes, and faulty septic systems.

The accompanying pie charts show the percentages of NPS pollutants that come from various sources.

Where Does NPS Pollution Come From?



*Waters of the U.S. that have been assessed for NPS pollutants.
Source: *Aquatic Resources and Nonpoint Source Pollution*. Commonwealth of Virginia, Department of Conservation and Recreation, 1995.

Benefits of a Survey

The first critical step in improving water quality and reducing NPS pollution is for people to become aware of conditions affecting their local streams and watersheds. Many people may not even be aware that there is a stream nearby, much less what types of activities may be influencing the water quality. To do a survey you must get out and look around with one question in mind: What are we doing and how is it affecting the stream?

Your survey will be a comprehensive investigation, or inventory, of your watershed. You will examine the history and geography, land and water uses, and potential and actual pollution sources for your stream and its watershed. This information can be used by water quality professionals, elected officials, and concerned citizens to plan for the protection and conservation of the water, our essential natural resource.

For example, your discoveries may spur on activities like stream cleanups, backyard composting, and storm drain marking projects (in which signs are placed on storm drains, warning potential dumpers that the drain flows into a creek). One thing is certain—as our population continues to grow, so will the effects on the quality and quantity of our water. Volunteers with a strong interest and a willingness to learn can play an important role in defining and solving the environmental challenges we all face.

A thorough survey requires little training or equipment. All you need is a desire to explore your watershed and a willingness to take notes on what you see. Uses of the survey include:

- screening for pollution problems;
- identifying potential sources of pollution;
- helping interpret biological and chemical information;
- providing a blueprint for possible community restoration efforts such as planting trees or cleaning up stream banks;
- educating volunteers and the local community about potential pollution sources affecting your stream and its watershed;
- giving volunteers and local residents a sense of the value of your stream and watershed; and
- providing an educational framework in which students and teachers may explore a variety of topics and issues about water, its properties, and the environment.

Did You Know?

Each year, more than 240 million gallons—nearly 60 percent—of the used motor oil generated by do-it-yourself oil changers is dumped in ways that damage the environment. That represents 20 times the amount of oil spilled by the 1989 Exxon Valdez accident in Alaska.

One quart of used motor oil dumped near a lake can create an oil slick nearly two acres in size.

Two Main Parts of a Survey

The watershed survey may be divided into two distinct parts: background investigation and visual assessment.

The Background Investigation

The background investigation is a history of the stream and its watershed. This part of the survey is accomplished through research of town and county records, maps, photos, news stories, industrial discharge records, and oral histories.

The Visual Assessment

The visual assessment is a periodic (seasonal) look at a stream and its watershed. This part of the survey is achieved by walking along the stream and by exploring the entire watershed (in a car, on a bike, or on foot), noting key features and how they may change over time.

Before you begin your survey, you may want to become familiar, if you aren't already, with some of the things we do in our daily lives that affect the quality and quantity of the water. The next chapter explains common land uses that contribute to nonpoint source pollution and some of the things that can be done to prevent it. If you are already familiar with these issues, feel free to move on to the explanation of the Background Investigation. You may want to refer to the land use chapter, though, when you get ready to begin work on your background investigation.

Land and Water Uses That Affect Water Quality

In nature there is neither praise nor blame, but there are consequences.

—*Anonymous*

Everyday activities that go on in your watershed, including things you do around the house, have a direct impact on the quality of water in the watershed. Government regulation seeks to preserve and protect the water for all its many purposes. However, regulation alone is not enough. According to the EPA, about 80 percent of the pollution in our water today comes from nonpoint source pollution, which is difficult to regulate. By learning how our activities affect the water and how we can change our habits to protect the water, each of us can make an important contribution to protecting this valuable resource.

Land uses and practices in a watershed directly influence water quality. While land use activities vary across the state, this chapter discusses the following common land uses that can affect water quality:

- agriculture and grazing
- failing septic systems
- point source discharges
- landfills and dumps
- construction sites
- logging
- chemical spills
- air pollution/transportation
- lawn and garden care

Controlling NPS Pollution with Best Management Practices

The term ***best management practice*** (BMP) is used to describe the most effective practice or combination of practices to control nonpoint source pollution. BMPs are generally grouped into structural and nonstructural measures.

Structural BMPs are designed to capture surface runoff and remove pollutants through settling or other processes. Structural BMPs can include water diversions, retention devices, detention basins, or filter systems.

Nonstructural controls rely on planning, design, maintenance, education, economic incentives, and regulation to prevent runoff contamination. Nonstructural controls include local ordinances, public awareness campaigns, and waste-oil recycling centers.

Individuals can implement nonstructural BMPs in their own day-to-day activities to reduce nonpoint source pollution. BMPs for individuals include washing cars where the detergent will not run off into a storm drain, recycling motor oil, eliminating fertilizer and pesticide runoff from lawns, composting yard waste, using less toxic alternatives for home maintenance products, and properly disposing of hazardous chemicals.

Agriculture and Grazing

In the United States, 60 percent of all nonpoint source pollution comes from agricultural runoff. Poor management of livestock and crop production practices contributes significant amounts of nutrient and sediment runoff. Crop production also discharges pesticides into the water, which can be harmful to aquatic life depending on the concentration of the chemicals.

Best management practices for livestock pastureland include maintaining a fenced buffer zone to keep livestock from trampling riparian (streamside) vegetation, stream banks, and stream habitat. Other BMPs include rotating livestock on different pastureland to prevent overgrazing, providing alternate watering sources to the stream, and constructing basins that temporarily detain runoff and allow sediment and nutrients to settle out of the water.

A BMP that should be practiced in urban as well as agricultural areas is the preservation or planting of a 50-foot area of trees and shrubs along each side of the stream. This buffer zone helps reduce sediments and agricultural or lawn care chemicals entering the stream.

For information on agricultural BMPs, contact the Texas State Soil and Water Conservation Board (TSSWCB) or the Natural Resources Conservation Service (see contact information in the appendixes).

Failing Septic Systems

Twenty-four percent of American rural and suburban homes rely on septic systems to handle household wastes. When septic systems fail, raw human waste can enter nearby streams. This waste carries nutrients that can cause an overgrowth in aquatic plants and algae, called an algae bloom. These nutrients can also cause an explosion in the number of wastewater-loving aquatic insects, such as blackflies.

Septic tanks must be maintained in order to function properly. If the sludge is not removed from the tank regularly (usually every two to five years) the tank fills with solids and can pollute a nearby stream or groundwater. Septic systems rely on microscopic organisms to break down the organic wastes. Dumping hazardous chemicals into a septic system can kill these microscopic organisms and cause a system failure.

Health Notice

If you suspect untreated wastewater is causing problems in your stream, be careful around the water. Wastewater contains many disease-causing organisms that can be very harmful. Always wear protective gloves and boots when around raw wastewater. Notify your regional TCEQ office of the problem (see "TCEQ Regions" in the appendixes).

Solving these problems through regulation and enforcement is difficult and costly. Educating septic system users about the impact of wastewater on streams and aquatic life can help prevent this problem. Often, people may not be aware that their actions (or inactions) could cause such problems.

Point Source Discharges

Point source refers to water pollution that comes from an easily identifiable source, such as the end of a pipe that leads from a treatment plant. In order to control the quality of point source discharges, the state wastewater permitting program and the Texas Pollutant Discharge Elimination System (TPDES) require point source dischargers to obtain a permit before releasing wastewater into surface waters. TPDES permits require identification of pollutants in wastewater and set limits on them in order to maintain a certain standard of water quality in the receiving stream.

If you have a concern about a point source discharger in your watershed, contact your regional TCEQ office (see "TCEQ Regions" in the appendixes). Wastewater treatment plants add chlorine to their effluent to kill pathogenic (disease-causing) bacteria. The chlorine, however, can be highly toxic to aquatic life, and some treatment plants are not required to remove chlorine before discharge.

Symptoms of Water Pollution

- Scum, algal mats, and other materials floating near lake shores
- Excessive plant growth choking waters
- Sediment-clogged drainage ditches and sewers
- Decreasing depth of a body of water
- Fewer fish and wildlife
- Contaminated water supply for drinking, recreation, and industry
- Fish kills
- Fish or oyster advisories. These advisories are warnings issued by the Texas Department of Health about eating oysters and fish from certain bodies of water. Advisories are issued when conditions indicate that oysters may be contaminated by bacteria from human and/or animal waste, or when there is evidence that fish and oysters are contaminated by toxic chemicals.
- Extreme flooding or streambank erosion

Landfills and Dumps

Sanitary landfills are dumps that have a clay and/or plastic liner underneath and are covered by a layer of earth each day. But landfills can degrade, and older landfills did not have to follow the strict rules established for landfills today. The age of the landfill and the thickness and type of liner is important in understanding the relationship between landfills and water quality.

In an ordinary landfill, you could expect to find anything from paint thinners, old batteries, and pesticides to bleach, oil filters, and other potentially damaging waste products. If you can throw it away, it's probably in the landfill. With the many different chemicals at these sites, it is difficult to identify specific pollutants responsible for environmental damage.

To keep products you use around the house from contaminating groundwater:

- buy only what you need and use it for the intended purpose;
- if you can't use it, give it to a neighbor or relative who can; or
- for unusable household hazardous waste (HHW), participate in an HHW collection event (for information on collection events in your area, contact your regional TCEQ office—see appendixes).

Organic waste such as yard trimmings and clean wood waste can be diverted from landfills to produce beneficial materials such as compost and mulch. When compost and mulch are applied to home gardens and agricultural land, the need for pesticides and fertilizers is reduced. For more information, see "Lawn and Garden Care" in this chapter.

Construction Sites

Construction sites often cause sedimentation that can destroy stream habitat and impair water quality. Erosion and sediment control structures, such as silt fences and sedimentation ponds, are very effective at keeping sediments from entering streams.

Examples of BMPs for construction sites include regrading and revegetating the land, leaving forested buffers along the stream, using silt fences and check dams to prevent disturbed soil from leaving construction sites, and creating sediment basins to trap muddy water. Once the control structures are in place, it's important that they are properly maintained.

Logging

Erosion from logging roads and heavy machinery crossing streams, the harvesting of riparian trees (trees growing along the stream bank), and other improper practices make logging one of the industries that commonly affects water quality. Many of these effects can be avoided by using forestry BMPs, such as proper design and layout of logging roads and trails and protection of at least 50 feet of natural vegetative buffer along each side of a stream. After an area is harvested, BMPs can be used to regrade the site and replant native vegetation in unstable areas otherwise prone to erosion.

For more information about how to promote and encourage forestry BMPs, contact the U.S. Fish and Wildlife Service, the U.S. Forest Service, and the Texas Forest Service (see the appendixes for contact information).

