

The Santa Fe Blue Pages



Living Well with the Water We Have

Produced by The Santa Fe Watershed Association and The City of Santa Fe

By Laurel Savino

Acknowledgements

This publication was funded by the City of Santa Fe as part of the City's 20-year Municipal Watershed Management Project. The project is a collaboration between the City Water Division, the City Fire Department, the US Forest Service Santa Fe National Forest, the Santa Fe Watershed Association and The Nature Conservancy. The goal of the project is to maintain reduced fire hazard within the municipal watershed in order to protect the Santa Fe River and the Municipal Watershed and to ensure delivery of a safe and reliable source of water to City residents.

This publication is a centerpiece in the project's education and outreach efforts to raise awareness about the City's water supply system, the risks to this system posed by wildfire, and the importance of protecting the source of the Santa Fe River, our watershed.

A special thank you to:

Marion Phelps, Director, Aqua Therapy Center of Santa Fe
David Barsanti, GIS Analyst, City of Santa Fe Water Division
Claudia Borchert, Water Resources Coordinator, City of Santa Fe Water Division
Rick Carpenter, Water Resources and Conservation Manager, City of Santa Fe Water Division
Dale W. Lyons, Water Resources Coordinator, City of Santa Fe Water Division
Daniel Ransom, Water Conservation Manager, City of Santa Fe Water Division
Laurie Trevizo, Water Conservation Manager, City of Santa Fe Water Division
Rolf Schmidt-Peterson, Hydrologist, New Mexico State Engineer's Office
The City of Santa Fe Arts Commission's Community Gallery
The artists, including those featured in *Meander: Works Inspired by the Santa Fe River*
Ruthanne Greeley, for proofreading

The Santa Fe Blue Pages was adapted, with permission, from *The Orleans Blue Pages*, reflecting conditions specific to Santa Fe. *The Orleans Blue Pages* was born on the shores of Puget Sound as *The Puget Soundbook* © 2003, 1991, by author James A. Kolb and illustrator Diane Gusset Bressler. *The Puget Soundbook*, originally funded by the Puget Sound Water Quality Authority, is part of the award-winning FOR SEA family of curriculum guides for grades 1012, available FOR SEA Institute of Marine Science, Indianola, Washington 98342 (forsea.org).

The Puget Soundbook grew into the Island Blue Pages, with permission, by the "Booklet Committee," a dedicated group of volunteers from Vineyard environmental groups, the Martha's Vineyard Commission, and town employees under the leadership of the Martha's Vineyard Shellfish Group, who adapted it to the East Coast waters of Martha's Vineyard. The Wampanoag Tribe of Gayhead (Aquinnah) provided the major funding. For a complete version of *The Island Blue Pages*, visit the website www.islandbluepages.org or contact the Martha's Vineyard Shellfish Group at (508) 693-0391.

The Orleans Pond Coalition, with permission, adapted *The Puget Soundbook* and *The Island Blue Pages* to *The Orleans Blue Pages* reflecting conditions specific to Orleans but also generic to Cape Cod in hopes other organizations would continue to spread the word to protect our waters.

Cover: Dan Boldman, Thunderhead IV



Jim Boyer, New Mexico Cloud Scape



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Preface

The Santa Fe Blue Pages is a reference and resource filled with easy ways to protect our water resources and enjoy the Santa Fe River watershed. We hope you will keep it handy and will consult it for information and suggestions on living sustainably in our region.

It includes information about where Santa Fe's water comes from—including original maps of the entire watershed and close-ups on its three reaches—and how our water resources are managed by the City of Santa Fe. Readers will learn why public investment in sound management practices makes sense for our health, safety and economy.

It also features detailed recommendations for ways of using less water and protecting people, water resources, and lands downstream from us.

The Santa Fe Blue Pages differs from similar publications by including images from artists inspired by the beauty of community. Art is a significant part of our local economy and influences how we think and feel about our natural surroundings. We hope that by including these images, we help readers recognize the role they can play in preserving the beauty and vitality of our natural heritage.

To obtain more copies of *The Santa Fe Blue Pages*, visit santafewatershed.org or call (505)820-1696.



Matthew Chase-Daniel, Pinon

Introduction

What is a watershed? A watershed is an area of land draining into a river, groundwater system or other body of water. In our case, that body of water is the Santa Fe River. Most of the time, for most of its length, the Santa Fe River is dry. Our community's needs for water outpace our watershed's capacity to fill both our cups and the majority of the river channel. The Santa Fe River runs normally only above the municipal reservoirs and below the wastewater treatment plant.

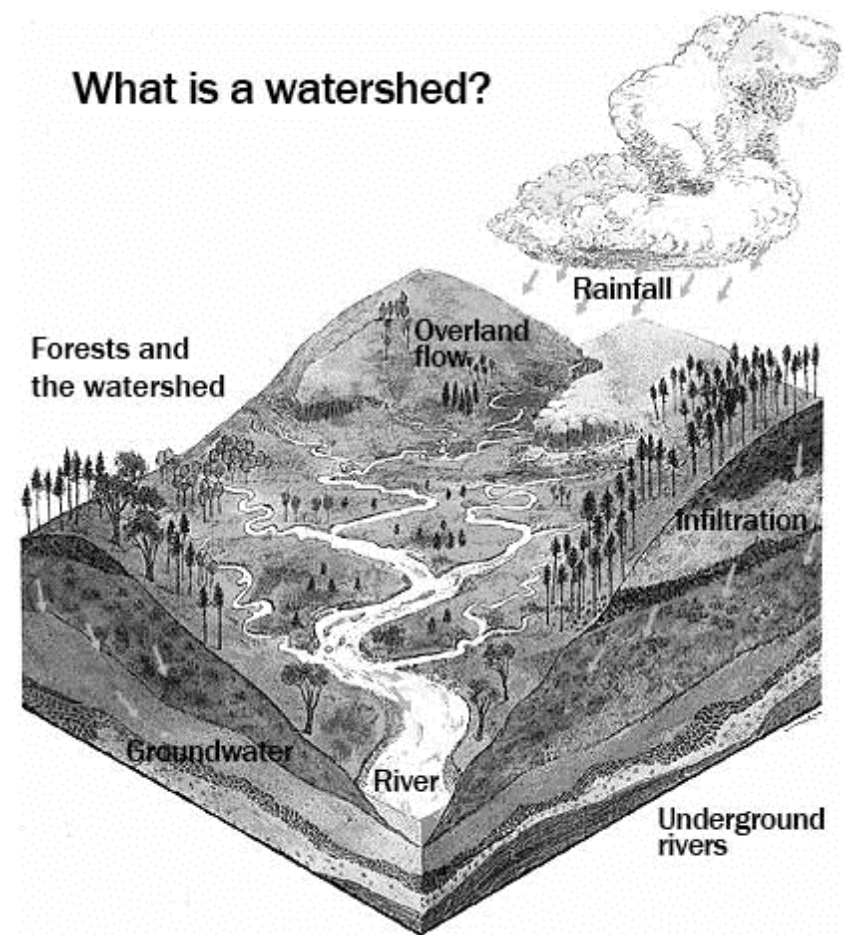
But the Santa Fe River is the focus of our watershed nonetheless. Throughout its reaches, rainwater and snowmelt drains from streets, channels and arroyos into the river. And as a tributary to the Rio Grande, the Santa Fe River is part of the larger Rio Grande watershed.

