



SAN ANTONIO
RIVER AUTHORITY

San Antonio River Watershed
CREEK BOOK
A Guide to Healthy Creeks and Rivers



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Introduction

Texas is home to numerous beneficial and useful water courses. These water courses are referred to as rivers, sloughs, brooks, branches, bayous and headers. In Central and South Texas they are most commonly called creeks.

Creeks are a vital resource, both for you and the animal and plant species that depend on them. Creeks provide essential **habitat** for aquatic and terrestrial life, so it is important for property owners and communities to maintain the health of their creeks. If mistreated, creeks can easily become **impaired** with poor **water quality** and little to no animal or plant life. Natural habitats are sensitive, and human activity can have detrimental effects on the ecosystem. In addition to habitat for animal and plant species, healthy creeks provide water supply, **groundwater** recharge, a channel for flood waters and a priceless amenity that everyone can enjoy.

This book will teach you the characteristics of healthy creeks and how you can help maintain them. You will learn how to prevent **erosion** and flood loss, improve water quality, prevent pollution from entering creeks and groundwater, use alternative products that are safer for the environment, minimize waste and conserve our natural resources. Be sure to share this information with others so they, too, can help maintain a healthy system of creeks and streams. Residents who do not live near a creek can also use this book, as all the creeks within the San Antonio River Watershed are connected through **watersheds**. If you and others in your community ensure the health of your creeks, everyone will benefit.



Snowy Egret (*Egretta thula*)

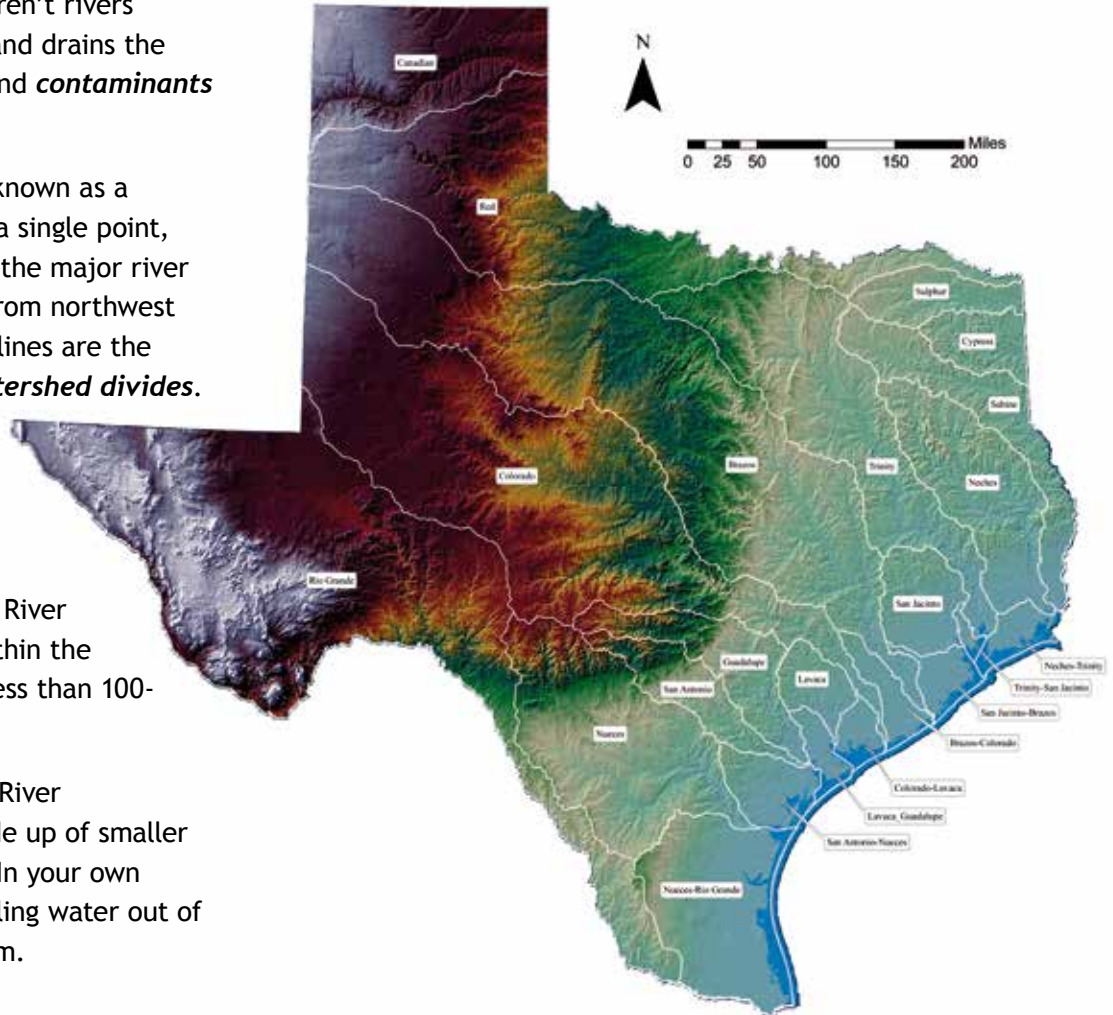
Watershed Basics

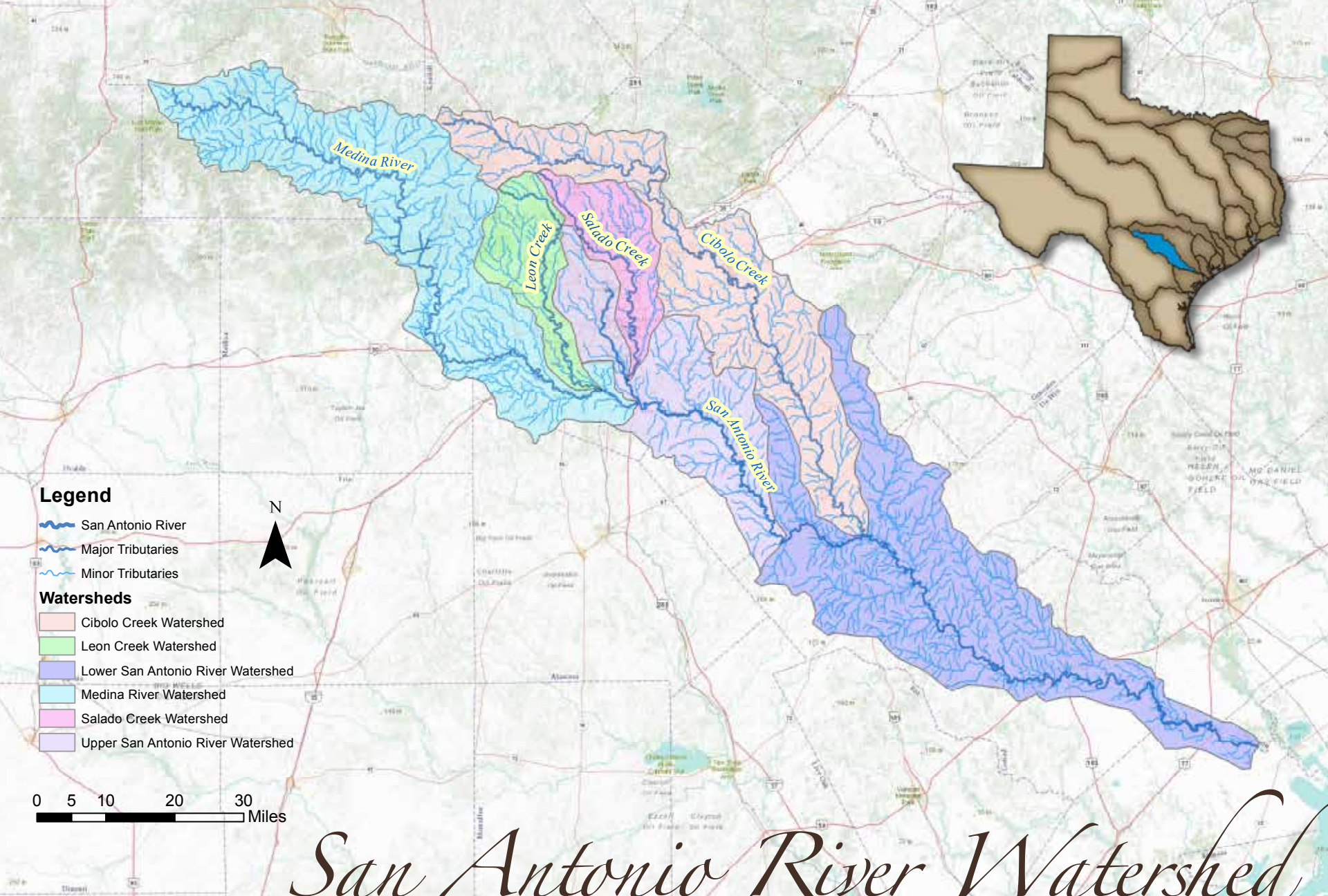
The lines on this Texas map aren't roadways. They aren't rivers either, but they tell us a great deal about how the land drains the state of Texas, and how **runoff** carrying pollutants and **contaminants** ends up in our rivers, creeks and streams.