Spills

Oil contaminants reach water on the surface and underground through spills, storage tank leaks, and illegal dumping of waste oil. One quart of oil can contaminate 2 million gallons of water and form a slick that covers two acres. It is estimated that some 28 percent of the oil in the sea originates from river runoff.

The State of Texas and participating automobile service stations sponsor used oil recycling programs. Many service stations also accept antifreeze and other auto wastes free of charge. Many municipalities, with support from the TCEQ, have hazardous waste pickup days and provide collection centers where citizens can safely dispose of harmful household chemicals, such as used oil and pesticides.

Businesses should use aboveground storage tanks when possible for easier monitoring of leaks. Citizens can support regulations that require monitoring around storage facilities, testing of underground tanks, and use of corrosion-resistant tank materials. Gas stations should be equipped with absorbent materials to use to clean up spills rather than wash the spill down storm drains and into the nearest creek. Citizens may also want to get permission and support from the public works department to mark storm drains with messages such as "Don't dump—drains to stream." For information on storm drain marking, see the TCEQ publication GI-212, *Storm Drain Marking* (see back cover for how to order).

Air Pollution/ Transportation

Emissions of chemicals into Earth's atmosphere from coal-burning electric power plants, industry smokestacks, and automobiles are the cause of acid rain. Normal rainfall is naturally acidic, with a pH of 6.5 (7.0 is neutral; lower numbers indicate increasing acidity). When rainfall reacts with airborne pollutants such as sulfur dioxides and nitrogen oxides, the result is a much lower pH (more acidic). Acid rain with pH values as low as 2 and 3—similar

Tuning Up Your Car Habits Can Prevent Water Pollution

For years, pollution prevention efforts have focused on the ***air*** pollution that cars produce; but you rarely hear mention of cars and ***water*** pollution. The cumulative effect of thousands of cars driving down a road leaving tire particles, brake dust, and drops of oil or other chemicals on the road can affect water quality just as easily as it can air quality. Here's how you can help:

- Cut down on your driving; instead, carpool or use public transportation.
- Don't dump used oil, gasoline, or other automotive products in the toilet, sink, curbside storm drain, street gutter, or on the ground.
- Pump gas and change fluids carefully to avoid spills on the ground. Place a drip pan under your work area. Pour kitty litter, sawdust, or cornmeal on spills. Allow these absorbents to remain on the spill spot for several hours. For a small spill, place the used absorbents in a strong plastic bag in the trash. For a large spill (over one gallon of absorbent), take the material to a household hazardous waste disposal center or event. Be especially careful with antifreeze—sweet but deadly to curious pets.
- Recycle used motor oil, antifreeze, transmission and brake fluids, and car batteries. Recycling opportunities vary by

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Tuning Up Your Car Habits Can Prevent Water Pollution *(continued)*

community. Call your community solid waste sanitation or public works department, or look in the phone book to find an automobile service station, reclamation center, or household hazardous waste collection program that accepts used oil and other auto wastes. Call 1-800-Cleanup and enter your zip code to get automated information on recycling near you, or visit the Web site at <www.earth911.org>.

- Don't mix waste oil with gasoline, solvents, or other liquid wastes before recycling.
- Recycle car batteries. Texas law requires a retailer to accept your old battery when you buy a new one.
- Check for leaks under the car after an overnight stop. Taking your car in for regular service helps prevent leaks and reduce emissions.
- Store car wax and unused automotive fluids in airtight containers in a cool, dry, dark place. These items have a long shelf life, and are better used than discarded or recycled.
- Wash your car with as little soap as possible. Get a pistol grip hose nozzle to conserve water. Dump the bucket of soapy water in the toilet or sink, not the street or storm drain. Rinse soap suds onto grass or gravel, where they can filter through vegetation and soil before entering storm drains, from which water flows unfiltered into our waterways. Better yet, park your car on grass or gravel before washing. Avoid washing on paved driveways or the street. If you use car washes, patronize those that recycle water.
- Read product labels and choose those with the least toxic ingredients; some to avoid include ammonia, ethanol, and muriatic acid.
- Substitute nontoxic products whenever possible. Baking soda paste works well on battery heads, cable clamps, and chrome; mix the soda with a mild, biodegradable dishwashing soap to clean wheels and tires. For windows, try white vinegar or lemon juice mixed with water.
- Maintain your air conditioning to prevent coolant leaks. Run your air conditioning once every two weeks to keep seals from cracking. Freon, a chlorofluorocarbon (CFC) used for air conditioners in older cars, contributes to the thinning of Earth's ozone layer.

Adapted with permission from estuarywise, *published by the San Francisco Estuary Project.*

to the acidity of vinegar—has been reported in some parts of the country.

Putting filtering devices on smokestacks, practicing energy conservation, using low-emission vehicles and alternative fuels, properly maintaining gasoline-powered cars, riding the bus, or taking mass transit when possible are ways to help reduce emissions.

Lawn and Garden Care

In some suburban neighborhoods there is a war raging—the war for the greenest, most weed-free yard. Unlike the majority of farmers, the urban weekend gardener often thinks "if a little is good, a little more will be better." Texas homeowners pour about 4 million pounds of pesticides on their lawns and gardens each year. More pesticides per square inch are applied to a typical yard than to the most intensely sprayed farmland.

It is also common for people living close to a stream or storm drain to dump lawn clippings, leaves, and branches into the stream. When this yard waste rots, it robs the stream of oxygen needed by aquatic organisms.

There are numerous ways to prevent your lawn and garden from becoming a burden on your local stream or landfill.

- To decrease the amount of runoff from your yard, choose native plants that do not require as much water, fertilizer, or pesticides.
- Position sprinklers so that only plants are watered, not sidewalks, streets, and patios.
- Look for natural alternatives to chemical pesticides or fertilizers.
- If you do use chemical fertilizers or pesticides, follow the directions carefully and use only the amount you need. Never apply these products right before it rains; most of the product will wash into the storm drain, harming nearby streams and wasting your money and efforts.
- Let your grass clippings fall to the turf as you mow. The clippings will act as a mulch and will reduce the water and fertilizer needs of your yard.

- Use compost to protect soils from erosion and compaction, and reduce the need for chemical fertilizers and pesticides.
- Add organic matter to the soil to increase its ability to retain water, making it more drought resistant.

Good mulches, including wood chips, leaves, grass clippings, and compost, can benefit your lawn and garden by preventing erosion, suppressing weeds, retaining soil moisture, moderating soil temperature, and adding nutrients. (See the highlight box for a good compost recipe. For more comprehensive information on environmentally friendly yard care, take a look at the TCEQ's *Green Guide to Yard Care*—see back cover for how to order.)

Simple, No-Cost Compost Recipe

1. Pick a 4-foot by 8-foot area, preferably shaded, where water does not collect when it rains.

2. Cover half the area with a 6-inch layer of leaves. Water thoroughly.

3. Add a 2-inch layer of grass clippings and/or fruit and vegetable scraps, and add a dash of soil.

4. Mix this layer lightly with the layer below it using a hoe or cultivator. Water thoroughly.

5. Top with a 2-inch layer of leaves.

6. Repeat steps 3 through 5 as ingredients are available. ***Note:*** *The top layer of the completed pile should be at least 4 inches of leaves and should cover all food materials. Build the pile to 3 feet high as soon as you can.*

7. Turn the whole pile over to the uncovered area with a hay fork or shovel every 2 to 3 weeks, adding water as needed to make the whole pile moist like a wrung-out sponge.

8. Compost is well done when most of the original ingredients have broken down and when it smells like rich soil.

(If desired, you can get composting bins for as little as $10–20 to keep the material looking neater and more closely contained.)

The Background Investigation

We do not see nature with our own eyes, but with our understanding and our hearts.

—William Hazlitt

In the background investigation, you will identify and map the watershed you plan to survey. You will also look at the history of your watershed from many different perspectives. The history of your stream may shed light on things you discover when you go out to the stream to conduct your visual assessment. This chapter will provide you with tips on how to obtain maps of your area and how to draw the borders of your particular watershed using a topographic map. It also directs you to resources available for obtaining background information for your watershed. A sample from a background investigation is included to spark some ideas for your group.

A Look at Blunn Creek in Austin, Texas

Here is a brief example of the natural history portion of a background investigation. You may want to go into more detail in some areas of your survey and leave other areas out completely. Choose what you want to emphasize.

What's in a Name?

Joseph Blunn, a carriage trimmer who had lived in Austin since the 1860s, met with a tragic fate one rainy October night on his way home to his wife and six children. When he came to the creek he found it roaring five feet deep. The next morning his buggy was found smashed and his horse dead. A half mile down the creek Blunn was found drowned, and ever since then, the creek in which he lost his life is referred to as Blunn Creek.

Natural History

During the late Cretaceous period (83–79 million years ago) central Texas was covered by a vast shallow sea. Over millions of years, marine clams, oysters, and other shelled animals died, sank to the bottom of the ocean, and turned into many layers of limestone and caliche. Some layers are especially full of fossils. The Austin chalk layer is the predominant formation visible along the creek bed near the East Creek Trail.

One of the most intriguing features of Blunn Creek is the volcanic tuff, which is rock composed of compacted volcanic ash, formed when molten rock flowed out of the volcano and covered the limestone. This igneous rock, which has a green color, is still visible along the creek bed. The remnant of the volcano crater which deposited the volcanic ash 80 million years ago is found nearby at St. Edwards University. The exposed ash beds mixed with limestone deposits are present near Travis High School. During this time period, there were 12 active volcanoes east of the Hill Country.

... the oceans receded and the Colorado River flooded parts of Blunn Creek. The results of this flooding are evident in the alluvial deposits of gravel, sand, silt, and clay. Most of the volcanic tuff is covered by the silty clay Altoga soils. The wooded slopes are supported by Eddy soil, which is prone to erosion. Ferris soil, which shrinks and swells to extremes, is also found in the watershed. This soil, also known as Houston Black, can leave cracks that may reach a width of four inches and result in severe erosion when dry.

Vegetation

Just as geology determines soil type and characteristics, climate [and soil type] determines vegetation. There are three vegetation zones in the watershed, each with a different type of soil that best supports native plant life that is uniquely adapted to its environment. Each zone is dynamic and has changed over time.

Upland—Large live oaks and Texas persimmon trees are scattered along the higher elevations. Cedar, mesquite, Mexican buckeye, agarito, and hackberry are common.

Rolling Prairie—The second vegetation zone is characterized by hackberry, prickly ash, Texas redbud, and prickly pear. This vegetation zone is in ecological transition, possibly becoming oak/elm woodland. Bluebonnet and Indian paintbrush dominate during the springtime, and little bluestem grass is being reestablished, replacing the invasive Johnson grass.