Beyond the formal definition, however, the Santa Fe watershed is a kind of neighborhood. Much of what we humans, plants and animals do depends on the resources found within the watershed boundaries and can impact the watershed's health and function. Our health, safety, quality of life and economy depend on the quality and quantity of our water. The Santa Fe watershed provides our community with some of our most basic needs; in an average year about 40% of our water for drinking, cooking, bathing, washing clothes and dishes, and irrigation comes from river water and city wells. The watershed also helps sustain our economy. Every business in Santa Fe depends on a reliable source of high-quality water.

Water plays an important role in shaping our natural landscape. Without it there would be no towering cottonwood trees, no swooping birds, no golden chamisa in the thin winter sunshine. Water is an important part of what makes up a high-quality life in New Mexico.

The water collected in the Santa Fe River watershed is why we're here. For nearly 12,000 years, people have lived along the Santa Fe River's banks. Ancestral Puebloans lived here, leaving spear points, pottery shards and tools as evidence of their lives along the river.¹ Sixteenth century Spaniard settlers chose the site of the villa that became Santa Fe because of its access to water.

We've inherited this precious resource and each of us has a role to play in keeping the watershed safe and healthy and conserving it for future generations. The extreme weather patterns to come—higher temperatures and less rain and snowfall, anticipated as part of global climate change—make our efforts to conserve our water supply more important than ever. Our use of water—for drinking and eating, for growing and cooking our food, for processing our waste, for manufacturing and commerce, and for recreation and art—tells us a lot about who we are. Our careful stewardship of our water supply shows respect for the people who came before us and our regard for those who come after.



Snow in Winter, Rain in Summer

Santa Fe receives an average of 14 inches of precipitation each year. About 60% of it falls as snow in winter, with the largest snowfalls in January and February. Moist air over the Pacific Ocean is pushed east until it encounters the Sangre de Cristo Mountains. When temperatures fall below freezing the moisture is forced upward, cools and condenses to form storm clouds which produce snow. Our snowfall can accumulate up to 15 feet deep among the tall trees of the higher elevations and typically lasts six months.²

From July through September, Santa Fe often receives hard and fast rainstorms, accounting for approximately 40% of our annual precipitation, sometimes accompanied by lightning, thunder and hail. Our summer storms are part of a vast feature of our climate known as the North American Monsoon. Like the monsoons of the Far East, our wet summers, when they occur, are the result of a shift in wind direction. As the deserts of the Americas heat up, the air above them rises and draws moisture from the Gulfs of Mexico and California across northern Mexico into Arizona and New Mexico. The moist air from the southern oceans continues to heat and rise as it flows over the deserts, and as it rises, it cools, causing condensation. As the air temperature reaches its peak in the afternoon, clouds condense into massive thunderheads full of moisture. The clouds grow until they become saturated and water begins to fall as rain, the way water falls from a soaked sponge. If the water droplets become super cooled as they fall from the higher hotter air into the cold air beneath they may fall as hail.

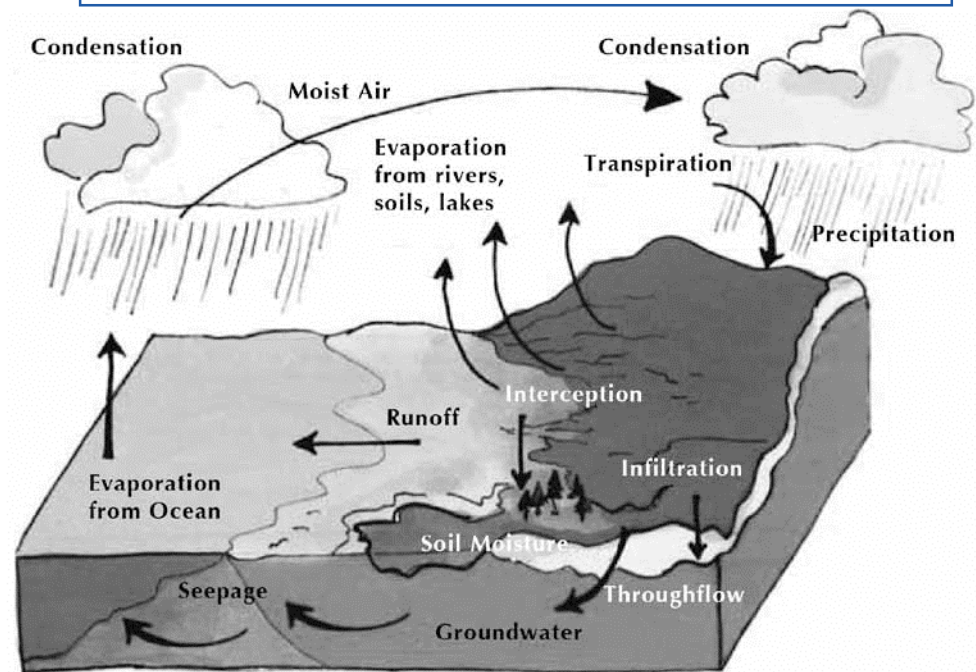
Subtle shifts in wind direction can instead suppress the monsoon cycle. If the winds change from east-southwest to north, dry air is pushed over Arizona and New Mexico, keeping the moist ocean air from heating and rising over the deserts to form rain clouds.⁴