Everyone on planet Earth lives in a watershed, also known as a **basin**. A watershed is an area of land that drains to a single point, usually a river, creek or stream. This map illustrates the major river basins of Texas. Generally, Texas river basins drain from northwest to southeast and into the Gulf of Mexico. The white lines are the boundaries that separate the watersheds, called **watershed divides**.

The San Antonio River Watershed is one of 23 major basins in Texas, and drains 4,180 square miles of land area into the San Antonio River, then into the Guadalupe River, and, 11 miles downstream, into San Antonio Bay. The 240-mile-long San Antonio River carries **surface water** from 2,500-foot elevations within the Texas Hill Country of Bandera and Kerr counties to less than 100-foot elevations in Refugio County.

Just as Texas is divided into basins, the San Antonio River Watershed contains numerous watersheds, each made up of smaller **subwatersheds** and even smaller **catchment** areas. In your own neighborhood, hills and valleys play a role in channeling water out of your subwatershed and into the next one downstream.





San Antonio River Watershed

Stormwater Pollution

Prior to human settlement in the San Antonio River Watershed, rainfall was absorbed into the soil, carried into aquifers, consumed by wildlife or evaporated as it flowed from higher elevations to lower elevations until it reached the San Antonio River. Along the way, native grasses, trees, root systems and other features of the natural environment would slow down the flow and filter out many of the **sediments**, bacteria and other natural contaminants.

Today, water travels differently through the San Antonio River Watershed. Urbanized areas of the basin now contain **impervious cover** such as rooftops, driveways, parking lots, roads and highways. **Storm sewers** and other drainage systems carry water directly to our streams. Rural areas are farmed, ranched or otherwise worked and fertile top soils may have washed or blown away.

Impervious cover in these areas carries more rainwater—and carries it faster—than natural, undisturbed groundcover. As more natural surfaces are paved and developed, less water **percolates** into the ground and more water instead goes over streets and into storm drains, picking up pollutants and carrying them to creeks. Water that goes into storm drains is not treated before it reaches **water bodies**. This is known as **stormwater runoff** or **non-point source pollution**. The faster the water moves across a surface, the more pollutants it can transport into our waterways. Runoff is the most significant contributor to water quality degradation in the San Antonio River Watershed.

It is also the most difficult to control, because runoff pollution is potentially caused by every one of the more than 2 million people who live in the basin.

The biggest non-point source pollution concern in the San Antonio River Watershed is elevated levels of ***E. coli*** bacteria. Numerous creeks do not meet **primary contact recreation** criteria set by the State. San Antonio River Authority (River Authority) scientists have seen a correlation between stormwater events and elevated bacteria levels in the river. River Authority’s River Recreation website (sariverauthority.org) illustrates this by showing weekly bacteria levels at selected sites within the San Antonio River Basin and identifying samples collected up to four days after a rainfall event.

The most effective way to prevent stormwater pollution is to keep excessive pollutants from accumulating on surfaces where they may be picked up by stormwater runoff. Pollutants left on impervious cover are particularly vulnerable to being transported by stormwater.

Another way to reduce stormwater pollution is to retain the ‘first flush’ of pollutants on-site—the way an undeveloped piece of land would—instead of letting it drain to a river or creek. This concept is known as “low impact development” (LID).

The San Antonio River Authority believes reducing stormwater pollution is an essential element of achieving a sustainable environment in the San Antonio River Watershed. To learn more about LID and the concept of watershed sustainability, visit the River Authority’s website at sariverauthority.org.

Low Impact Development

What is Low Impact Development (LID)?

Low Impact Development, or LID, is an integrated site design approach for addressing hydrologic and environmental impacts often associated with conventional land development. LID concepts and designs seek to mimic the pre-development **hydrology** of a site. In other words, LID helps prevent additional stormwater runoff from leaving a developed site.

Undeveloped land in the San Antonio River Watershed generally allows stormwater to infiltrate the soil because of natural features such as vegetation and soil type. When stormwater infiltrates instead of running off, there is less water to carry any pollutants or debris that may be lying on the surface of the ground.

When a development adds impervious cover such as concrete, asphalt or rooftops to a site, more stormwater runs off of the property. More stormwater runoff means more pollutants and debris can be carried off the site and into creeks and rivers. LID concepts help to reduce impervious cover and stormwater runoff, making a site act more like it did when it was undeveloped.

Porous surfaces such as permeable pavement allow rainfall to be absorbed into the ground faster, thus reducing the amount of water and surface pollutants that wash into our rivers and creeks.

Why is LID important?

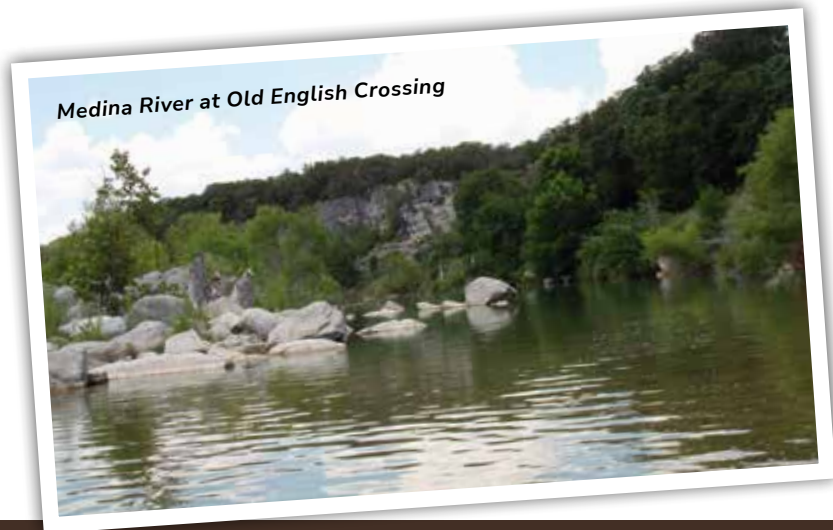
Non-point source pollution, the kind of pollution found in stormwater runoff, is the biggest threat to surface water quality in the San Antonio River Watershed. The goal of LID site design is to reduce stormwater runoff and to treat pollutant loads where they are generated.



Keeping Your Creek Healthy

All creeks in the San Antonio River Watershed have been altered by human development in some way. However, some creeks within our community are still healthy and support a diverse wildlife population. All creeks—whether or not they have been altered—need to be protected and treasured. With help from our community, even the most impaired creeks can be restored to a healthy state.

Creeks are characterized as being *intermittent* or *perennial*. Intermittent creeks, which are sometimes dry, are just as important as perennial creeks because they can recharge ground water and pass on stormwater to perennial creeks. Following are some typical signs of healthy creeks and impaired creeks in the San Antonio River Watershed. These signs can help you assess the health of your creeks.



Typical signs of a healthy creek

- Clear, cool water with no signs of contaminants and no **excess algae**
- **Stream flow** cycles that vary
- Stable banks with vegetation and minimal erosion
- **Riffles, runs, glides** and **pools**
- Abundant rock and gravel substrate (critical for fish spawning and feeding)
- Canopy of **native riparian trees**, which helps stabilize banks, provides habitat for birds and mammals, provides a food source and keeps water temperature cool for aquatic ecosystems
- Abundant native riparian vegetation, which provides roots that stabilize banks and shelter for wildlife and aquatic organisms
- Presence of a diverse **aquatic plant community**
- Fallen logs, branches, twigs, leaves and other natural debris which provide cover and hiding places for fish and other invertebrates; this natural debris helps support the aquatic food chain
- High animal and plant diversity along streams
- Thriving aquatic animal populations, including fish, amphibians and insects



Everyone living within the San Antonio River Watershed has a direct or indirect impact on creeks. Your actions can help reduce and prevent pollution, and you can encourage your neighbors to do the same.