Riparian—The third vegetative zone is a narrow strip of woodland known for its beauty and abundance of species. This habitat traps excessive water runoff in its soil. The absorbed water filters into the ground, enters the groundwater, and is released into the creek at a later time and at a slower rate, thus maintaining Blunn's base flow. This habitat is occupied by water-loving native black willows, cottonwood, roughleaf dogwood, pecan, and sycamore. Several bald cypresses have been planted along the creek edge. American beautyberry, green ash, elderberry, Southern shield fern, and mustang grape are found in the understory of this habitat.

Wildlife

Mammals, such as fox squirrels, raccoons, opossums, and armadillos can be found throughout the length of the creek. High densities of these occur, along with additional species, including several native rodents and more wary forms such as the gray fox. An elaborate network of animal trails exists throughout the watershed. These small paths are made by animals in their nocturnal trek throughout the woods. In the evening the gray fox can be seen crossing St. Edward's drive to forage for food and water.

The Blunn Creek watershed has a diverse population of birds. The red-bellied woodpecker, cardinal, cedar waxwing, mockingbird, warblers, flycatchers, and mourning dove all reside in the watershed. The common species, such as house sparrows, blue jays, starlings and grackles are found as well.

Blunn's aquatic habitat hosts a wide variety of aquatic insects and fish. The largest reptiles that may be seen in the creek are the red-ear slider turtle and the snapping turtle. Other reptiles include the redstripe ribbon snake and the Texas spiny lizard.

(From "Blunn Creek Nature Preserve," a brochure prepared by the Youth Rangers, a City of Austin Parks and Recreation Department Youth Opportunities Program. Reprinted with permission of Blunn Creek Nature Preserve.)

Getting Started

Research on the watershed is generally conducted just once, with occasional updates or additions if needed. The background investigation should yield valuable information about the cultural and natural history of your stream and the uses of the land surrounding it. Most of the information can be gathered by research, using maps and state and local records, and by investigating some of the more prominent historical events in the watershed, such as flooding and damming.

The investigation may emphasize the issues that are most important to your group or issues that are unique to your watershed. It can be as brief or as complete as you want to make it. Your group may be interested in the history and geology of the stream, or you may want to limit your investigation to determining and mapping your area of investigation. Later, letting the field work be your guide, you may want to collect additional background information. For example, you may find something unexpected during the visual assessment, such as a discharge pipe, a drain, or a storage tank near the stream.

The following three lists show some of the things you may want to include in your investigation, depending on the interests of your group.

Essential Decisions

- Decide what area you want to investigate, and map it.
- Decide how you will gain access to your chosen stream, and obtain permission from landowners if you must cross their property to gain access.

Essential Information to Gather

Here are some pieces of information that you must gather to effectively assess your watershed.

- How much area is developed or undeveloped?
- What are the current land uses?
  - Are there any quarries/mines/wells, and if so, where are they?
  - Are there agricultural and/or urban uses in the watershed?
  - Are there industries or treatment plants that discharge into the stream or its watershed?
  - How is the land in the watershed zoned (residential, commercial, industrial)?
- Where are the stream's headwaters, where does it flow, where does it empty, and how long is it?
- What are the watershed's name and boundaries, what is its population, and through which communities does the stream flow?
- What are the roles of various jurisdictions in managing the stream and watershed?
- What are the stream's *designated uses* (such as fishing, swimming, drinking water supply, irrigation)? See "Information on Regulated Activities" later in this chapter for more details on designated uses.

Other Information You Can Collect

Various other historical and cultural information can be interesting, and even fun, to gather.

- How did the stream get its name?
- What are the historical land uses?
- What types of vegetation are common?
- What wildlife is common?
- Are there any archeological sites in the area or any Native American stories about it?
- What types of soil are found?
- What is the geological structure of the area?
- What is the percentage of the watershed's land area in each town or jurisdiction?

This information will make up the backbone of the survey while also bringing the story of the watershed to life. The different areas of investigation can be assigned to different members or groups of members to end up with a complete picture of the stream.

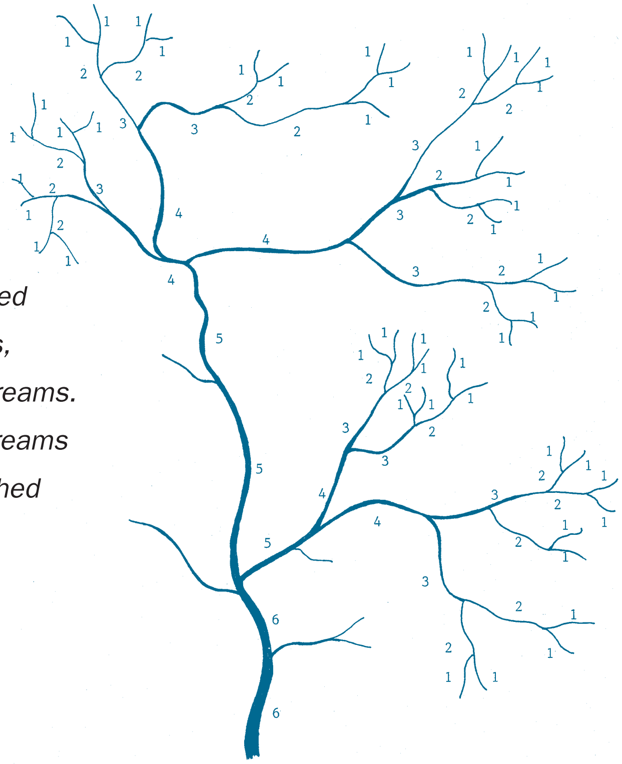
Classifying Streams by "Order"

Water quality professionals have developed a simple method to categorize the streams of a river system. Streams that have no tributaries flowing into them are called first-order streams. Streams receiving the flow from only first-order streams are second-order streams. When at least two second-order streams combine, the result is a third-order stream. This continues until all the streams merge into the largest river, which ultimately drains into a lake or ocean.

Map Your Watershed

Stream headwaters, length, tributaries, final destination, and watershed boundaries are best determined with U.S. Geological Survey (USGS) $7\frac{1}{2}$-minute topographic maps (on a 1:24,000 scale where 1 in = 2,000 ft). These maps depict landforms, major roads, developments, streams, lakes,

Stream Order



Small headwater streams, also called first-order streams, flow into larger streams. The network of streams in a single watershed is known as the river system.

Ordering USGS Topographic Maps

The Earth Science Information Center (ESIC) of the USGS can provide a catalog of available USGS topographic maps, a brochure on how to use topographic maps, and general information on ESIC services. Contact the Texas ESIC office at:

Texas Natural Resources Information System (TNRIS)
1700 N. Congress Ave., Room B-40
P.O. Box 13231
Austin, TX 78711-3231
512-463-8337
<www.tnris.state.tx.us>

Or contact USGS directly at:

USGS Information Service
P.O. Box 25286
Denver, CO 80225-0286
888-ASK-USGS (888-275-8747)
<www.usgs.gov/pubprod>

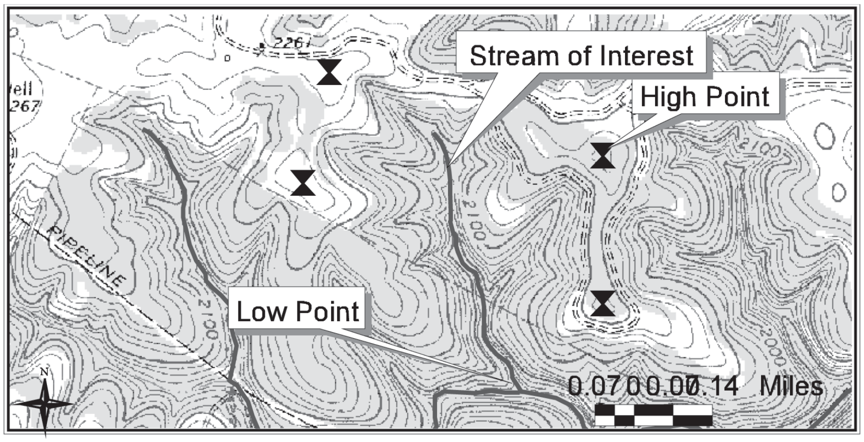
and other land features. See the highlight box "Ordering USGS Topographic Maps."

After you've obtained topographic maps of your area, follow these steps to draw your watershed boundaries:

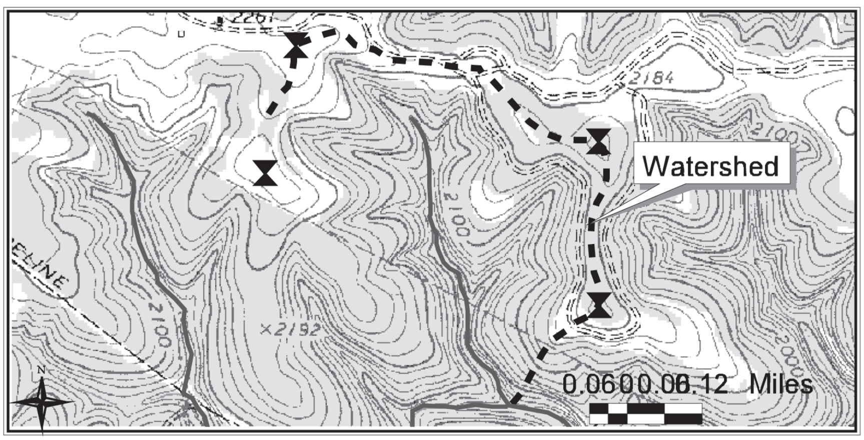
1. Locate and mark the downstream outlet of the watershed. For rivers and streams, this is the farthest downstream point in which you are interested.
2. Locate all the water features such as streams, wetlands, lakes, and reservoirs that eventually flow into the outlet. Start with major tributaries, then include smaller creeks and drainage channels. To determine whether a stream is flowing to or from a lake or river, compare the elevation of the land features to that of the water body. A lake will occupy only one elevation. If a stream crosses a contour or elevation line higher than the lake, then that stream is flowing towards the lake.
3. Use arrows to mark the direction of the stream or wetland flow. By showing flow direction, you can begin to visualize the topography of the streambed and the watershed.
4. Find and mark the high points (hills, ridges, saddles) on the map. Then connect these points, following ridges and crossing slopes at right angles to contour lines. This line forms the watershed boundaries.

For an example of a topographic map with the watershed boundaries drawn, see the highlight box "How to Draw a Watershed Boundary."