El Niño y La Niña

The peoples of the Americas have long noticed periods of unusual precipitation or drought. Sixteenth century Incans planned for climatic changes by building on hilltops and storing food in the mountains away from flood-prone rivers.³

An El Niño event, Spanish for The Child for its occurrence around Christmas, results from unusually still winds over the Pacific Ocean near the Equator. The still air results in warmer temperatures in the central and eastern Pacific Ocean that can have a profound impact on weather around the world. In the Southwest, El Niño tends to produce stormier winters with more snowfall and rain.

La Niña years are marked by unusually cold eastern Pacific Ocean temperatures and typically result in dryer winters in the Southwest.



Where Does our Water Come From?

Since 2012, Santa Feans have five primary sources for water: city water from the Santa Fe River municipal watershed, city wells, the Buckman wells, the Buckman Direct Diversion and private wells. In 2012, Santa Feans were projected to draw about 10,000 acre feet (or 3,258,514,286 gallons) of water through the municipal sources.

Gallons consumed per capita have declined dramatically, from 168 gallons per day per person to 105, in the past 20 years as people have made efforts, through practice and more efficient technology, to conserve. Nevertheless, with demand at or near capacity and a drier climate in our future, conservation measures are more essential than ever.

From Lake Peak to the Rio Grande: The Santa Fe River Watershed

The Santa Fe watershed covers 285 square miles. It extends from Lake Peak (12,408 feet elevation) in the Sangre de Cristo Mountains to the confluence with the Rio Grande at Cochiti Pueblo.

A little less than 10% of this area (17,400 acres) northeast of Santa Fe is known as the Santa Fe Municipal Watershed. This area, mostly within the Santa Fe National Forest, is managed for the City of Santa Fe's water supply by the City and the US Forest Service. The Santa Fe Municipal Watershed was closed to the public in 1932 by order of the Secretary of Agriculture, so that it could be managed without risk of impact from livestock grazing, logging, and other human impacts.



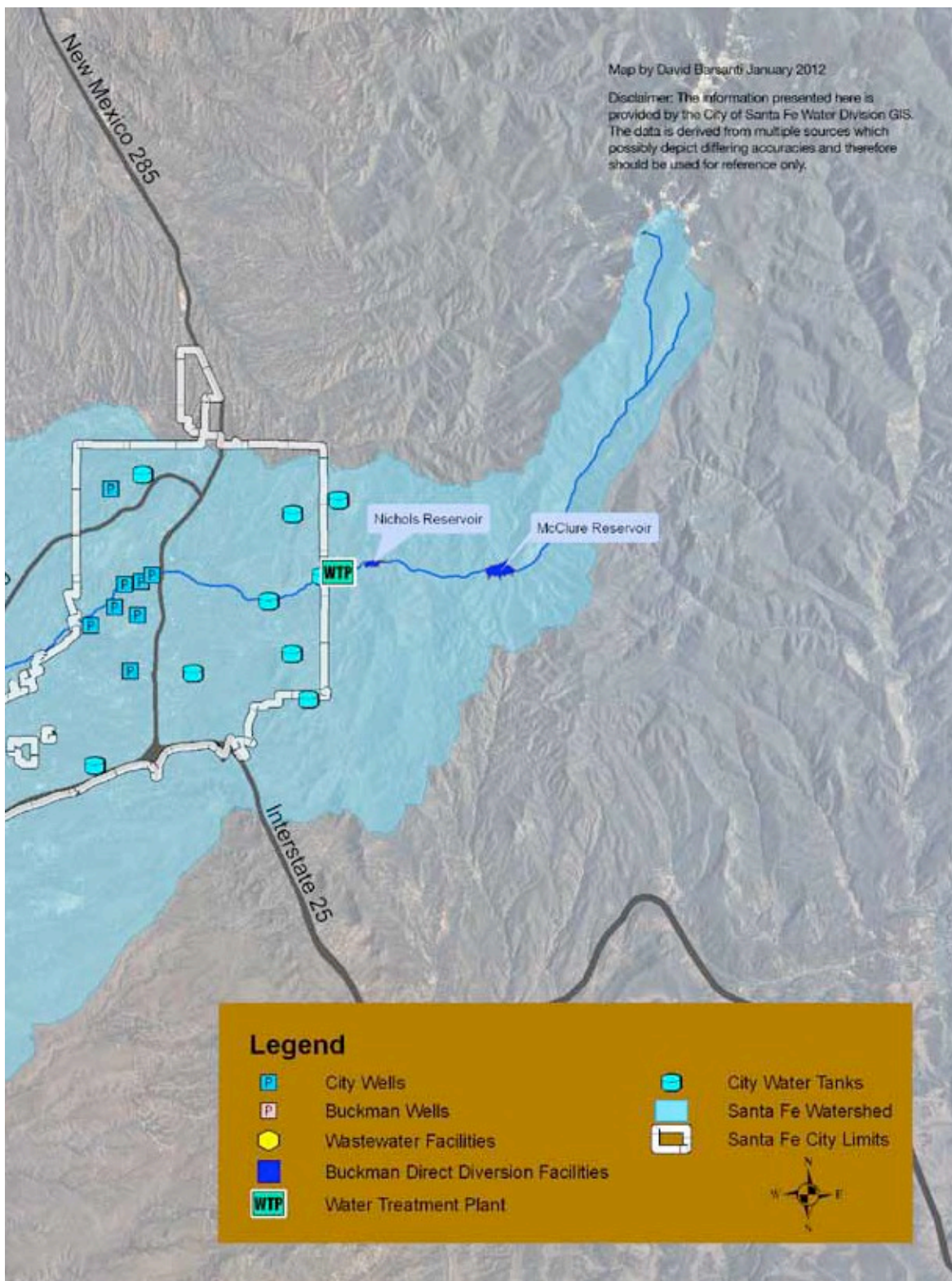
Ecosystem Services: The Source

Healthy forests within our watershed provide a host of ecosystem services, including water purification, groundwater and surface flow regulation, erosion control and streambank stabilization. The importance of these ecosystem services will only increase as water quality and quantity become critical issues around the world. Their financial value becomes particularly apparent when costs of protecting an ecosystem and the services it provides are compared to investments in improved water treatment and flood control infrastructure.