Typical signs of an impaired creek

- Poor water quality, which includes excess algae, *suspended sediments*, contamination from sewage scum or animal waste
- Elevated water temperature
- Stagnant water
- Unpleasant odors
- Foam or floating sheens (oils) on water surface
- Reduced water flow below what is normal for the creek
- Excessive erosion along banks, deeply incised stream bed or high rates of sedimentation obstructing stream flow
- ***Channelization***
- Dumped trash, litter, yard clippings or other unnatural debris
- Desolate creek banks with a lack of vegetation and tree canopy
- Large percentage of non-native species that compete with native species within the habitat
- Limited diversity in animal and plant species
- Decreased or nonexistent population of fish, amphibians and insects
- A stressed fish community (fish swimming at water surface)

Dos & Don'ts for Urban & Rural Landowners/Residents

Some of our everyday activities can seem harmless to the environment. However, our behaviors actually have a significant impact on our creeks and ecosystems. Developing good habits can help prevent pollution and keep our creeks and environment healthy.

<p>Grass Clippings/Leaves</p>	<p>Don't... Dump or blow grass clippings and leaves into creeks, storm drains or streets, and don't put them in the garbage.</p> <p>Do... Add them to a compost pile, leave them on your yard so they can fertilize your lawn or use a curbside yard waste collection service if it is available.</p>	<p>Why? Grass clippings and leaves provide nutrients to your lawn. Clippings that are carried or dumped into creeks can lead to less <i>dissolved oxygen</i>.</p>
<p>Washing Your Car</p>	<p>Don't... Wash your vehicle in your driveway.</p> <p>Do... Take your vehicle to a commercial carwash where special drains are installed to dispose of runoff.</p>	<p>Why? The runoff from your driveway carries pollutants into storm drains and creeks.</p>
<p>Trash/Litter</p>	<p>Don't... Put any trash in creeks or outside a recycling or garbage bin where wind or rain can carry it to storm drains or creek channels.</p> <p>Do... Place items that can be recycled into a recycling bin, and then make sure all other items go into a garbage bin with a lid.</p>	<p>Why? Trash that is not disposed of properly can end up in creeks, obstructing flow and harming wildlife.</p>
<p>Lawn Care</p>	<p>Don't... Fertilize or apply <i>herbicides/pesticides</i> to your lawn right before a rain event.</p> <p>Do... Try to avoid applying lawn treatments on days when a rain event has been predicted.</p>	<p>Why? Fertilizer or chemicals applied just before a rain event will be washed away, bringing unnecessary nutrients and potentially toxic chemicals to aquatic life in creeks.</p>

Dos & Don'ts for Urban & Rural Landowners/Residents

<p>Automotive/Household Products (Motor oil, antifreeze, paint, etc.)</p>	<p>Don't... Hose down or dump any solvent or product into streets or creeks.</p> <p>Do... Dispose of these wastes by placing them in clean, leak-proof containers and taking them to your local hazardous waste collection site. Use water-based paints whenever possible. Wash water-based paint from brushes in the sink. For oil- or latex-based paint, wash paintbrushes in a container with thinner, then take the thinner to a hazardous waste facility.</p>	<p>Why? If not disposed of properly, automotive and household waste can contaminate creeks and groundwater.</p>
<p>Recyclable Household Products (Batteries, Electronics, Metal hangers, etc.)</p>	<p>Don't... Let recyclable household products end up in creeks or in landfills.</p> <p>Do... Check to see if the product can be recycled, then take it to a recycling center. Some companies will take recyclables by mail.</p>	<p>Why? Many household products contain hazardous materials that can be toxic to aquatic life if they end up in creeks.</p>
<p>Grease & Used Cooking Oil</p>	<p>Don't... Pour grease or used cooking oil down your drain or into creeks.</p> <p>Do... Find the nearest hazardous waste recycling facility where you can take used grease. If you cannot recycle used grease, put it in a sealed, disposable container and discard in the garbage.</p>	<p>Why? Grease or oil can build up in <i>sanitary sewers</i>, causing back-ups and overflow, which can drain into creeks.</p>
<p>Animal Waste</p>	<p>Don't... Leave animal or pet waste in your yard or on the ground where you walk your pet.</p> <p>Do... Make sure you clean up after your pet. Carry waste bags on walks. Ideally, biodegradable bags are the best choice.</p>	<p>Why? Animal/pet feces that are not picked up can end up in storm drains and creeks. Feces can carry bacteria that cause disease.</p>

Dos & Don'ts for Urban & Rural Landowners/Residents

<p>Rain Gutters</p>	<p>Don't... Direct water from your rain gutters or other pipes directly into storm drains or creeks.</p> <p>Do... Divert water to a grassy area or <i>rain garden</i>. You might also consider capturing rain water for use on your lawn.</p>	<p>Why? Diverting rain water allows grass to filter the water before it leaves your property. You can use captured rain water for watering your lawn.</p>
<p>Pools & Spas</p>	<p>Don't... Drain your pool or spa into a creek or storm drain.</p> <p>Do... Make sure pool water ends up in a sewer access point (this is usually a 3-4 inch plastic pipe on your property with a screw cap on it which leads directly into the sewer), or drain water onto an open grassy area to allow the chlorine to dissipate. Contact your local pool service company for assistance.</p>	<p>Why? Chlorine and other chemicals can harm creeks and wildlife, so make sure they are kept away from creeks or storm drains.</p>
<p>Constructing Pathways</p>	<p>Don't... Create impervious cover that prevents water from entering the ground.</p> <p>Do... Use pervious cover, such as pervious concrete, bricks or rocks for roads, sidewalks or driveways. Use <i>berms</i> or <i>silt fences</i> to prevent erosion when you disturb vegetation.</p>	<p>Why? Reducing impervious cover allows water to soak into the soil, reducing stormwater runoff, soil erosion and the amount of pollution in creeks.</p>
<p>*Livestock</p>	<p>Don't... Allow livestock access to creek bank areas that have been severely affected by uncontrolled grazing.</p> <p>Do... Manage livestock access to creek banks by fencing out heavily trampled areas. Piping water from the creek to adjacent areas for livestock use can be an effective measure for protecting riparian habitat.</p>	<p>Why? Fencing off stream banks allows for re-growth of vegetation and can help stop pollutants in manure from entering the stream.</p>

Dos & Don'ts for Urban & Rural Landowners/Residents

<p>*On-Farm Disposal of Dead Animals</p>	<p>Don't... Dispose of dead farm animals in a creek or in the 100-year <i>floodplain</i>.</p> <p>Do... Bury the animal at least 300 feet from the nearest drinking water well, creek, pond, lake or river, and at least 200 feet from adjacent property lines.</p>	<p>Why? Disposal of dead animals should always be done in a manner that protects public health and safety, does not create a nuisance, prevents the spread of disease and prevents adverse effects on water quality.</p>
<p>*Septic Systems</p>	<p>Don't... Install a septic system near a drinking water line, creek or in the floodplain.</p> <p>Do... Have your septic system installed outside of the floodplain and away from a creek. Have your septic system installed by a licensed installer. Report sewer overflows or leaks to your local authorities.</p>	<p>Why? Most septic systems use surrounding soils to remove phosphorus; certain soil conditions, combined with close proximity to surface water, can result in contamination of creeks.</p>
<p>*Stream & Floodplain Alterations</p>	<p>Don't... Alter the floodplain or the channel of a creek bed without appropriate state and local permits.</p> <p>Do... Acquire all appropriate permits and consider impacts to water quality and aquatic habitat of a creek.</p>	<p>Why? Obtaining the proper permits ensures that the property owner has legal permission from regulatory agencies to alter creek beds or floodplains, and that floodplain modifications will not endanger lives or property.</p>

*Typically applies to Rural Landowners/Residents

Hazardous waste, if not disposed of properly, can harm a creek and pose serious health threats to our communities and the environment. Some hazardous wastes can be recycled, but others need to be taken to a special facility for proper disposal. Applying this knowledge to our everyday practices can help prevent pollution and keep our creeks clean.