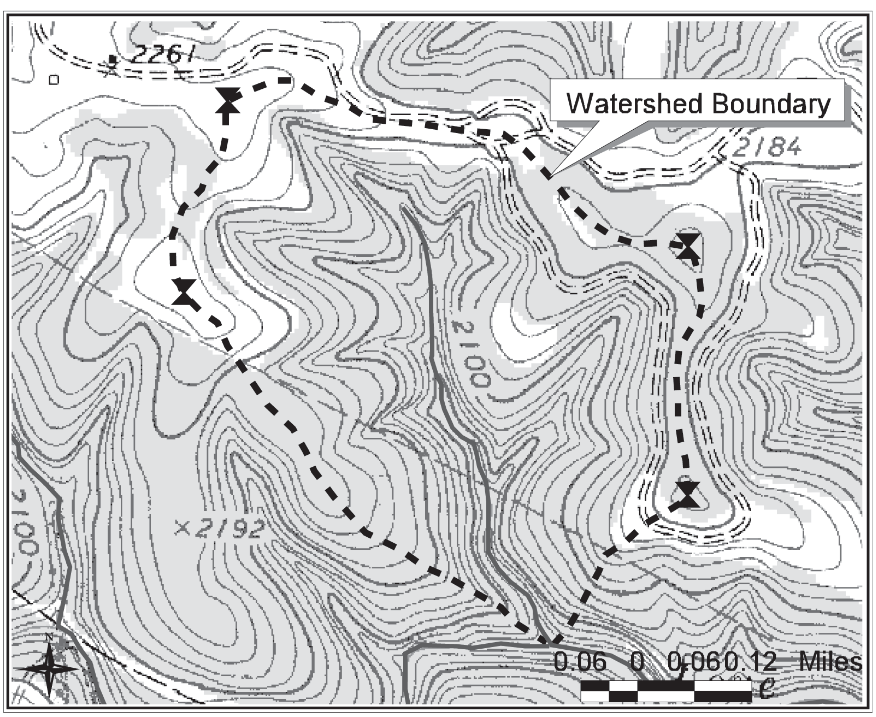
How to Draw a Watershed Boundary



1. *Find the low point of the stream or water body of interest.*
2. *Mark the high points—usually a small enclosed topographic line—along the ridge of the stream.*



3. *Try to visualize the topography of the streambed and the watershed, always asking yourself which way water would flow.*
4. *Start connecting the high points, following ridges, and crossing slopes at right angles to contour lines.*

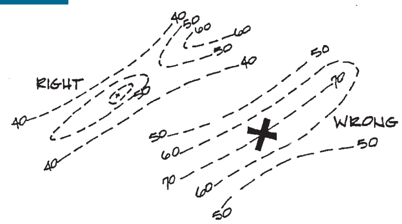


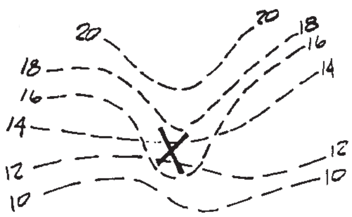
5. *The watershed boundary should come back to the starting low point. For an artificial lake, the low point would be the dam.*

For tips on how to read contour maps see "Six Cardinal Laws of Contours" on the next page.

The Six Cardinal Laws of Contours

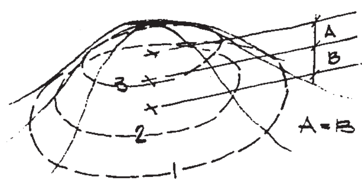
- ***Contours always occur in pairs.*** *Contours that indicate a ridge will always close; therefore, on a map if you crossed a 50 ft. contour moving uphill, you must cross another 50 ft. contour when moving in a downhill direction.*

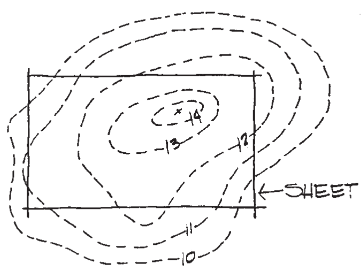




- ***Contours never cross.*** *Contour lines will never cross unless an overhanging ledge is indicated.*

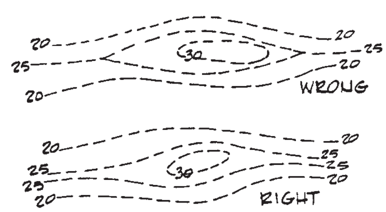
- ***Contours have equal vertical separation.*** *The vertical distance that is measured between two contour lines is the same for any two adjacent lines on a map.*

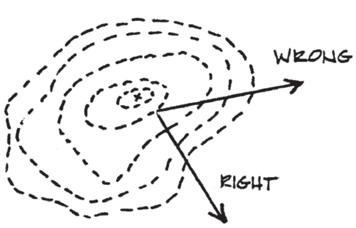




- ***All contour lines close on themselves.*** *All contour lines will close someplace on the earth, even though they may appear to be a single line on a map.*

- ***Contour lines do not merge or split.*** *Since contours must always be continuous and close on themselves, they cannot merge or split.*





- ***The steepest slope is perpendicular to the contour.*** *This principle is illustrated by streams that always flow along the steepest slope and always cross contour lines perpendicularly.*

Identify Land and Water Uses

Some land uses, such as railroads, and urban developments in the watershed will be depicted on your topographic maps and should be considered more closely during the second part of the watershed survey. It will be useful to develop broad statements about the land use in the watershed (for example, the watershed is 60 percent residential, 20 percent park land/recreational, and 20 percent light industrial). Determining the land use in the watershed helps pinpoint areas for closer investigation in your visual assessment of the watershed.

General Sources of Information

The appendix "Helpful Addresses and Phone Numbers" contains contact information for some of the following types of general sources.

- Local planning offices maintain information about current land uses and about potential land uses for which the area is zoned.
- Conservation district offices, the Agriculture Extension Service, or the Natural Resources Conservation Service (formerly the Soil Conservation Service) should have information about agricultural development in rural areas such as crop yields, types of crops, and irrigation and pest control practices.
- Local offices of the USGS might provide a variety of publications, special studies, maps, and photos on land uses and land forms in the area.
- Aerial photographs provide current and historical views of land uses. (See the highlight box "Obtaining Aerial Photographs" for more information.)

Obtaining Aerial Photographs

Historic and current aerial photographs can be obtained from local, state, and federal governments, as well as private firms. Try planning offices, highway departments, soil and water conservation districts, state departments of transportation, and universities.

Sources of aerial photographs include:

TNRIS
1700 N. Congress Ave.
Room B-40
P.O. Box 13231
Austin, TX 78711-3231
512-463-8337
<www.tnris.state.tx.us>

USGS Information Services
P.O. Box 25286
Denver, CO 80225-0286
888-ASK-USGS
<www.usgs.gov/pubprod>

Sources of Information on Regulated Activities

Industries and wastewater treatment plants that have permits to discharge into the stream are on record at city or county environmental offices or at your regional TCEQ office (see "TCEQ Regions" in the appendixes). These permits, through the state wastewater permitting program and the Texas Pollutant Discharge Elimination System (TPDES), specify where, when, and what industrial and domestic wastewater treatment plants are allowed to discharge.

In areas where there has been heavy development, a comparison of earlier maps and photographs can be an interesting project. You may be able to find old maps and photos; infrared photos are particularly helpful in showing the distinction between urban development and vegetation.

Current *designated uses* of the stream are established in state water quality standards, which specify what the uses of all classified state waters should be. These uses can include fishing, swimming, public water supply, and irrigation. The state standards also establish limits on pollutants in the waters in order to maintain sufficient water quality to support those uses, and they contain a narrative statement that prohibits degradation of waters below their designated uses. The complete standards are contained in the Texas Surface Water Quality Standards, Texas Administrative Code (TAC), Title 30, Chapter 307. For additional information on urban water quality standards, refer to Chapter 216 of TAC Title 30. These chapters are available from the TCEQ on the agency's Web site (go to <www.tceq.state.tx.us> and follow the link for "Rules" and click on "Download TCEQ Rules").

Sources for Historical Land Use Information

Historical land uses and the history of the stream might take a little legwork to uncover. Good starting places include local historical societies, libraries, and newspaper archives. Look for photos and stories about fishing contests, spills, floods, and other major events affecting the stream and its watershed. Contact county or town planning offices to obtain information on when residential areas were developed and when streams were channelized or diverted. The Texas Department of Transportation (TxDOT) and local transportation agencies should have records on when highways and bridges were built.

Longtime residents who remember the stream from their youth can provide invaluable and interesting information about the stream. Perhaps they fished or swam in the stream when they were children, and they may be able to recount some of the major changes such as channelization or damming. These oral histories can add an interesting local color to your historic investigation, such as where the name of your stream or river came from. If it is named after a person, who was this person and why did the stream get his or her name?

You've Completed Your Background Investigation—What's Next?

Once the investigation has been completed, one person from your group should compile the information into a report and present it to the others in the group. At a minimum, key information on land uses, water uses, watershed boundaries, and discharges should be maintained in written form for your group's use, and be available as a reference for future activities and projects. Maps and photographs will prove useful, especially for comparisons over time and to spark interest in people new to the project.

The Visual Assessment

Never a day passes but that I do myself the honor to commune with some of nature's varied forms.

—*George Washington Carver*

In the visual assessment portion of the watershed survey, you take a firsthand look at your watershed and keep a record of your observations on maps, field notes, and on the watershed field data sheets supplied at the end of this publication. You may find you draw insight from what you learned in the background investigation when you survey conditions in the field. The steps involved in completing the visual assessment include:

- deciding on the area to be assessed,
- deciding when to survey,
- gathering the necessary equipment,
- exploring the watershed and stream, and
- completing the field data sheets.

Safety First

As with all outdoor activities, be careful and use common sense. Always work with at least one other person. Park your car safely off roads and out of the way of traffic. Make sure to obtain the landowner's permission before entering private property. Texas streams can have many hazards—always be on the lookout for poison ivy, fire ants, wasps, snakes, and other wild animals.

Decide on the Area to Be Assessed

The visual assessment will be most valuable when the same area is observed each time. Your watershed may be too large for your group to visually assess in its entirety. Larger watersheds can be divided into sections by using easily definable boundaries such as roads, tributaries, power lines, and gas lines. These watershed sections can then be assessed by different groups of observers. The boundaries of your watershed section should be marked on your topographical map to help future volunteers continue the visual assessment and help professionals locate any problems that have been identified.

Once the area has been chosen for the assessment, define the area clearly in words; for example, "the Walnut Creek watershed from IH 35 upstream to Loop 1." After the area for the survey has been chosen, draw the outline and significant features of the stream and its surroundings on a blank sheet of paper or obtain a more detailed map of the area, such as a city map or a detailed set of county road maps. These maps provide detail such as roads, structures, and other human-made features not found on topographic maps. Community or city maps can be obtained from local retailers or chambers of commerce. County road maps are available from the Texas Natural Resource Information Service (see the appendixes for contact information).

This will be your field map, which you will use to mark stream obstructions, pollution sources, land use, litter, spills, or other problems you notice during the visual assessment. You may add to this field map each time you visit the stream, as land uses change. You might want to make a copy of your map each time you update it, in case it is lost or damaged.