The Santa Fe River watershed and the water supply it provides made life here possible and remains a key part of our region's economy. Every home and business, regardless of the type of business, is dependent on access to a safe, reliable water supply.

Water is the most basic need for people and all living things around us; not only do we use water to meet our essential biological needs, but we use water daily in countless other ways as part of maintaining our properties and participating in the local economy.

- Water and the foliage it supports cools our surroundings—a benefit that will only become more critical as the global climate trends toward warmer temperatures and more dramatic changes to our local weather.
- Water irrigates our crops and supports pollinators like bees, butterflies and hummingbirds. As long as we have water, we can produce some of our food supply locally and enjoy our traditional foods.
- A healthy watershed ecosystem cycles nutrients, the process through which minerals and fertilizers that plants need to grow are broken down from dead plants, animals and animal manure. Without water, organisms like earthworms, insects and bacteria that process these nutrients can't function.
- Water is an essential part of Santa Fe's characteristic landscape. Not only do we enjoy and even need the beauty around us to be healthy, we depend upon it for our tourism-dependent economy.

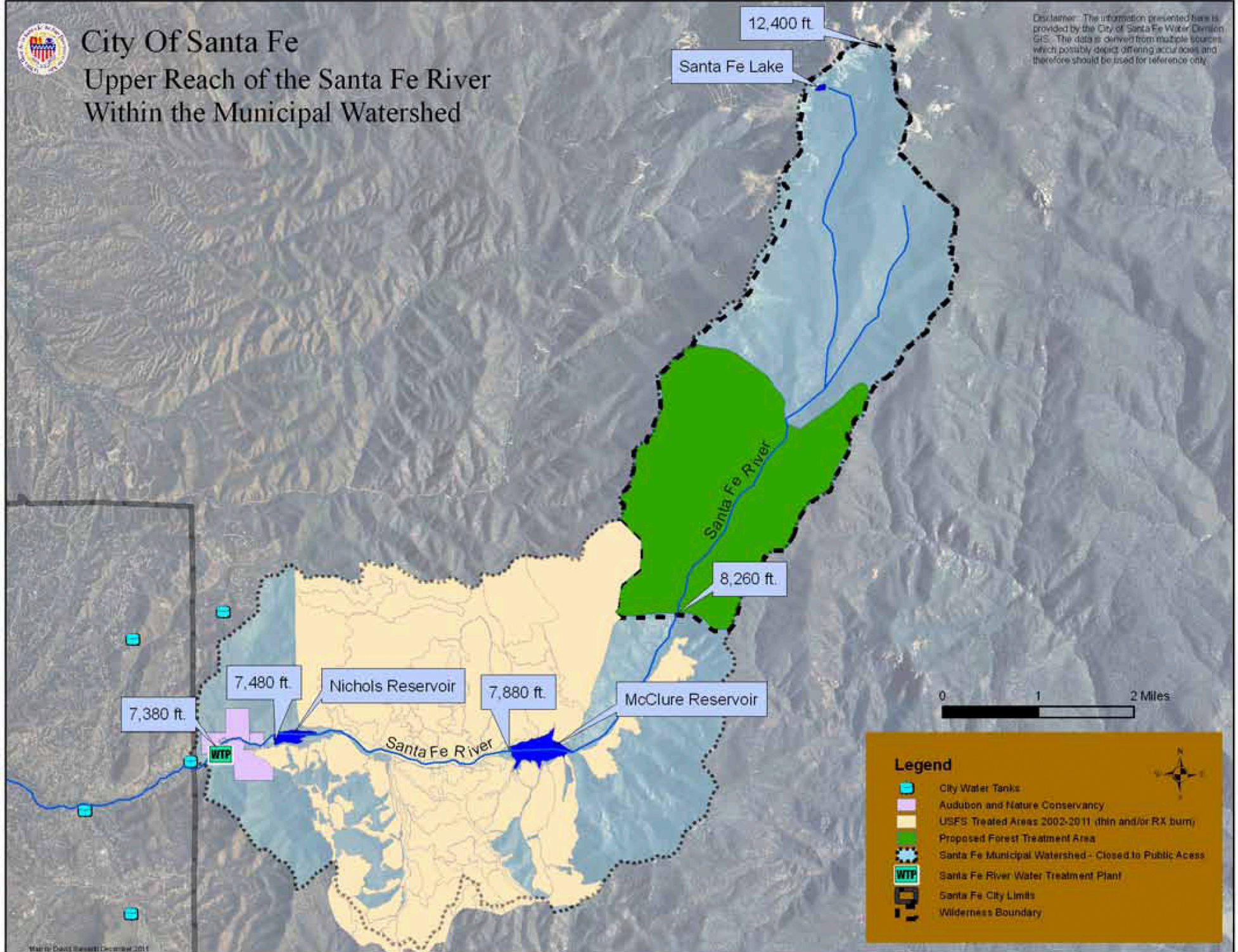




City Of Santa Fe

Upper Reach of the Santa Fe River Within the Municipal Watershed

Disclaimer: The information presented here is provided by the City of Santa Fe Water Division GIS. The data is derived from multiple sources which possibly depict differing accuracies and therefore should be used for reference only.