Livestock & Pet Waste

Livestock manure, if used wisely, can be a valuable fertilizer. However, if it enters a creek, it can cause many problems for water quality, aquatic life and other wildlife that depend on the creek. Nutrients from animal waste can cause algae blooms, which decrease dissolved oxygen in the water. Animal waste also produces ammonia and methane—gases poisonous to aquatic life—and carries bacteria, which can contaminate the creek. Livestock can also trample creek banks, destroying the vegetation that helps stabilize them, so avoid allowing livestock to create trails along the banks.

The best practice for managing livestock is to keep paddocks, stalls and feedlots away from creeks, ditches and storm drains. A wide riparian buffer between livestock and the creek will keep waste products from entering the stream.

Though most pet owners wouldn't think so, even small amounts of waste from smaller pets such as dogs can affect water quality in creeks. The best thing to do to prevent this is to pick up your pet's waste and dispose of it properly.

Illegal Dumping & Trash

Unfortunately, some people see creeks as dumps for used appliances, furniture, shopping carts, mattresses and other trash. Trash will negatively affect water quality, aquatic habitat and wildlife that depend on the creek. Even if a creek is dry most of the time, trash should never be dumped in it because flood waters after rain events will carry the trash downstream, polluting a wider area and increasing the risk of flooding. Dispose of trash properly to prevent contamination of creeks, aquifers and ground water. Recycle any materials that you can, then make sure everything else goes into a proper garbage container. *Refer to Page 26 for recycling tips and suggestions.*

If you see illegally dumped trash, or witness illegal dumping, please report it to your local authorities. Illegal dumpers can face substantial fines and are responsible for clean-up. For the San Antonio area, dial 3-1-1 to report an incident. *For other cities and counties, contact information is listed in the Resources section. You can also contact the Texas Commission on Environmental Quality (TCEQ): 1-800-832-8224 (24 hrs.) or 1-888-777-3186.*

Hazardous Waste Disposal

Household & Automotive Waste

Some consumer products contain chemicals that can present safety concerns if improperly used or disposed of; these materials are often called hazardous household wastes (HHWs). Additionally, these household products need to be stored properly (out of floodplains, away from creek beds and banks).

If thrown in the trash, HHWs could potentially harm solid waste collectors. Most of these materials are recyclable. Therefore, disposal in the regular garbage is not appropriate. The City of San Antonio maintains a permanent HHW Drop-Off Center (DOC). This center provides an environmentally safe means for citizens to dispose of items such as paint, pesticides, oil, anti-freeze, batteries and household cleaners. Please dispose of your HHWs properly by bringing them to the HHW DOC.

Unwanted and unused pharmaceuticals can also make their way into rivers and creeks and could potentially affect aquatic species and habitats. It is advisable to dispose of them appropriately. Please see the References section on page 30 to find HHW and pharmaceutical drop-off events throughout the watershed.

Automotive care, whether at an auto body shop or at home, generates several kinds of potentially hazardous waste, including solvents and coatings; contaminated rags, wipes and absorbents; empty containers; used oil and antifreeze; sanding or grinding dusts; and contaminated wash water.

You can also take containers of used motor oil to any auto parts store to be recycled at no charge. Keep up with your vehicle

maintenance to prevent fluid leaks. Use a drip pan to catch any fluids when working on your vehicle. Be sure to report spills or leaks to your local government.

Proper disposal of these materials is essential for protecting water bodies and public health. *If you are outside the San Antonio area, check out the Resources section to find out where to take hazardous materials. You can also call 1-800-CLEAN-UP to find the nearest hazardous waste collection facility in your area.*



Septic Systems & Wastewater Treatment Plants

Wastewater treatment is very important in keeping our state's most important resource safe and suitable for our use. Clean water is needed to provide for human consumption and recreation, maintain aquatic wildlife habitats, supply bays with fresh water and recharge groundwater.

Septic Systems

Homes and businesses in several rural communities in the San Antonio River Watershed use septic systems to dispose of wastewater. When septic systems are properly designed, constructed, installed and maintained, they effectively reduce or eliminate most human health or environmental threats posed by pollutants in household wastewater. Septic systems need regular maintenance to ensure they do not fail. Inadequate treatment of sewage by septic systems can cause groundwater contamination.

Septic systems should be inspected at least every 3 years by a TCEQ-approved septic system professional. Tanks should also be pumped at least every 3 to 5 years. Inspectors should measure the *scum* and *sludge* layers in the tank. Generally, if the scum layer is within 6 inches of the tank bottom or the sludge layer is within 12 inches of the tank outlet, the tank needs to be pumped. The *drainfield* tied to your septic system also requires care. Avoid planting trees and shrubs directly over or near your septic system. Roots from trees and shrubs can clog or damage your drainfield. Never drive or park vehicles on any part of your system, as this will compact the soil and damage your system.

Keep gray water drains and rainwater drainage systems away from your drainfield, as additional drainage can cause flooding of the drainfield and plumbing fixture back-ups. If your washing machine is tied into your septic system, washing load after load can flood your drainfield. Allow time between loads for your septic system to recover.

In order to maintain an effective system, monitor the products you put down your drains. Never flush kitchen, bathroom and personal hygiene items that can clog the system. You should also avoid flushing household chemicals and cleaners (unless labeled "septic safe"), gasoline, oil, pesticides, antifreeze and paint because these chemicals destroy the beneficial bacteria that live in your septic system.

Fats, oils and grease should always be recycled or thrown in the trash because they can cause the scum layer to grow too quickly in your septic system. Limit the use of your garbage disposal to lessen the amount of grease and solids entering the septic tank. If you must use a garbage disposal, you should have grease traps installed, since grease and oils will cause your septic system to fail. Be on the lookout for household cleaners, detergents, toilet paper and other products that are now labeled "septic safe."

Septic Systems & Wastewater Treatment Plants

Septic systems should never be installed in or near the floodplain. TCEQ will not approve plans for installing a septic system in the floodplain unless plans demonstrate that the system will not be damaged or release contaminants during flooding.

TCEQ can provide contact information for licensed companies and individuals who can install and inspect septic systems in each county. If you're interested in inspecting your own septic system, contact TCEQ for information on courses and licenses.

Wastewater Treatment Plants

There are many benefits to treating wastewater at a central plant. It helps to prevent water pollution, protects human and animal health and helps prevent dissolved oxygen depletion in water. Treated effluent meeting TCEQ standards can also be discharged into nearby streams, creeks and rivers to add to the **instream flows**, and, eventually, to the **freshwater inflows** entering our bays and estuaries. Wastewater treatment plants are more efficient than septic systems in treating large volumes of wastewater. We as a community can help the wastewater treatment plant operate at a high standard by just taking a few simple steps like taking oil and grease to a recycling center or throwing it away in the garbage instead of pouring it down the sink, and never flushing any pharmaceutical drugs or commercial household products down the sink or toilet.



Salatrillo Wastewater Treatment Plant



Preventing Erosion

The next time you are home during a rain shower, head outdoors with your boots and umbrella and watch where the rainwater goes. Does water infiltrate, or soak into the ground quickly, or does it collect in puddles and flow off lawns and driveways? Do you see a stormwater superhighway? Soil type affects how water infiltrates the ground. As you might expect, water quickly infiltrates sandy soil, but has a hard time seeping into fine-grained clay soils.

Homeowners can use landscaping and site management to control runoff and protect the creeks in their subwatersheds. Land-disturbing activities, uncovered soil surfaces and the absence of water-retaining structures may allow runoff to deposit soil in creeks, streams, lakes, marshes, estuaries and, ultimately, the ocean. Excess soil and the contaminants it carries can reduce water quality, so it is important that you try to keep your soil on your property.

Large-scale loss from erosion results in at least two major environmental problems:

- Cropland becomes less productive because the soil that remains after large-scale erosion loses its fertility and is unable to supply plants with necessary nutrients
- The soil's ability to retain water is also greatly diminished, leading to further erosion

These changes, in turn, result in higher production costs, including costs for additional fertilizer. The eroded soil becomes sedimentation in waterways which threatens aquatic life and hinders water flow. Eroded soil also carries polluting agricultural chemicals into rivers, streams, lakes and reservoirs.