Decide When to Survey

Because streams can vary significantly from season to season, it is best to visually assess the stream and the watershed at least once every season. There may be areas that require additional spot checks such as a new housing development or road construction. It's a good idea to look at some areas during or just after a heavy rain. This approach could identify some erosion problems as well as failing septic systems. A septic drainage field should never be heavily saturated with water.

If your stream is used for irrigation, it is important to keep an eye on the flow levels during the summer months to see how this use may affect the stream. Here are some guidelines for when to survey:

- March to April, before trees and shrubs are in full leaf and when water levels are generally high.
- June to July, when trees and shrubs are in full leaf and when water levels are generally low.
- September to October, when trees and shrubs may be starting to change color and water levels are low.
- December to January, when trees and shrubs have lost their leaves and water levels are variable.

Gather the Necessary Equipment

Before beginning the visual assessment, gather the materials listed below.

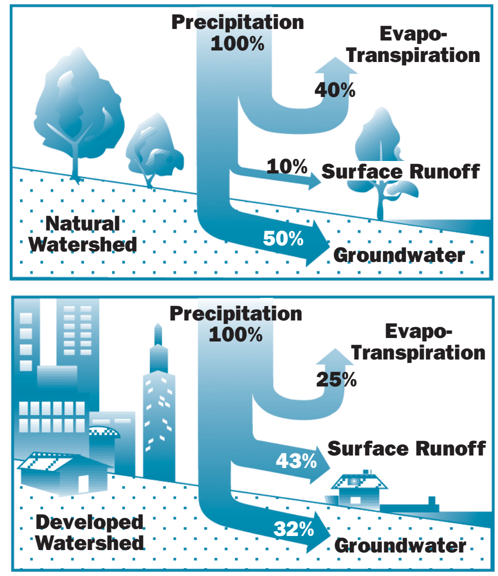
- Reference maps, such as your topographic map or neighborhood map, to locate the stream and the area to be assessed.
- Map on which to record the land uses, land characteristics, sources of pollution, construction sites, stream obstructions, and landmarks.
- Watershed field data sheets.
- Additional blank paper or notebook to draw maps and make notes as needed.
- Relevant information from the background investigation, such as location of industrial or treatment plant discharges, farms, abandoned mines, or areas of recreational uses.

Explore the Watershed

The purpose of exploring your watershed is to get an overall view of the land that drains into your stream and record observations on the field data sheet. Even if you have lived in the watershed for years, you may be surprised by some of the new things you will

Fate of Precipitation

The fate of precipitation in a natural watershed and a developed watershed. Developed areas greatly reduce the amount of precipitation that becomes groundwater. Evaporation and transpiration (water loss from plants) are also reduced in urbanized areas. (EPA, 1995)



notice with your freshly trained eyes.

Always work with at least one other person. If you are driving through the watershed, one of you should navigate with a road map while the other partner drives. Keep your field sheets handy for recording relevant discoveries. It may be a good idea to pull over and make detailed observations, especially at road crossings. As you explore your watershed look for the following:

- *Terrain*. Become aware of the topography of the area by observing hills, valleys, and ridges and see how they relate to a topographic map. Does any of this area periodically flood? Are there areas where the land seems unstable—for example, do you see sinkholes or evidence of erosion?
- *Channel Modifications*. Look for evidence indicating how the community has dealt with the stream and its flood potential. Are there areas where the banks have been covered with concrete and/or the stream has been straightened? Is it dammed, diverted, or culverted? Note any evidence of erosion or pollution beneath railroad, street, power line, and pipe crossings. Is stream flow obstructed by debris hung up beneath the bridges?
- *Land Uses.* Look for construction sites, parking lots, manicured lawns, golf courses, farming, cattle crossings, mining, industrial and wastewater treatment plant discharges, illegal dumps, and landfills. Look for the areas of interest you identified in the background investigation. Look for forested land, healthy riparian zones, undisturbed wetlands, wildlife, and the presence of recreational users of the stream, like swimmers and fishers. Is this recreational usage intense, moderate, or light?
- *Vacant Lots*. Make note of the number of vacant lots and which ones would be good candidates for community gardens or playground projects. Look for ways to enhance community life in the watershed.

Explore the Stream

Locate public areas of the stream that are easily accessible, and go down to the water's edge. Using all your senses, describe the area. Does the creek smell? If so, what does it smell like? Is the water covered with debris, an oil sheen, or foam? Is the water clear or turbid? Make note of the type and abundance of riparian vegetation (grasses, shrubs, trees, and so forth). Is there any sign of erosion? Fill out a "Pipe and Drainage Ditch Inventory" sheet for each pipe and drainage ditch you see discharging into the creek.

While conducting the survey in the streambed, remember to note your location as specifically as possible. Draw new maps or take pictures to help record your location and your observations. See the accompanying drawing "Major Parts of the Stream System." You can use some of the standard terms shown there to help organize your description. Don't be afraid to take too many notes or draw too many pictures.

Major Parts of the Stream System

Surrounding land use affects stream habitat.

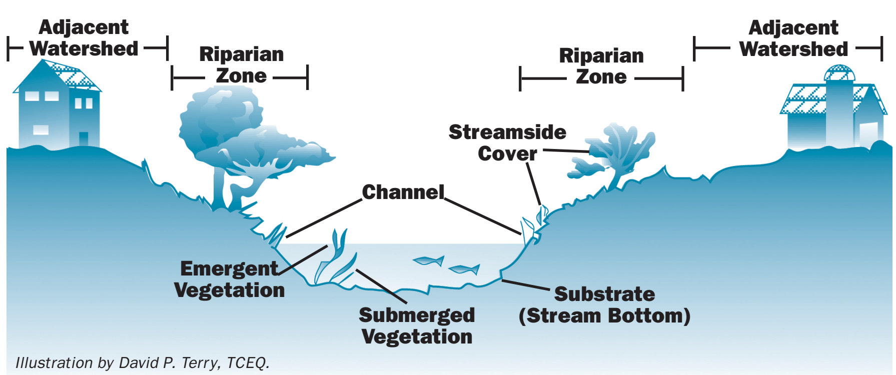


Illustration by David P. Terry, TCEQ.

There will be time to sort through your observations later.

It is important to take note of the positive conditions and activities you see throughout the watershed as well as the negative. Make note of construction sites that are using erosion control practices such as erosion control fences, temporary grass cover, and storm drain covers. Look for things such as stable, naturally vegetated banks, fish and waterfowl, or other signs that the stream is healthy.

Using the Field Data Sheets

The field data sheets found at the end of this document are designed to help you answer questions about the land uses in your watershed. Sometimes it is difficult to put numbers and percentages down describing land uses, but percentages, rather than simple verbal statements about the activities, help make the survey more objective.

When the opportunity arises to compare two watersheds, the major differences in land uses will be described and will be easy to locate on the data sheets. If biological and/or chemical water quality information was accessible, comparisons could be drawn between the land uses and the water quality. This could help pinpoint areas in the watershed where restoration projects would be most useful.

Review Your Maps and Field Data Sheets

The final step of the watershed survey is to review your maps, field notes, drawings, photos, and field data sheets for your watershed segment. Take time to rewrite and organize the information you have gathered into a clear picture or inventory of your watershed. What is the information telling you about problem areas, overall condition of the stream, good and bad land management practices, and the need for more community involvement and action?

By answering these questions and providing an overall view of the watershed, your group could promote additional monitoring or community activity. With that in mind, what areas on the stream would be the best places for water quality monitoring to take place? Are there places that could benefit from a community cleanup project? Are there signs that area residents have dumped yard wastes such as lawn clippings, leaves, branches, or other trash into the creek? A neighborhood education campaign by your group might be the answer.

After you have completed your survey, you may find it has many other potential uses, such as:

- a good resource for targeting areas for cleanups and tree plantings;
- a guide for groups that are interested in conducting water quality tests;
- a planning tool for the community to design some long-term goals for improving the watershed;
- a science project encompassing land use and water quality, nonpoint source pollution, geography, urban development, and planning;
- a historical project, looking at the watershed's development using historical documents, aerial photos, and maps;
- the focus of a plant or animal survey; and
- a guide for developing a nature trail.

Whether you choose to identify fish communities and their location in the stream, learn to identify bird calls and get an estimate of the number of species in the watershed, or do a vegetation analysis, the information could be important to the Audubon Society, area biologists, educators, or local civic and environmental groups.

So take a look around, explore, keep track of what you see, and share what you learn. There are many new things to see, from the small to the large, the beautiful to the disturbing. You may even find places you never knew existed before. Perhaps Baba Dioum sums it up best:

> *In the end, we will conserve only what we love. We will love only what we understand. We will understand only what we are taught.*

Appendixes

When I arise in the morning, I am torn by the twin desires to reform the world and enjoy the world. This makes it hard to plan the day.

—E.B. White

Appendix

Texas Stream Team—Volunteer Environmental Monitoring Program

Texas Stream Team (formerly Texas Watch) is a network of trained volunteers and supportive partners working together to collect information of assured quality that can be used to assist professionals in developing local and regional management strategies. Established in 1991 and funded primarily through the federal Clean Water Act, Texas Stream Team promotes a wide range of activities, including a program on certified water quality monitoring, programs on nonpoint source pollution and environmental education, and statewide and regional conferences and workshops. Currently, over 1,400 Texas Watch volunteers collect water quality data on lakes, rivers, streams, wetlands, bays, bayous, and estuaries in Texas.

Texas Stream Team is a partnership of the TCEQ, the Environmental Protection Agency (EPA), and Texas State University (TSU) at San Marcos. Texas Stream Team offices are housed at the River Systems Institute at the TSU campus.