Neighbor Profile: Beaver

After many years of absence from the Santa Fe Municipal Watershed, beavers have returned to the upper reach of the Santa Fe River. With their powerful four-inch front teeth, they fell trees and build lodges in which they live. Beaver lodges serve as natural dams that slow swift flowing water, creating meandering streams, spreading the water laterally away from the river and giving the water more time to soak through soil to the aquifer below and cool the air above. As the shallow groundwater level rises with the construction of more beaver dams in the river's floodplain, some conifer species are drowned and replaced by plants more highly adapted to saturated soils, such as willow and cottonwood. Beaver dams above Santa Fe's reservoirs also naturally filter the water, preventing sediment from entering the reservoirs.

The Upper Reach (The Municipal Watershed)

The City of Santa Fe maintains our watershed's upper reach as the Santa Fe Municipal Watershed. From steep slopes, snow melt and rain drain downhill, forming the Santa Fe River in the upper watershed. The river flows through steep terrain: first through spruce, fir and aspen trees, then through a mix of Douglas fir and ponderosa pine. To provide drinking water for Santa Fe, the City owns and operates two reservoirs within the Municipal Watershed, McClure and Nichols, constructed in 1923 and 1943, respectively. Combined, these reservoirs can store up to 4,000 acre-feet of water (an acre-foot is one acre of water one foot deep) and provide between 25% to 50% of Santa Fe's annual water supply.⁵

The remains of Santa Fe's oldest dams, Two-Mile Dam and Old Stone Dam, now support a large wetland area for the Santa Fe Canyon Preserve at the top of Upper Canyon Road. The preserve, managed by The Nature Conservancy, is open to the public (but not dogs) year-round. Visitors to the preserve may see songbirds, wildflowers, deer, bear and beaver.



Kappy Wells, Beaver and Lodge



The Santa Fe Watershed Investment Program

Santa Fe's watershed investment program began following the disastrous Cerro Grande Fire in 2000, which was started as a U.S. Park Service "controlled" burn that got out of control. The fire resulted in 261 residences being destroyed, leaving 444 families homeless and costing a total of \$970 million, only 3% of which was for fire suppression. This catastrophic event prompted City of Santa Fe water managers and the U.S. Forest Service (USFS) to begin thinking about the vulnerability of the Santa Fe River watershed, which supplies about 40% of the City's water, to a similar event.

Funded by a congressional earmark, the initial forest treatment work in the municipal watershed began in 2002, following the USFS' completion of an Environmental Impact Statement. Now with over 5,500 acres of critical ponderosa pine forest successfully treated and an additional 3,000 acres of mixed conifer within wilderness portion of the 17,000 acre watershed identified for future treatment, a long-term plan was needed to maintain treated areas, address the acreage in the wilderness, and establish the financial framework to ensure sustainable funding for ongoing water source protection.

Using a \$50,000 grant from the USFS Collaborative Forest Restoration Program, the City along with its partners, the USFS Santa Fe National Forest,

The Nature Conservancy, and the Santa Fe Watershed Association, developed a comprehensive 20-year watershed management plan with four basic components: water management, vegetation management, education and outreach, and finance. The plan calls for different treatments in different parts of the watershed, whose forest types range from high-elevation spruce-fir, mid-elevation mixed-conifer and lower-elevation ponderosa pine. Because City water customers pay relatively high rates compared to other Western cities, the City has taken a careful approach to funding the work called for in the watershed plan.

Based on the plan and the City's well established partnerships with the USFS and non-profit organizations, the City was awarded \$1.3 million in state funds to implement the watershed management plan for the first three years (FY 2011-2013). After this period, project costs, including ongoing forest treatment work conducted by the USFS and cost-shared by the City through a collection agreement, will be covered by City water customers through existing water utility rates. A survey conducted as part of the project's extensive public education and outreach campaign, in cooperation with the Santa Fe Watershed Association and The Nature Conservancy, has shown strong ratepayer support for the project.

More information: www.santafenm.gov/index.aspx?NID=2442

The Municipal Watershed: Santa Fe's Original Water Supply

The City of Santa Fe's Water Division and Fire Department, in collaboration with the US Forest Service, manage the Santa Fe Municipal Watershed for protection from catastrophic fire and damage to the City's water supply infrastructure. Fire is chief among concerns about the safety and reliability of this major source of our water supply provided by the Santa Fe Municipal Watershed.

Years of fire suppression have left our forests dense and vulnerable to high intensity wildfires that, among other things, strip steep slopes of vegetation that hold soils in place. In such conditions, wildfires followed by heavy rainfall can result in runoff, soil erosion and ash flows. This material can fill the City's reservoirs, reducing water storage capacity and damaging the water supply infrastructure.

The City and its partners have made great strides in restoring the forest condition within and adjacent to the Santa Fe Municipal Watershed, reducing the risk of catastrophic fire and preventing huge inflows of mud and ash from filling the reservoirs and ruining the City's water treatment and distribution system. Thinning treatments, which began in 2002, reduce the tree load by first cutting smaller trees with diameters less than 16 inches, piling and burning the tree slash and broadcast burning the underbrush and pine needle duff layer, followed in later years by periodic maintenance burns. This work, done by US Forest Service and Santa Fe Fire Department crews, has successfully treated over 5,500 acres within the Santa Fe Municipal Watershed.

This forest restoration work has reduced the tree density to levels consistent with historical densities found in the watershed, as indicated by extensive tree-ring studies conducted in the Municipal Watershed. By reducing density from 1,000+ trees per acre to 20-50 trees per acre in the Ponderosa zone, the forest is left with much more open space, which is beneficial in many ways:

- Competition for sunlight, soil nutrients and water is reduced among the larger remaining trees, allowing them to grow even bigger with thicker bark that is more resistant to fire;
- More sunlight on the forest floor allows other plant species to flourish, which in turn supports more diverse wildlife; and
- Less dense forest floors reduce the chance of a low-intensity ground fire growing into a high-intensity wildfire in the crown of full grown trees.