Preventing Erosion & Protecting Flow

Protecting Flow

Owners of property which contains creeks, open channels or drainage ditches are faced with many often unexpected challenges and responsibilities. Some of these challenges are increased maintenance, bank erosion and pollution prevention. These property owners face at least two major tasks:

- Maintaining the **stream buffer** of deep-rooted, native vegetation along the creek
- Removing excessive **vegetative litter** or debris before it affects downstream communities

Taking these actions lessens the adverse impact of polluted runoff on downstream neighbors.

Actions **NEGATIVELY** impacting stream flow

- Dumping of man-made debris, yard debris, concrete or rocks on creek banks and in creeks
- Disturbing land within the stream buffer
- Draining roof or lawn runoff directly into streams via piping
- Removing native vegetation within the stream buffer
- Storing materials in the stream buffer
- Building structures in the stream channel



Preventing Erosion & Protecting Flow

Tips for Preventing Erosion in Urban Areas

Plant trees and shrubs, especially along slopes. Trees can reduce runoff by 50%.

Keep to established pathways. Compacted soil on footpaths creates areas which promote excess runoff.

Minimize impervious surfaces. Choose materials which allow for water infiltration. Flagstone and wood are good alternatives to concrete and asphalt.

Use mulch material to cover bare soil. Mulch helps protect bare soil from erosion.

Use ground cover plants in areas where grass will not grow. Ground cover plants create a root system which protects soil from erosion.

Plant vegetation on steep slopes. Contact local nursery suppliers for plants that grow well on steep slopes and which have root systems that help retain soil.

Avoid damaging or removing vegetation along creeks. Less vegetation means less protection from erosion.

Install rain gardens or rain collection barrels. Rain gardens and rain collection barrels collect stormwater runoff, reducing the amount of stormwater in creeks.

Tips for Preventing Erosion in Rural Areas

Install gutters on roofs, with downspout outlets on grassed, level, non-erosive areas, rain gardens or rain barrels. Locate water outlets to avoid runoff to bare soil or steep slopes.

Keep animals away from slopes during wet weather. Keep slopes in thick ground cover. Plant slopes with grass, shrubs and small trees to stabilize soil. Native varieties are recommended.

Contour **tillage** - On slopes, align tillage and planting operations on the contour. This will slow runoff, increase infiltration and reduce erosion.

Plant dense, low-growing vegetation in ditches, **swales** or other waterways or install an inlet structure with pipeline to carry water safely around erosive areas. Thick groundcover will hold the soil, slow runoff and increase infiltration.

Include annual rye in the fall seed mix as a good winter “nurse” crop to start growing fast and protect soil.

Leave abundant plant debris on soil surface. This slows runoff, traps soil particles, increases infiltration and improves soil structure.

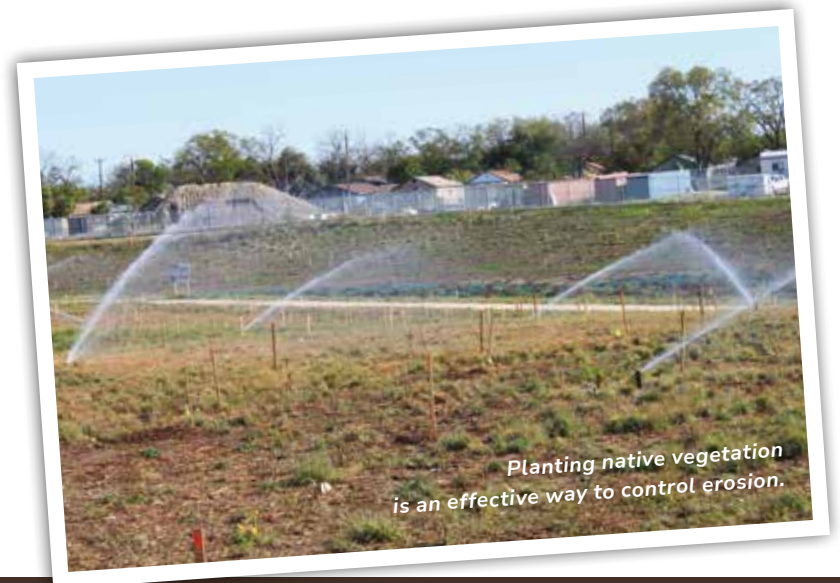
Preventing Erosion & Protecting Flow



San Antonio River Authority employees remove debris which negatively affects stream flow.

Actions POSITIVELY impacting stream flow

- Allowing stream buffer area to grow naturally
- Storing materials in secure locations away from the stream
- Installing a rain garden and rain barrels to collect rain water
- Using a mulching mower, letting clippings fall instead of bagging them
- Composting yard debris away from stream bank
- Mulching or planting over bare earth on your property
- Removing excessive vegetative litter and fallen trees that block stream flow
- Enjoying the stream using passive recreation measures



Planting native vegetation is an effective way to control erosion.

The San Antonio River Watershed Riparian Corridor

A **riparian corridor** is the area that borders streams, rivers and other water courses, including the natural floodplain. The San Antonio River Watershed riparian corridor exists along the San Antonio River, its four major tributaries (Salado Creek, Leon Creek, Medina River and Cibolo Creek) and numerous smaller tributaries including intermittent and perennial creeks.

These areas can often be seen as corridors of trees weaving through the landscape of urban, suburban and rural land, including housing developments and agricultural fields. Throughout its path, the riparian corridor of the San Antonio River Watershed ranges from wide to narrow, and from very healthy to highly degraded. Riparian areas are some of the most productive **ecosystems** for wildlife habitat, and these areas are critical to the preservation of our native San Antonio River Watershed flora and fauna.

Riparian Corridor Benefits

Everyone benefits from a healthy riparian corridor through a variety of ecosystem services provided by these areas. Healthy riparian corridors provide the following vital environmental services:

- **Water quality enhancements** - filtering pollutants, trapping sediments and slowing stormwater runoff
- **Erosion control** - stabilization of the soil by plant roots, especially on banks
- **Wildlife habitat** - terrestrial and aquatic species including intermittent visitors such as migratory songbirds and permanent dwellers such as raccoons
- **Input of organic matter** - leaf litter and woody debris (large and small) which supports aquatic organisms
- **Shading** - naturally regulates water temperatures and can help to minimize temperature extremes that could negatively affect aquatic organisms such as fish

Riparian corridors that are wider and more connected to other natural areas are better able to provide the important ecological functions and benefits described above. Humans can positively affect the health of riparian corridors by providing careful stewardship of these areas and implementing best management practices on their land such as maintaining a natural stream buffer along water courses. Alternately, humans can negatively affect the health of riparian corridors directly, through destruction and over development, and indirectly, through incompatible activities within or adjacent to these areas.



The Mission Reach of the San Antonio River will include 23,000 trees, recreating a riparian corridor in this highly urbanized watershed.



Riparian Corridor Plants

Plants in the riparian corridor are greatly influenced by water, whether it is moving slowly through the soil or moving quickly in a watercourse following a rain event. Plant species found in the riparian corridor must withstand great fluctuations in the amount of water available to them throughout the year, including periodic flooding or drought. A diversity of native plants is needed in the riparian corridor to provide quality habitat and long-term stability of the ecosystem. A mix of native trees, shrubs, vines, grasses, **sedges** and wildflowers is ideal for maximum wildlife habitat value in the riparian corridor. Individual plants provide different habitat functions throughout the year, such as nectar production in the spring for butterflies and seed production in the fall for birds.

Many riparian areas, particularly those in urban and suburban environments, are overtaken by **non-native** plant species, which can result in a decrease in **biodiversity** and a loss of native plant species and the wildlife they support. In fact, invasion by non-native species is considered the second greatest threat to biodiversity next to habitat destruction. It is important to remember that each non-native plant in a given area removes habitat functions that native plants could provide.

You can help provide important ecosystem functions and benefits by planting native plants on your property, whether it includes a riparian corridor or not. Even if you only contribute a few native plants to the ecosystem, you're still providing native habitat.

The more connected native plants are to each other and to adjacent native plant communities, the better these areas are at providing habitat for a greater amount and diversity of wildlife. The following table lists native plants commonly found in the San Antonio River riparian corridor, and the Appendix includes additional information regarding native plant alternatives for some problematic non-native plants commonly found in residential landscapes and the San Antonio River riparian corridor.