If you are interested in becoming involved in Texas Stream Team as a volunteer monitor or as a Texas Stream Team Partner organization, visit the TSU Texas Stream Team Web site at <txstreamteam.rivers.txstate.edu/>, or contact Texas Stream Team at:

Texas Stream Team
Texas State University
River Systems Institute
601 University Drive
San Marcos, TX 78666-4616

E-mail: txstreamteam@txstate.edu
Toll-Free: 877-506-1401

Some Effects of NPS Pollution

In-Stream Effects

Biological:

- Loss of species
- Destruction of species habitat
- Alteration of food web
- Interruption of ecosystem functions

Recreational:

- Loss of recreational fishing
- Loss of boating and swimming opportunities
- Loss of waterfowl habitat for birdwatching

Water Storage Facilities:

- Need to construct larger sediment pools
- Need to dredge and excavate sediments
- Early replacement of storage capacity
- Additional water quality treatment required

Navigation:

- Delays and accidents in shipping, boating
- Damage to marine engines
- Need for dredging and disposal of spoil

Other:

- Loss of fisheries
- Reduced property values and aesthetics

Off-Stream Effects

Flood Damage:

- Loss of human and animal life
- Deposition of sediment on cropland, roads, etc.
- Loss of productivity

Water Conveyance Facilities:

- Deposition and removal of sediment in drainage ditches, canals, etc.
- Increased pumping requirements

Water Treatment Facilities and Water Users:

- Additional treatment required
- Increased maintenance of equipment
- Loss of productivity

Drinking Water Supplies:

- Increased health risks, illnesses from contaminated surface water and groundwater
- Supplemental drinking water required

Appendix

Information Resources

Type of Information Needed	Sources
Natural Resource Assessment, Inventories, and Other Data	
Water Quality Data	U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, state water quality agencies, state fish and game departments, state departments of health, and tribal environmental offices
Land-Use Data	U.S. Department of Agriculture's Natural Resources Conservation Service and Agricultural Stabilization and Conservation Service, U.S. Forest Service, Bureau of Indian Affairs, U.S. Bureau of Reclamation, U.S. Bureau of Land Management, state cooperative extension services, state land office, tribal environmental or agricultural offices, local government offices such as city planners and county commissioners
Economic Data	County Extension Service, Councils of Governments, Economic Research Service, chambers of commerce, state departments of commerce, tribal councils, real estate agents, private consultants
Demographic Data	Councils of Governments, census reports, chambers of commerce, state statistics bureaus, almanacs
Pollution Control Methods or Best Management Practices	
Agriculture	U.S. Department of Agriculture's Natural Resources Conservation Service and Agricultural Stabilization and Conservation Service, U.S. Environmental Protection Agency, County Extension Service, Agricultural Research Stations, state soil and water conservation commissions, state departments of agriculture, state water quality agencies
Urban	U.S. Environmental Protection Agency, Councils of Governments, state water quality agencies, city planners, private engineers
Mining & Other Resource Extraction Processes	U.S. Office of Surface Mining, Bureau of Land Management, U.S. Forest Service, U.S. Minerals Management Service, U.S. Environmental Protection Agency, Tennessee Valley Authority, state departments of mining and minerals, state water quality agencies
Roads	U.S. Department of Transportation, U.S. Environmental Protection Agency, U.S. Department of Agriculture's Soil Conservation Service, U.S. Forestry Service, Bureau of Land Management, state highway departments, state water quality agencies, private engineers, county commissioners, county extension services
Forestry	U.S. Fish and Wildlife Service, U.S. Forest Service, state departments of forestry, private consultants, timber companies

Appendix

Web Sites of Interest

Here are some information resources available if you have access to the World Wide Web. Many agencies revise their Web sites frequently, so you may have to do a little browsing around if you find that information has moved.

Environmental Protection Agency (EPA) at <cfpub.epa.gov/surf/locate/index.cfm>. This site allows you to search for a map of your local watershed using a map or a word search.

National Archives and Records Administration (NARA) at <www.archives.gov>. Click on Government Information Locator Service for a searchable database of NARA information resources with links to other sources of government information. Southwest regional office located in Fort Worth at <www.archives.gov/southwest>.

Natural Resources Conservation Service (NRCS) at <www.nrcs.usda.gov>. Contains general natural resource information. Follow the link to "Technical Resources" to find data, maps, and information about soils, water, climate, and conservation.

Texas AgriLife Extension Service (TAEX) at <texasextension.tamu.edu>. Contains information about natural resource programs of the TAEX and the Texas Agricultural Experiment Station (TAES). Both of these groups are part of the Texas A&M University System.

Texas Association of Regional Councils (TARC) at <www.txregionalcouncil.org>. Links are provided to Web sites for many of Texas' regional councils of government (COGs). Some of the COG sites, such as the one for the North Central Texas Council of Governments (NCTCOG), provide local area maps.

Texas General Land Office (GLO) at <www.glo.state.tx.us>. This agency is responsible for managing the state's land resources. Of interest here are historical documents and Beach Watch program information.

Texas Commission on Environmental Quality (TCEQ) at <www.tceq.state.tx.us>. This is the Texas agency charged with protection of the state's air and water resources. Some pages of interest are Geographic Information System (GIS) maps; Pollution Prevention and Recycling; Water Resource Management; Environmental Education; and Publications.

Texas Natural Resource Information System (TNRIS) at <www.tnris.state.tx.us>. TNRIS is the data clearinghouse of the TWDB, and is a source for maps, aerial photos, soil surveys, and more.

Texas State Soil and Water Conservation Board (TSSWCB) at <www.tsswcb.state.tx.us>. This site discusses nonpoint source pollution and has watershed-protection plans.

Texas Water Development Board (TWDB) at <www.twdb.state.tx.us>. This agency is responsible for planning and development for the state's water resources. Some areas of interest at this site are Population and Water Use Statistics and Hydrographic Surveys.

United States Department of Agriculture (USDA) at <www.usda.gov>. Contains general information about the USDA's mission and programs and a search engine.

United States Geological Survey (USGS) at <ask.usgs.gov> or <www.usgs.gov/pubprod>. These sites contain a wealth of information on maps and product ordering, map dealers, and natural resource data. Each site has a search engine for finding specific information. For USGS programs in Texas, see <tx.usgs.gov>.

United States Government Printing Office (GPO) at <www.gpo.gov>. This page gives you access to government information products, and to the Government Information Locator Service.

Helpful Addresses and Phone Numbers

National Archives and Records Administration (NARA), Southwest Region
P.O. Box 6216
Fort Worth, TX 76115-0216
<www.archives.gov/southwest>

Natural Resources Conservation Service (NRCS)
Attn: Public Affairs Division
P.O. Box 2890
Washington, DC 20013
202-720-3210
<www.nrcs.usda.gov>

USDA-NRCS Texas Office
101 South Main Street
Temple, TX 76501
254-742-9800
<www.tx.nrcs.usda.gov>

Texas AgriLife Extension Service
106 Jack K. Williams Administration Bldg.
7101 TAMU
College Station, TX 77843-7101
979-845-7800
<texasextension.tamu.edu>

Texas Association of Regional Councils (TARC)
Austin Centre
701 Brazos Street, Ste. 780
Austin, TX 78701
512-478-4715
<www.txregionalcouncil.org>

Texas Department of Transportation (TxDOT)
125 East 11th Street
Austin, TX 78701
800-558-9368
<www.txdot.gov>

Texas Forest Service
John B. Connally Building
301 Tarrow, Suite 364
College Station, TX 77840-7896
979-458-6606
<txforestservice.tamu.edu>

Texas General Land Office (GLO)
1700 North Congress Ave., Ste. 935
Austin, TX 78701-1495
512-463-5001
<www.glo.state.tx.us>

Texas Commission on Environmental Quality (TCEQ)
P.O. Box 13087
Austin, TX 78711-3087
512-239-1000
<www.tceq.state.tx.us>

Texas Natural Resource Information Service (TNRIS)
P.O. Box 13231
Austin, TX 78711-3231
512-463-8337
<www.tnris.state.tx.us>

Texas Parks and Wildlife Department (TPWD)
4200 Smith School Road
Austin, TX 78744
512-389-4800 or 800-792-1112
<www.tpwd.state.tx.us>

Texas State Soil and Water Conservation Board (TSSWCB)
P.O. Box 658
Temple, TX 76503-0658
254-773-2250 or 800-792-3485
<www.tsswcb.state.tx.us>

Helpful Addresses and Phone Numbers

Texas Water Development Board (TWDB)
P.O. Box 13231
Austin, TX 78711-3231
512-463-7847
<www.twdb.state.tx.us>

United States Department of Agriculture (USDA)
1400 Independence Ave., SW
Washington, DC 20250
202-720-2791
<www.usda.gov>

United States Environmental Protection Agency (USEPA)
Ariel Rios Building
1200 Pennsylvania Ave., NW
Washington, DC 20460
202-272-0167
<www.epa.gov>

USEPA Region 6
1445 Ross Avenue
Suite 1200
Dallas, TX 75202-2733
214-665-2200 or 800-887-6063
<www.epa.gov/region6>

United States Geological Survey (USGS)
12201 Sunrise Valley Drive
Reston, VA 20192
703-648-4000
<www.usgs.gov>

USGS Texas Office
U.S. Geological Survey
8027 Exchange Drive
Austin, TX 78754
512-927-3500
<tx.usgs.gov>

United States Government Printing Office (GPO)
732 North Capitol St., NW
Washington, DC 20401
866-512-1800
<www.gpo.gov>

United States Forest Service
1400 Independence Ave., SW
Mailstop: 1111
Washington, DC 20250-1111
800-832-1355
<www.fs.fed.us>

United States Fish and Wildlife Service
Region 2 (Southwest)
P.O. Box 1306
Albuquerque, NM 81703-1306
505-248-6911
<www.fws.gov/southwest/contact.html>

Appendix

TCEQ Regions *(including counties in each region)*

Region 1 - Amarillo
806-353-9251

Armstrong, Briscoe, Carson, Castro, Childress, Collingsworth, Dallam, Deaf Smith, Donley, Gray, Hall, Hansford, Hartley, Hemphill, Hutchinson, Lipscomb, Moore, Ochiltree, Oldham, Parmer, Potter, Randall, Roberts, Sherman, Swisher, Wheeler

Region 2 - Lubbock
806-796-7092

Bailey, Cochran, Crosby, Dickens, Floyd, Garza, Hale, Hockley, King, Lamb, Lubbock, Lynn, Motley, Terry, Yoakum