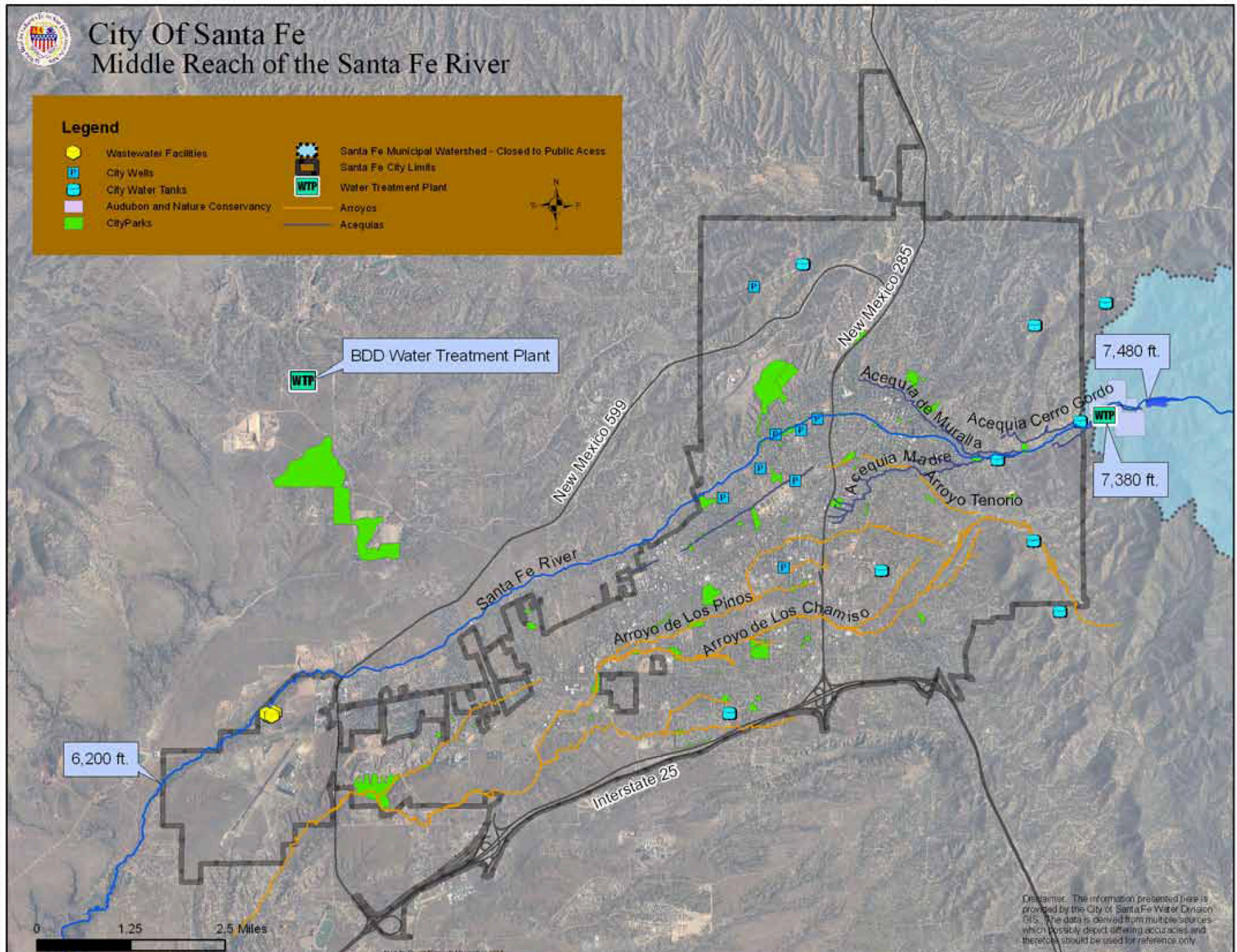
Matthew Chase Daniel, Two Mile Reservoir



City Of Santa Fe Middle Reach of the Santa Fe River

Legend

- Wastewater Facilities
- City Wells
- City Water Tanks
- Audubon and Nature Conservancy
- CityParks
- Santa Fe Municipal Watershed - Closed to Public Access
- Santa Fe City Limits
- Water Treatment Plant
- Arroyos
- Acequias



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Railyard Park Water Harvesting System

The development of Santa Fe's railyard into a large park, plaza and new buildings for non-profits and businesses offered a compelling chance to build a much needed community space. But in a high, arid desert and a city with water restrictions for all new development, how could we create 12 acres of new landscaping without a big impact to the city's water supply? Drought tolerant plants were selected for most areas, but more water was required for the park's irrigation. Through a feat of design, engineering and collaboration, runoff from the roofs of new and historic buildings within the project area drain into five underground 15,000-gallon cisterns and the 35,000-gallon water tower on the Railyard Plaza. By virtue of the water tower's elevation (a pump raises some water into the tower), 110,000 gallons of rainwater can be distributed throughout the park by gravity. While water catchment is an ancient practice, irrigation on the Railyard Park is an interesting modern-day test of a familiar strategy on a large scale.



Heads Up Landscaping, Water Tower at Night

Water and Transportation

Transportation has a huge impact on water quantity and quality. It takes as much as 39,000 gallons of water to produce each car. It takes 70 gallons of water to produce one gallon of gas. Cars and trucks are a significant source of water pollution through runoff from roads. Riding a bike, walking, or using public transportation is one of the best things you can do for Santa Fe's water quality.

The Middle Reach

The urban reach of the Santa Fe River extends from the Santa Fe Canyon Preserve to the wastewater treatment plant on Airport Road. Water sometimes flows in this stretch due to storm runoff, overflow from snowmelt, or, when supplies are sufficient, the City chooses not to store up to 1,000 acre-feet of water and allows it to flow instead into the river channel for the benefit of the river ecosystem and the community.

Other river flows in the urban reach occur when the watershed receives high levels of snowpack in the winter and the reservoirs spill as their storage capacity is reached. Flows in the urban reach also occur when heavy rains in town cause runoff from impermeable surfaces—think streets, parking lots and rooftops—to drain into arroyos and ultimately the river channel itself. Storm flow in the river is characterized by fast moving water flowing over a short period.