Native Plants commonly found in the San Antonio River Riparian Corridor

Trees	Black Willow* 	Cedar Elm* 	Hackberry* 	Pecan* 	Sycamore* 
Shrubs & Vines	Baccharis* 	Bluewood Condalia, Brazil* 	Buttonbush* 	Mustang Grape** 	Roughleaf Dogwood* 
Wildflowers (Forbs)	Arrowhead* 	Bush Sunflower* 	Frogfruit* 	Pickerelweed* 	Water Primrose** 
Grasses, Sedges & Rushes	Bushy Bluestem* 	Eastern Gamagrass* 	Inland Sea Oats* 	Switchgrass* 	Wild Rye* 

(See appendix for more information on common native plants of South Texas)

Riparian Corridor Wildlife

The riparian corridor of the San Antonio River Watershed provides shelter and food for a variety of wildlife. This corridor allows movement of wildlife between the upper and lower watersheds. Connectivity of the riparian corridors allows wildlife to establish territories and migrate from one habitat to another for shelter, feeding and breeding purposes.

The health of the creek and adjacent riparian habitat are directly related to one another; if one or the other is negatively impacted, both will be affected. A wide variety of healthy habitats increases biodiversity in an area, so protection of these riparian habitats is essential.

Common mammals that may be seen include the Common raccoon, Eastern Fox squirrels, Virginia opossums, White-tail deer, Nine-banded armadillos, Eastern Cottontail rabbits and feral hogs. Common reptiles include Diamondback water snakes, Texas rat snakes, Red-eared Sliders, Guadalupe Spiny Softshell turtles and Six-lined Racerunners.

The San Antonio River Watershed riparian corridor is extremely important for many birds because it is located within the Central Flyway, a primary bird migration route generally located in the U.S. Great Plains and Canada. Various bird species travel thousands of miles within this flyway while migrating between the Arctic Ocean and the southern region of South America. A healthy, diverse riparian corridor sustains these migratory birds as they pass through, providing water, food and protective cover.

Common migratory birds that may be seen include the Belted Kingfisher, Great Blue Heron, Night Heron, Cormorant, White-winged Dove and Turkey Vulture. Uncommon migratory birds that might be seen include the Bald Eagle, Snow Goose and Golden-cheeked Warbler.

The diversity of fish found in a water course can be an indicator of water quality and conditions. Fish can be very sensitive to changing conditions in a creek, including sediment and nutrient levels in the water and temperature changes. Some fish have a low tolerance of disturbance, while others have a high tolerance.

More than 80 different species of fish are found in the San Antonio River Watershed, which is a result of an overall healthy riparian corridor capable of supporting such a diverse fish community. This fish community includes Red Shiner, Largemouth Bass, Logperch, Longear Sunfish, Bluegill Sunfish, Channel Catfish, Western Mosquitofish and Spotted Gar.

When visiting a creek, be sure your recreational activities are creek-friendly. Supervise children and control pets so that wildlife is not disturbed or harmed. Pick up any trash and make sure it goes into proper containers. Respecting the creek and habitat is important for its preservation, and will make the visit for you and others more enjoyable.



Texas Logperch (*Percina carbonaria*)

Many materials can be recycled, including plastic bottles, aluminum cans, food cans and paper. Unfortunately, these recyclable materials often end up in our creeks, creating flow obstructions and harming wildlife. The benefit of recycling is two-fold: these materials can reduce the amount of raw materials used to create new products, and we can keep them out of our waterways.

In addition to recycling, reducing and reusing materials can also benefit our environment by decreasing the overall disposables you use, keeping these items out of the waste stream. Using reusable drinking containers or cutlery, buying products with minimal packaging, and bringing reusable bags to the grocery store are all ways you can reduce disposable materials that are used and discarded every day. Incorporating these simple practices can help reduce your footprint and help us create a more sustainable environment.

To request a recycling bin or for additional information on the city of San Antonio's program or where to recycle other materials, please visit sanantonio.gov/swmd, or dial 3-1-1. If you do not live within the city limits, contact your local authorities to see if they have a recycling program. If they do not, you can ask if they can start a program. (The more interest there is in recycling, the greater the chance of a recycling program being developed.)

Even if the area where you live does not have a recycling program, you can use several resources to find out how to recycle your materials. For example, *Earth911.com* is a great website for recycling tips, a list of recyclable materials and the nearest place you can take them. The TCEQ has a program called Take Care of Texas that gives tips on how to recycle and conserve at takecareoftexas.org.

TCEQ also has several publications that can provide more information about recycling. You can download these publications at tceq.texas.gov, or call (512) 239-0028 to order them.





CHOCOLATE SANDWICH COOKIES

Nutrition Facts
Serving Size 12 cookies
Amount Per Serving
Calories 100
Total Fat 10g
Sodium 100mg
Total Sugar 10g
Net Weight 100g

MINI

Cascades

Shredded Cheddar Cheese
100g (3.5oz)

Chicken

STARS

NET 32 FL OZ (946 ml)

ANTONIO RECICLA
Recycling symbol

Alternative Products

Many alternative products are available that are more environmentally friendly than your average consumer product. These products are usually made from recycled materials, require less energy to make, use sustainable materials and/or biodegrade more easily. Many products such as disposable utensils made of biodegradable materials or more energy-efficient light bulbs are available so both consumers and businesses can make less of an impact on our planet.



There are many inexpensive, easy-to-use natural alternatives which can be used in place of commercial household cleaners. Here is a list of common, environmentally safe products which can be used alone or in combination for a wealth of household applications.

- **Baking Soda** – cleans, deodorizes, softens water, scours.
- **Soap** – unscented soap in liquid form, flakes, powders or bars is biodegradable and will clean just about anything. Avoid using soap which contains petroleum distillates. Antibacterial products have chemicals that may not break down naturally and could reside for long periods of time in the environment. The Center for Disease Control and Prevention says that antibacterial soap is not necessary, but washing your hands with warm water and regular soap is one of the most effective ways of preventing infection.
- **Lemon** – one of the strongest food acids, effective against most household bacteria.
- **White Vinegar** – cuts grease, removes mildew, odors, some stains and wax build-up.

Organic Cleaner Recipes:

Dishwashing Soap

- Mix equal parts of borax and baking soda

Toilet Bowl Cleaner

- Mix $\frac{1}{4}$ cup baking soda and 1 cup vinegar, pour into basin and let it sit for a few minutes. Scrub with brush and rinse. A mixture of borax (two parts) and lemon juice (one part will also work).

Window Cleaner

- 8 parts water
- 1 part vinegar
- Mix ingredients, scrub and wipe with newspaper

Abrasive Cleaner

- Sprinkle baking soda or borax; add juice of $\frac{1}{2}$ lemon and scrub

Silver Polish

- Make a paste out of baking soda and water, or use a small amount of toothpaste

Drain Cleaner/Opener

- $\frac{1}{4}$ cup vinegar
- $\frac{1}{4}$ cup baking soda
- Mix ingredients and pour mixture down drain
- Let stand for a few minutes and rinse with boiling water

Toilet Lime Deposit Removal

- Pour full strength white vinegar in the bowl, let sit for several hours
- Scrub with sturdy brush

Composting

Composting is a very useful practice that not only reduces the amount of trash in landfills, but also helps with lawn care. Organic materials such as food scraps (except meat or dairy products) and yard clippings are combined with bulking agents (such as wood chips) to create a fertilizer. Adding this to your lawn can reduce or eliminate the need for chemical treatment. TCEQ has a very helpful publication about mulching and composting that is available online and by phone.

Visit tceq.texas.gov/p2/nav/composting.html to download a helpful document about mulching and composting.

Making a Difference

Rivers and creeks provide us with the most important resource for all living organisms – water. Everyone and everything living in the San Antonio River Watershed shares this resource, so it is essential that we each contribute to maintain its health. Taking care of our creeks helps improve and sustain habitats and wildlife populations, conserving the natural diversity and beauty of our basin. Make sure you are part of the solution for preserving and protecting our creeks for future generations.