Region 3 - Abilene
915-698-9674

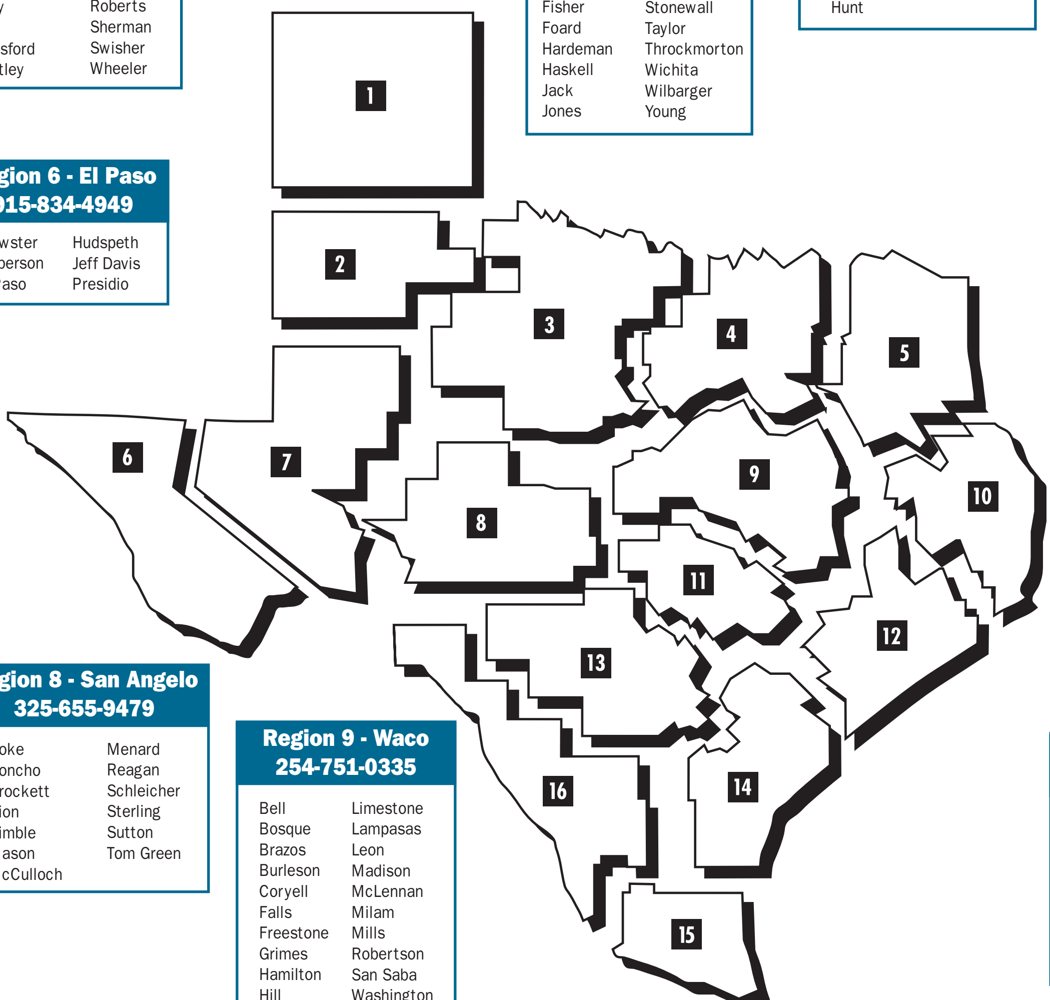
Archer, Baylor, Brown, Callahan, Clay, Coleman, Comanche, Cottle, Eastland, Fisher, Foard, Hardeman, Haskell, Jack, Jones, Kent, Knox, Mitchell, Montague, Nolan, Runnels, Scurry, Shackelford, Stephens, Stonewall, Taylor, Throckmorton, Wichita, Wilbarger, Young

Region 4 - Dallas/FW
817-588-5800

Collin, Cooke, Dallas, Denton, Ellis, Erath, Fannin, Grayson, Hood, Hunt, Johnson, Kaufman, Navarro, Palo Pinto, Parker, Rockwall, Somervell, Tarrant, Wise

Region 5 - Tyler
903-535-5100

Anderson, Bowie, Camp, Cherokee, Cass, Delta, Franklin, Gregg, Harrison, Henderson, Hopkins, Lamar, Marion, Morris, Panola, Rains, Red River, Rusk, Smith, Titus, Upshur, Van Zandt, Wood



Region 6 - El Paso
915-834-4949

Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, Presidio

Region 7 - Midland
432-570-1359

Andrews, Borden, Crane, Dawson, Ector, Gaines, Glasscock, Howard, Loving, Martin, Midland, Pecos, Reeves, Terrell, Upton, Ward, Winkler

Region 8 - San Angelo
325-655-9479

Coke, Concho, Crockett, Irion, Kimble, Mason, McCulloch, Menard, Reagan, Schleicher, Sterling, Sutton, Tom Green

Region 9 - Waco
254-751-0335

Bell, Bosque, Brazos, Burleson, Coryell, Falls, Freestone, Grimes, Hamilton, Hill, Limestone, Lampasas, Leon, Madison, McLennan, Milam, Mills, Robertson, San Saba, Washington

Region 10 - Beaumont
409-898-3838

Angelina, Hardin, Houston, Jasper, Jefferson, Nacogdoches, Newton, Orange, Polk, Sabine, San Augustine, San Jacinto, Shelby, Trinity, Tyler

Region 11 - Austin
512-339-2929

Bastrop, Blanco, Burnet, Caldwell, Fayette, Hays, Lee, Llano, Travis, Williamson

Region 12 - Houston
713-767-3500

Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, Wharton

Region 13 - San Antonio
210-490-3096

Atascosa, Bandera, Bexar, Comal, Edwards, Frio, Gillespie, Guadalupe, Karnes, Kendall, Kerr, Medina, Real, Uvalde, Wilson

Region 14 - Corpus Christi
361-825-3100

Aransas, Bee, Calhoun, De Witt, Goliad, Gonzales, Jackson, Jim Wells, Kleberg, Lavaca, Live Oak, Nueces, Refugio, San Patricio, Victoria

Region 15 - Harlingen
956-425-6010

Brooks, Cameron, Hidalgo, Jim Hogg, Kenedy, Starr, Willacy

Region 16 - Laredo
956-791-6611

Dimmit, Duval, Kinney, La Salle, Maverick, McMullen, Val Verde, Webb, Zapata, Zavala

TCEQ Regional Office Addresses

1 AMARILLO
3918 Canyon Dr.
Amarillo, TX 79109-4933
806-353-9251 FAX: 806-358-9545

Perryton Office
511 South Main
Perryton, TX 79070
806-435-8059 FAX: 806-434-8443

2 LUBBOCK
5012 50th St., Ste. 100
Lubbock, TX 79414-3421
806-796-7092 FAX: 806-796-7107

3 ABILENE
1977 Industrial Blvd.
Abilene, TX 79602-7833
325-698-9674 FAX: 915-692-5869

4 DALLAS/FORT WORTH
2309 Gravel Dr.
Fort Worth, TX 76118-6951
817-588-5800 FAX: 817-588-5700

Stephenville
(Confined Animal Feeding Operations)
580-D W. Lingleville Rd.
Stephenville, TX 76401
254-965-9200 or 800-687-7078

5 TYLER
2916 Teague Dr.
Tyler, TX 75701-3734
903-535-5100 FAX: 903-595-1562

6 EL PASO
401 E. Franklin Ave., Ste. 560
El Paso, TX 79901-1212
915-834-4949 FAX: 915-834-4940

7 MIDLAND
3300 North A St., Bldg. 4, Ste. 107
Midland, TX 79705-5406
915-570-1359 FAX: 915-570-4795

8 SAN ANGELO
622 S. Oakes, Ste. K
San Angelo, TX 76903-7035
325-655-9479 FAX: 325-658-5431

Concho Watermaster Office
325-481-8069 or 866-314-4894
FAX: 325-658-5431

9 WACO
6801 Sanger Ave., Ste. 2500
Waco, TX 76710-7826
254-751-0335 FAX: 254-772-9241

10 BEAUMONT
3870 Eastex Fwy.
Beaumont, TX 77703-1830
409-898-3838 FAX: 409-892-2119

11 AUSTIN
2800 S. IH 35, Ste. 100
Austin, TX 78704-5700
512-339-2929 FAX: 512-339-3795

12 HOUSTON
5425 Polk Ave., Ste. H
Houston, TX 77023-1452
713-767-3500 FAX: 713-767-3520

13 SAN ANTONIO
14250 Judson Rd.
San Antonio, TX 78233-4480
210-490-3096 FAX: 210-545-4329

South Texas Watermaster Office
210-490-3096 or 800-733-2733
FAX: 210-545-4329

14 CORPUS CHRISTI
6300 Ocean Dr., Ste. 1200
Corpus Christi, TX 78412-5839
361-825-3100 FAX: 361-825-3101

15 HARLINGEN
1804 West Jefferson Ave.
Harlingen, TX 78550-5247
956-425-6010 FAX: 956-412-5059

Rio Grande Watermaster Office
956-430-6056 or 800-609-1219
FAX: 956-430-6052

Eagle Pass Office
1152 Ferry St., Ste. H
Eagle Pass, TX 78852-4367
830-773-5059 FAX: 830-773-4103

16 LAREDO
707 East Calton Rd., Ste. 304
Laredo, TX 78041-3887
956-791-6611 FAX: 956-791-6716

Appendix

Glossary

Some of the terms defined in this Glossary are used in the text of this manual. Others are terms you are likely to encounter as you conduct your survey.

acid rain: rainfall that has reacted with airborne pollutants such as sulfur dioxides and nitrogen oxides, thereby reducing the pH (or increasing the acidity) of the rain.

algae bloom: an overgrowth in aquatic plants and algae caused by an increase in nutrients.

algal mat: a thick layer of filamentous algae floating at the surface of lakes, ponds, and slow-moving areas of flowing water.

alluvial deposit: deposits of clay, silt, sand, gravel, or similar detrital material deposited by running water.

aquifer: stratum of the earth composed of water and layered between permeable rock, sand, or gravel.

best management practice (BMP): the most effective practice or combinations of practices to control nonpoint source pollution. See also Structural BMP and Nonstructural BMP.

boulder: rock greater than 10 inches in diameter.

buffer zone: an area along the streamside whose vegetative integrity is maintained in order to prevent erosion, trampling by livestock, and to reduce the amount of chemicals entering the creek.

classified waters: Texas rivers and their major tributaries, major reservoirs and lakes, and marine waters that the TCEQ has studied and rated for suitability to various uses—for example, swimming, fishing, drinking water supply.

clay: feels slick, sticks together.

cobble: rock 2 to 10 inches in diameter.

drainage basin: another term commonly used to describe a watershed.

dredging: the use of machinery to widen or deepen a channel, or to remove debris.

effluent: wastewater (treated or untreated) that flows out of a treatment plant or industrial outfall (point source) before entering a body of water.

estuary: regions of interaction between rivers and nearshore ocean waters where tidal action and river flow create a mixing of fresh and salt water.

first-order stream: a stream that does not receive the flow of a tributary.

food chain: the dependence of organisms upon others in series for food. The chain begins with producers (plants) and ends with the largest of the consumers (carnivores).

food web: an interlocking pattern of several or many food chains.

gravel: rock between 0.1 to 2.0 inches in diameter.

groundwater: water that remains below the land surface and travels below ground, such as an aquifer.

habitat: area and conditions in which an organism lives.

herbicide: an agent used to destroy or inhibit plant growth.

impervious cover: areas of ground cover, typically in urban areas, which limit the amount of water that soaks into the ground, such as parking lots, roads, and sidewalks.