When the river corridor is dry, it's because the urban river now runs through us. Instead of flowing through the river channel, it enters our homes, where we drink it, cook with it, wash with it and water our plants. It flows away from our bodies and homes as human waste, wash water and runoff from our properties and is piped toward the wastewater treatment plant. Everything we swallow or spill—pharmaceuticals and chemicals—in and around ourselves and our homes can end up back in the river downstream and the groundwater below.

The Buckman Direct Diversion Project

The Buckman Direct Diversion (BDD) project is a regional surface water supply project co-owned by the City of Santa Fe and Santa Fe County. The BDD pumps San Juan-Chama Project water from the Rio Grande northwest of Santa Fe, near the historical Buckman townsite. The project produces drinking water at a new water treatment plant located near the Municipal Recreational Complex.

The BDD infrastructure includes a diversion structure on the Rio Grande, a sediment separation facility, two raw water booster stations, two treated water pump stations, and 25 miles of raw and finished water pipelines. The BDD is one of the largest, most complex and most costly non-federal infrastructure projects ever built in Santa Fe County.

The BDD allows the City of Santa Fe to produce up to 5,230 acre-feet of treated drinking water each year. The County can draw up to 1,700 acre-feet of treated drinking water annually.

The benefits of the BDD project include an increased and diversified water supply with advanced water treatment technology. The addition of the Rio Grande and the San Juan-Chama Project water, which originates in the Colorado River watershed, as sources of water for Santa Fe allows the City to rest Municipal wells and let some Municipal Watershed water run into the Santa Fe River, creating more frequent flows and supporting a living Santa Fe River. However, bringing this new water supply to Santa Fe also draws down the Colorado River system, which, including its tributaries, already supplies water to 19 US states and northern Mexico.



Matthew Chase Daniel, Santa Fe River at La Cieneguilla

The Lower Reach

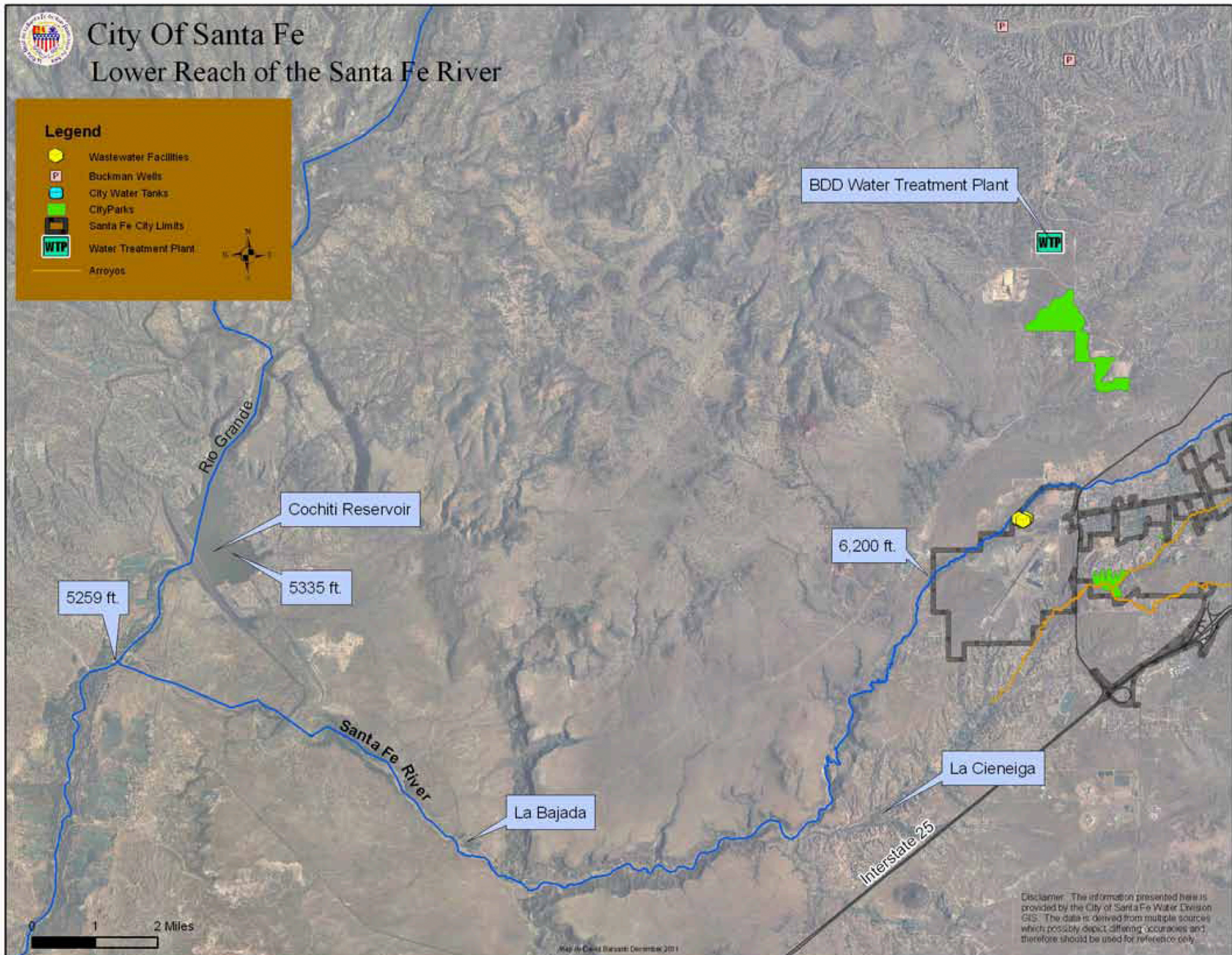
Water returns to the Santa Fe River below the wastewater treatment plant. About 60% of the water that is diverted upstream and used for municipal water supply is delivered to the treatment plant through the City's sewer system. Treated effluent that is not reused to water public parks is released to the river channel where it flows through La Cienega and La Bajada. Further downstream, the river is split by a diversion, with part running to Cochiti Lake and part flowing to its historic destination, the Rio Grande.