Regional Resources

San Antonio River Authority (River Authority)

Learn more about the San Antonio River and its tributaries, as well as how the River Authority is helping to preserve, manage and protect the water resources in the San Antonio River Watershed. sariverauthority.org

City of San Antonio (COSA)

- sanantonio.gov
- Recycling, Hazardous Waste and Other Collection*
sanantonio.gov/swmdl/
- Illegal Dumping*
sanantonio.gov/Remember-the-River/Get-Involved/Report-Illegal-Dumping

*Dial 3-1-1 to report a problem or for more information

Basura Bash

Find out about this annual San Antonio River and tributary clean-up and how you can help. basurabash.org

San Antonio Water System saws.org/conservation

SAWS hosts and the River Authority sponsors pharmaceutical drop-off events in San Antonio. Visit saws.org/meddropsa for more information.

County/City Resources

Bexar County • (210) 335-2011
bexar.org

Wilson County • (830) 393-7303
co.wilson.tx.us

Karnes County • (830) 780-3732
co.karnes.tx.us

Goliad County • (361) 645-3337
co.goliad.tx.us

Floresville • (830) 393-3105 (Public Works)
cityoffloresville.org

La Vernia • (830) 779-4541
lavernia-tx.gov

Kenedy • (830) 583-3223
kenedytx.gov

Goliad • (361) 645-3563
goliadcc.org

State Agencies & Programs

Clean Rivers Program (CRP)

This is a state fee-funded program for water quality monitoring, assessment and public outreach. It is administered by TCEQ.

sariverauthority.org/services/river-health/clean-rivers-program

tceq.texas.gov/waterquality/clean-rivers

Texas AgriLife Extension

Offers practical, how-to education to help improve stewardship of the environment and the state's natural resources.

agriflifeextension.tamu.edu

Texas Commission on Environmental Quality (TCEQ)

Responsible for setting policies to manage air quality, water quality and waste. Enforces environmental laws and regulations.

tceq.texas.gov

Regional Offices:

Region 13, San Antonio - (210) 490-3096

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

Region 14, Corpus Christi - (361) 825-3100

Counties: Aransas, Bee, Calhoun, DeWitt, Goliad, Gonzales, Jackson, Jim Wells, Kleberg, Lavaca, Live Oak, Nueces, Refugio, San Patricio, Victoria

TCEQ - Household Hazardous Waste (HHW)

Learn about hazardous waste and how it should be recycled and/or disposed of properly, and find local collection opportunities.

tceq.texas.gov/p2/hhw/hhw

TCEQ - Spills

800-832-8224 (24 hrs) or 888-777-3186

tceq.texas.gov/response/spills

TCEQ - Recycling

Contact if you are unsure where to take items for recycling or proper disposal.

tceq.texas.gov/p2/recycle

Texas Parks and Wildlife (TPWD)

State agency that provides information about state parks, recreational activities and environmental concerns.

tpwd.texas.gov

TPWD - Kills and Spills Team • (512) 389-4848 or (281) 842-8100

(24 hrs) Contact to report a fish kill or spill.

tpwd.state.tx.us/landwater/water/enviroconcerns/kills_and_spills

Texas State Soil and Water Conservation Board (TSSWCB)

The state agency that administers the soil and water conservation law and coordinates conservation and non-point source pollution abatement programs for the state.

tsswcb.texas.gov

Federal Agencies

Environmental Protection Agency (EPA)

Environmental public record resource that has information about air, water, soil, environmental laws/regulations and other environmental issues. *epa.gov*

United States Department of Agriculture (USDA) - Backyard Conservation Publication

Single printed copies of this colorful 28-page booklet on Backyard Conservation and tip sheets are available free by calling 1-888-LANDCARE. *nrcs.usda.gov*

USDA - Plants Database

Provides standardized information about the vascular plants, mosses, liverworts, hornworts and lichens of the U.S. and its territories. *plants.usda.gov*

Other Resources

Keep Texas Beautiful

An organization that coordinates many litter prevention and beautification activities and events statewide. Visit their website to look for different events and programs. *ktb.org*

Lady Bird Johnson Wildflower Center Native Plant Information Network

Allows you to search for native plant information by plant traits or names, browse 23,000 native plant images and pose plant-related questions. *wildflower.org*

Recycling

Find out which materials are recyclable and where recycling centers are located near you. Also find out facts about proper disposal or recycling information about numerous consumer products. *earth911.com*

Take Care of Texas

A statewide campaign initiated by the TCEQ that is designed to get all Texans involved in helping to improve water and air quality, conserve water and energy, reduce waste and save individuals money in the process.

takecareoftexas.org

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Aquatic plant community - a group of plants that commonly grow together in a stream, river, lake or pond.

Basin - another term for *watershed*.

Berm - earthen structure used to control erosion and sedimentation by reducing the rate of surface runoff. Berms either reduce the velocity of water or direct water to areas that are not susceptible to erosion, thereby reducing the adverse effects of running water on exposed topsoil.

Biodiversity - Refers to the variety and variability among living organisms and the ecosystems in which they occur.

Catchment - any device or structure that captures water.

Channelization - the reconstruction of a natural waterway to make the water flow differently, usually resulting in the removal of natural bends in the stream.

Contaminant - biological, chemical, physical or radiological substance which, in sufficient concentrations, can adversely affect living organisms.

Dissolved oxygen (DO) - the oxygen freely available in water. DO is vital to fish and other aquatic life and for the prevention of odors. Traditionally, the level of DO has been accepted as the single most important indicator of a water body's ability to support desirable aquatic life.

Drainfield - part of an on-site septic system; it is the area of ground and system of subsurface pipes or chambers into which partially treated wastewater from the septic tank is discharged for final treatment and absorption by the soil.

E. coli (*Escherichia coli*) - rod-shaped bacteria that reside and multiply in the gut of warm-blooded animals. They are used to indicate recent fecal matter contamination in water.

Ecosystem - the community of living things and the nonliving environment.

Erosion - the process by which a material is worn away by flowing water, wave action or wind. Erosion is often intensified by human activities, such as land clearing and channelization.

Excessive algae - an over abundance of algae due to excessive nutrients, resulting in decreased DO in the stream, negative change in the habitat for aquatic organisms or odor.

Floodplain - a strip of relatively flat and normally dry land alongside a stream, river, or lake that is covered by water during a flood. A 100-year flood does not refer to a flood that occurs once every 100 years, but to a flood level with a 1 percent chance of being equaled or exceeded in any given year.

Freshwater inflows (to bays and estuaries) - the amount of river and other flows of freshwater needed to maintain acceptable conditions in the estuarine areas that support marine life and other species. Freshwater inflows help control salinity levels and supply critical nutrients and sediments.

Glide - A section of stream that has little or no turbulence.

Groundwater - water that is stored underground in pore spaces within rocks and other alluvial material, including aquifers. Recharge of groundwater occurs when rainfall seeps into the subsurface. Groundwater can discharge into creeks where the water table intersects the stream channel.

Habitat - the place where an organism lives, nests, finds food and/or takes cover.

Herbicide - a type of pesticide used to kill undesired plants.

Hydrology - the science that encompasses the occurrence, distribution, movement and properties of the waters of the earth and their relationship with the environment within each phase of the hydrologic cycle.

Impaired - detrimental effect on the biological integrity of a water body caused by an impact that prevents attainment of the designated use.

Impervious cover - a material on the land surface that water cannot infiltrate. It is usually material like concrete, asphalt, metal or brick.

Instream flows - An amount of water running in a river, usually measured by the volume moving down the channel in a specified amount of time (discharge). A variety of instream flows are required to maintain a healthy river and to support fish and wildlife in and along waterways.

Intermittent stream - has flowing water during certain times of the year. During dry periods, these streams may not have flowing water. These streams are often called dry streams, creeks or washes.

Native riparian tree - naturally occurring tree along stream banks which is adapted to the local conditions.

Non-native species (or exotic species) - a species that humans have introduced to a new ecosystem.

Non-point source pollution - pollution that cannot be traced back to a single source. Non-point source pollution usually enters the water as overland flow, rather than from a single pipe.

Percolate - when liquid water flows through the soil due to the force of gravity. Water loses gravitational energy when it percolates through the soil.

Perennial stream - has flowing water year-round during a typical year.

Pesticide - any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant or desiccant.

Pool - a deeper, quieter area in a stream where there is no obvious current.

Primary contact recreation - Activities that are presumed to involve a significant risk of ingestion of water (wading by children, swimming, water skiing, diving, tubing, surfing and the following whitewater activities: kayaking, canoeing and rafting).