Glossary

insecticide: an agent that destroys insects.

nonpoint source (NPS): pollution sources without a specific point of origin, usually due to rainwater runoff from urban areas or agriculture/rangeland.

nonstructural BMP: best management practice that takes advantage of the land's natural features to remove pollutants; such controls include wetlands, grassed waterways, and buffer zones.

playa: small, shallow, circular lakes found scattered on the southern High Plains of Texas; an outlet for a watershed.

point source: an identifiable source of pollution that involves a direct discharge of wastes, such as a wastewater treatment plant.

reservoir: any natural or artificial holding area used to store, regulate, or control water.

riparian: an area, adjacent to and along a stream, that is often vegetated and constitutes a buffer zone between nearby lands and the stream. Considered important in controlling sediment and nutrient delivery into the channel.

river system: the network of streams in a single watershed.

runoff: the part of precipitation or irrigation water that runs off land into streams and other surface water.

saddle: low-lying area between two ridges.

sand: particles less than 0.1 inches in diameter—feels gritty.

scum: a thin, filmy layer floating on the surface of a body of water, made up of biological material (dead plankton, bacteria, and other microscopic organisms) or human-made substances (oil or gasoline).

second-order stream: a stream that receives the flow of two or more first-order streams.

settling basin: structures that allow sediments and nutrients to settle out of water, or fall to the bottom of the structure, to prevent them from getting into the stream.

silt: particles less than 0.05 inches in diameter.

silviculture: a branch of forestry dealing with the development and care of forests.

storm drain marking: messages that are marked onto storm drains warning that anything dumped into the drain flows, along with storm water, directly into a specific creek.

structural BMP: best management practice designed to capture surface runoff and remove pollutants through settling or other processes including, but not limited to, water diversions, retention devices, detentions basins, or filter systems.

surface water: water that remains on the land surface and contributes to lakes, streams, and reservoirs.

third-order stream: a stream that receives the flow of two or more second-order streams.

tributary: a stream that merges into another, thereby creating a larger stream.

watershed: geographic area in which water, sediments, and dissolved materials drain into a common outlet.

wetland: an area that is regularly saturated by surface water or groundwater and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions.

Watershed Survey Field Data Sheets

Forms Locator

Watershed Characteristics—General Land Use

Stream Name:

Furthest Downstream Point on Survey:

Size of Survey Area:

Size of Watershed:

County or Counties:

Investigators:

Date: Time:

Structures Crossing The Stream

List here only those structures that cross the stream **without** altering its flow (for example, bridges whose supports are not in the stream). On page 39 (Stream Characteristics) note structures that **do** alter streamflow.

Type of Road	Number	Other Crossings	Number
Single-Lane Road		Pipeline	
Two-Lane Road*		Power Line	
Four-Lane Road		Railroad	
Six-Lane Road		**One lane in each direction*	

Specific Water Uses

Agriculture (e.g., Irrigation, Livestock)	Industrial (e.g., Cooling Water, Process Water)
Domestic Drinking Water	Recreational
	Other

General Land Use

Place the total number of the following activities in the number column. If an activity is present in the watershed but can't be counted (for example, cropland, unless counting acreage), place a check indicating its presence.

Type	Number	Type	Number
Construction Site		Park/Natural Area	
Cropland		Poultry Farm	
Drinking Water Treatment Plant		Rangeland (Livestock Grazing)	
Feedlot		Refinery	
Gas Station		Residential Neighborhood	
Illegal Dump			
Landfill		Settling Basin/ Detention Structure	
Logging/Silviculture		Storm Drain	
Mining		Strip Mall/Store	
Office Complex		Wastewater Treatment Plant	
Oil Well		Water Well	

Other—Describe

Watershed Characteristics—Specific Land Use

Specific Land Uses

When appropriate, indicate the number of areas devoted to a particular land use category. For example, there may be two gas stations streamside, four within ¼ mile (not including the two streamside) and three elsewhere in the watershed (not including any of the previous). In some cases, it may be difficult to place a number on a land use. In this case, place a check in the appropriate location column. There could be more than one check for each land use. Total the number of land uses in each category.

Category	Location: Streamside	Within 1/4 Mile	Elsewhere in Watershed
Agricultural/Rural			
Abandoned/ Undeveloped Field			
Animal Feedlot			
Cropland			
Fish Hatchery			
Grazing Land			
Tree Farm			
Total Observations			
Commercial/Industrial			
Airport			
Auto Repair/Gas Station			
Bus or Taxi Depot			
Commercial—Stores, Restaurants, Malls			
Factory/Mill			
Junkyard			
Landfill			
Office Complex/Building			
Power Plant			
Refinery			
School			

Category	Location: Streamside	Within 1/4 Mile	Elsewhere in Watershed
Commercial/Industrial *(cont'd)*			
Wastewater Treatment Plant			
Water Treatment Plant			
Other			
Total Observations			
Forest/Parkland			
City/County Park			
State/National Park			
Woods/Greenbelt			
Other			
Total Observations			
Residential			
Apartment Complex			
Lawns			
Parking Lot			
Playground			
Single-Family Housing			
Other			
Total Observations			

Summary of Major Land Uses Observed

Use the total numbers of observations noted for each category and location to generate a percentage. The percentages of your observations for each major group of categories will give a rough index of land use in the watershed.

Agricultural/Rural				%
Commercial/Industrial				%
Forest/Parkland				%
Residential				%

Activities Observed in the Watershed

In the preceding form, you noted land uses that already exist in the watershed and have effects on it (for example, apartments, parking lots).

In this form you will note activities that, when completed, will have new, added effects on the watershed (for example, construction of additional apartments and parking lots).

In addition you will record ongoing activities that will continue to have effects on the watershed (for example, uses such as boating).

Category	Location		
	Streamside	Within 1/4 Mile	Elsewhere in Watershed
Construction			
Bridge Construction			
Commercial and Public Construction			
Residential Construction			
Roadway Construction			
Other—Specify			
Total Observations			
Logging			
Controlled Burning			
Intensive Logging			
Lumber Treatment Area			
Selective Logging			
Other—Specify			
Total Observations			
Mining			
Abandoned Mine			
Pit Mining			
Quarry			
Strip Mining			
Other—Specify			
Total Observations			
Recreation			
Biking/Off-Road (Vehicle Trail)			
Boat Ramp			
Campground			
Fishing Area			
Golf Course			
Horseback Trail			
Jogging/Hiking Trail			
Picnic Area			
Power Boating/ Water Skiing			
Swimming Area			
Trailer Park			
Other—Specify			
Total Observations			

Summary of Activities Observed

Use the total numbers of observations noted for each category and location to generate a percentage. The percentages of your observations for each major group of categories will give a rough index of land use in the watershed.

Construction			%
Logging			%
Mining			%
Recreation			%

Stream Characteristics

Note the number of structures that alter the natural flow of the stream. Only count bridges that alter the streamflow (have supports in contact with the stream).

Type	Number
Beaver Dams	
Bridges (Auto or Rail)	
Dams	
Log Jams	
Low Water Crossings	
Tributaries	
Waterfalls	

Note the approximate length the stream is affected by:

Concrete Banks/Bottom	feet or	miles
Dredging	feet or	miles
Stream Diversion	feet or	miles
Stream Straightening	feet or	miles

Check the categories that best describe the general appearance of the stream (you may want to mark these locations on your working map).

Erosion

- ❏ No streambank erosion or eroded areas are very rare
- ❏ Occasional areas of streambank erosion
- ❏ Areas of streambank erosion common
- ❏ Erosion heavy/artificial bank stabilization present

Categories *(cont'd)*

Litter

- ❏ No litter visible
- ❏ Small litter occasionally (cans, paper)
- ❏ Small litter common
- ❏ Large litter occasionally (tires, carts)
- ❏ Large litter common

Substrate Percentages

- ❏ Bedrock %
- ❏ Boulder % > 10 inches
- ❏ Cobble % 2-10 inches
- ❏ Gravel % 0.1-2 inches
- ❏ Sand % < 0.1 inch (gritty)
- ❏ Silt % < 0.05 inch
- ❏ Clay % (slick)

Other

- ❏ Fish kills
- ❏ Flooding
- ❏ Periods of no flow
- ❏ Spills (oil, chemical, etc.)
- ❏ Wildlife, waterfowl kills

Pipe and Drainage-Ditch Inventory

In this section, fill in information on pipes and drainage ditches found on the banks of the stream. Fill in this sheet for each pipe or ditch on the bank whether it is active or inactive. Keep a master copy of this sheet so copies can be made if necessary.

This information applies to a:

❑ Pipe ❑ Drainage Ditch ❑ Other—Specify ____________

Location of pipe/ditch

❑ In Stream ❑ In Bank ❑ Near Stream

Describe Location: ____________

Assign pipe/ditch an ID# to be placed on map ____________

Identify type of pipe (check one)

- ❑ Agriculture Field Drainage
- ❑ Feedlot Drainage
- ❑ Industrial Outfall
- ❑ Parking Lot Drainage
- ❑ Settling Basin/Pond Drainage
- ❑ Storm Drain
- ❑ Wastewater Treatment Plant Outfall
- ❑ Unknown
- ❑ Other—Specify ____________

Diameter of Pipe: _____inches or _____feet

Describe the discharge flow

Rate of Flow

❑ None ❑ Intermittent

❑ Trickle ❑ Steady ❑ Heavy

Appearance

❑ Clear ❑ Foamy ❑ Turbid

❑ Oily ❑ Colored—Specify ____________

Odor

❑ None ❑ Sewage ❑ Chemical

❑ Chlorine ❑ Other—Specify ____________

Describe the streambank and stream where the pipe or ditch enters

- ❑ No Problem Evident
- ❑ Eroded
- ❑ Litter (styrofoam, cans, etc.)
- ❑ Lots of Algae
- ❑ Sewage Litter (toilet paper, etc.)
- ❑ Other—Specify ____________

Comments on the pipe or ditch

You may want to discuss certain facilities, or discuss the condition of the stream in more detail.

Notes

Notes

Related TCEQ Publications

If you enjoyed this manual, you may want to receive some of the publications listed below. To order, call 512-239-0028; fax 512-239-4488; or write to TCEQ Publications, MC-118, P.O. Box 13087, Austin, TX 78711-3087. For other publications of interest, check the TCEQ Publications Catalog, PD-001. The catalog is available on the TCEQ's Web site at <www.tceq.state.tx.us/publications>.

Single copies of these publications are available free of charge. All of the publications listed below are also available at the TCEQ Web site at <www.tceq.state.tx.us/publications>.

Number	Title	Multiple Copy Cost
GI-316	Atlas of Texas Surface Water	$1.75
GI-036	Mulching and Composting	$1.75
GI-028	A Green Guide to Yard Care	$1.75
GI-034	A Guide to Freshwater Ecology	$5.00
GI-194	Land Use and the Water Cycle (poster)	$1.75
GI-170	Recycle Your Used Oil and Used Oil Filters (poster)	$1.75
GI-212	Storm Drain Marking	$1.75
RG-415	Surface Water Quality Monitoring Procedures, Vol. 1—Water Quality	$5.00
RG-416	Surface Water Quality Monitoring Procedures, Vol. 2—Biological/Habitat	$8.75
GI-079	Teacher's Guide to Environmental Education Resources	$1.75
GI-026	Water Education Field Guide	$3.25

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