Rain garden - a planted depression that is designed to collect and absorb rainwater runoff, reducing the amount of pollution and sediment reaching creeks and streams.

Run (in stream or river) - A reach of stream characterized by fast-flowing, low-turbulence water.

Runoff - see *Stormwater runoff*.

Riffle - a shallow part of a stream that is characterized by turbulent flow of water over stones 2-10 inches in diameter.

Riparian corridor - the zone of land adjacent to a stream, river or other water course.

Sanitary sewer - an underground system of pipes, manholes and tunnels that transports waste to a wastewater treatment plant for treatment and eventual re-use or release into creeks.

Sedge - grass-like plants often found growing on wet ground or in water, usually with triangular stems.

Sediment - material that is laid down or deposited by water, air or ice.

Scum - the light solids (oil, grease, hair, etc.) that accumulate on the surface of the water in a septic tank.

Silt fence - a temporary sediment control device used on construction sites to protect water quality in nearby streams, rivers, lakes and bays. A typical fence consists of a piece of synthetic filter fabric (also called a geotextile) stretched between a series of wooden or metal stakes.

Sludge - the heavier solids that separate from wastewater inside the septic tank and sink to the bottom. These solids accumulate and must be removed periodically by pumping.

Storm sewer - a system of storm drains, channels and pipes that rapidly transports stormwater runoff from streets, sidewalks and other impervious cover into streams with little or no treatment.

Stormwater runoff (or runoff) - water that flows over the surface of the land when rainfall is not able to infiltrate the soil, either because the soil is already saturated with water or because the land surface is impervious. Stormwater can pick up debris, chemicals, dirt and other pollutants and flow into a storm sewer system or directly to a lake, stream, river or wetland.

Stream buffer - zones of variable width which are located along both sides of a stream and are designed to provide a protective natural area along a stream corridor.

Stream flow (also referred to as flow) - the rate at which a volume of water passes a given point in a stream, usually expressed in cubic feet per second (cfs).

Subwatershed - a smaller basin within a larger drainage area where all surface water drains to a central point.

Surface water - all water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells or other collectors directly influenced by surface water.

Suspended sediment - fine material or soil particles suspended in water by the current.

Swale - an open drainage channel or depression explicitly designed to detain and promote the filtration of stormwater runoff.

Tillage - the mechanical manipulation of soil performed to nurture crops. Tillage accomplishes a number of tasks including seedbed preparation, weed control and crop chemical incorporation.

Vegetative litter - organic waste material which has been disposed of in areas not designated for solid waste disposal.

Water body - a stream, river or lake that receives the runoff water from a watershed.

Water quality - a measure of the suitability of water for a particular use based on selected physical, chemical and biological characteristics. To determine water quality, scientists first measure and analyze characteristics of the water such as temperature, dissolved mineral content and number of bacteria. Selected characteristics are then compared to numeric standards and guidelines to decide if the water is suitable for a particular use.

Watershed - all of the land area that drains water to a common point, usually a lake, river or stream.

Watershed divides - lines that separate watersheds.

Appendix: Plants

NON-NATIVE PROBLEMATIC PLANTS		WHY THIS PLANT IS PROBLEMATIC	NATIVE ALTERNATIVE PLANTS
Common Name	Scientific Name		
Chaste tree	<i>Vitex agnus-castus</i>	This small tree has beautiful flowers and is drought-tolerant but it invades riparian areas, re-seeds readily, spreads aggressively and is difficult to control. This species is often promoted in our region because many people are currently unaware of the problems that it creates in natural areas.	Wild olive (<i>Cordia boissieri</i>) – multi-trunked shrub or small tree; grows up to 25 ft tall; large, showy white flowers bloom throughout the year; can survive freezes except extreme situations where it will die back to the ground but often re-sprout
			Red buckeye (<i>Aesculus pavia</i>) – attractive shrub to small tree; grows to 20 ft tall; showy, spike-like clusters of deep red flowers; grows best in sandy soil; drops leaves at the end of summer
Chinaberry	<i>Melia azedarach</i>	This tree has attractive flowers but readily invades many different habitats, spreads aggressively and is difficult to control.	Western Soapberry (<i>Sapindus saponaria</i> var. <i>drummondii</i>) – attractive small to medium tree; grows up to 30 ft tall; fast-growing; tolerates poor soils; often suckers and forms groves
			Carolina buckthorn (<i>Rhamnus caroliniana</i>) - large shrub to small tree; grows up to 25 ft tall; shade and sun-tolerant; tolerates variety of site conditions
Chinese Tallow	<i>Triadica sebifera</i>	This fast-growing tree has attractive fall foliage but readily invades many different habitats, spreads aggressively and is difficult to control.	Sycamore (<i>Platanus occidentalis</i>) – drought-tolerant tree that grows quickly and can grow in difficult sites; grows up to 100 ft tall; bark can be an attractive feature
			Texas red oak (<i>Quercus buckleyi</i>) - small to medium tree; grows up to 20 ft tall; beautiful fall foliage; moderate to fast growth rate

Appendix: Plants

NON-NATIVE PROBLEMATIC PLANTS		WHY THIS PLANT IS PROBLEMATIC	NATIVE ALTERNATIVE PLANTS	
Common Name	Scientific Name			
Elephant ears	<i>Alocasia species, Colocasia species</i>	This widely available plant prefers the water's edge and is known to invade streams and other natural riparian areas and is very difficult to control.	Pickerelweed (<i>Pontederia cordata</i>) – aquatic perennial with blue hyacinth-like flowers that bloom through the summer	
			Arrowhead (<i>Sagittaria latifolia</i>) – aquatic-emergent perennial with arrowhead shaped leaves; flowers have showy white petals	
Giant cane, Georgia cane	<i>Arundo donax</i>	This very tall member of the grass family forms dense stands along waterways and is very difficult to control.	Yaupon holly (<i>Ilex vomitoria</i>) – typically a multi-trunked shrub or small tree, grows 12-25 ft tall; tolerates drought & poor drainage; can form a good hedge when densely planted	
Golden Bamboo	<i>Phyllostachys aurea</i>	This very tall member of the grass family is commonly used as a hedge, but it is extremely difficult to contain and spreads readily in all directions.	Yaupon holly (<i>Ilex vomitoria</i>) – typically a multi-trunked shrub or small tree, grows 12-25 ft tall; tolerates drought & poor drainage; can form a good hedge when densely planted	
Mexican petunia	<i>Ruellia brittoniana</i>	This well-known landscape plant is drought-tolerant but readily invades streambanks and other riparian areas. It is very difficult to control.	Pickerelweed (<i>Pontederia cordata</i>) – aquatic perennial with blue hyacinth-like flowers that bloom through the summer	
			Blue curls (<i>Phacelia congesta</i>) – leafy annual or biennial which grows 1-3 ft tall; numerous purple to lavender-blue, bell-shaped flowers, in coiled clusters which uncurl as the buds develop; usually found in large colonies	

Appendix: Plants

NON-NATIVE PROBLEMATIC PLANTS		WHY THIS PLANT IS PROBLEMATIC	NATIVE ALTERNATIVE PLANTS
Common Name	Scientific Name		
Nandina, Sacred bamboo	<i>Nandina domestica</i>	This common landscape plant has attractive fall foliage and berries but is known to invade woodlands and other natural areas and is difficult to control.	Barbados cherry, Wild crapemyrtle (<i>Malpighia glabra</i>) – this shrub (3-6 feet tall); attractive pink flowers April to October followed by large, bright red fruit; can form a good hedge when densely planted
Privet	<i>Ligustrum species</i>	Multiple species exist and are readily available in the nursery trade. It is known to aggressively invade woodlands and other natural areas and is very difficult to control.	Blackhaw (<i>Viburnum prunifolium</i>) – shrub or small tree 12-15 ft tall, sometimes growing to 30 ft; white flower clusters followed by yellow berries turning blue-black; attractive, dark-green foliage becomes reddish-purple in fall
			Texas mountain-laurel (<i>Sophora secundiflora</i>) – usually a multi-trunked shrub or small tree; grows up to 30 ft tall; dense, dark green evergreen foliage; fragrant and showy bluish-lavender flowers in drooping clusters



San Antonio River Upstream of Salado Creek Confluence



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