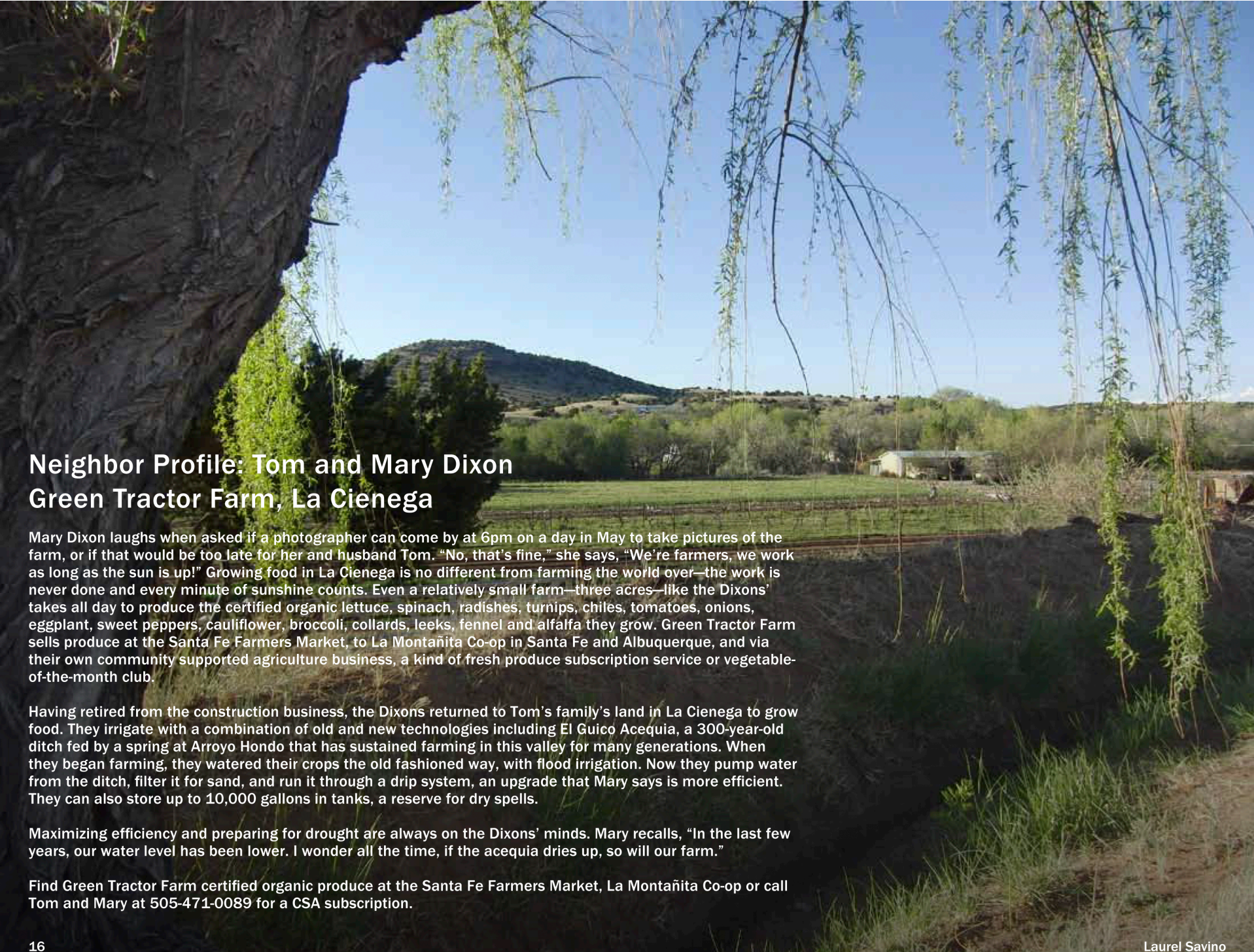
City Of Santa Fe Lower Reach of the Santa Fe River

Legend

- Wastewater Facilities
- Buckman Wells
- City Water Tanks
- City Parks
- Santa Fe City Limits
- Water Treatment Plant
- Arroyos



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Neighbor Profile: Tom and Mary Dixon Green Tractor Farm, La Cienega

Mary Dixon laughs when asked if a photographer can come by at 6pm on a day in May to take pictures of the farm, or if that would be too late for her and husband Tom. “No, that’s fine,” she says, “We’re farmers, we work as long as the sun is up!” Growing food in La Cienega is no different from farming the world over—the work is never done and every minute of sunshine counts. Even a relatively small farm—three acres—like the Dixons’ takes all day to produce the certified organic lettuce, spinach, radishes, turnips, chiles, tomatoes, onions, eggplant, sweet peppers, cauliflower, broccoli, collards, leeks, fennel and alfalfa they grow. Green Tractor Farm sells produce at the Santa Fe Farmers Market, to La Montañita Co-op in Santa Fe and Albuquerque, and via their own community supported agriculture business, a kind of fresh produce subscription service or vegetable-of-the-month club.

Having retired from the construction business, the Dixons returned to Tom’s family’s land in La Cienega to grow food. They irrigate with a combination of old and new technologies including El Guico Acequia, a 300-year-old ditch fed by a spring at Arroyo Hondo that has sustained farming in this valley for many generations. When they began farming, they watered their crops the old fashioned way, with flood irrigation. Now they pump water from the ditch, filter it for sand, and run it through a drip system, an upgrade that Mary says is more efficient. They can also store up to 10,000 gallons in tanks, a reserve for dry spells.

Maximizing efficiency and preparing for drought are always on the Dixons’ minds. Mary recalls, “In the last few years, our water level has been lower. I wonder all the time, if the acequia dries up, so will our farm.”

Find Green Tractor Farm certified organic produce at the Santa Fe Farmers Market, La Montañita Co-op or call Tom and Mary at 505-471-0089 for a CSA subscription.

The Village of La Cienega

It's easy to see why people have lived in what is now the Village of La Cienega for millennia. It's a bright green valley in the midst of a dry, spare landscape. Petroglyphs and evidence of Pueblos are abundant in the area. By the 17th century, it was a *paraje*, a resting place, on the El Camino Real, a last watering hole on the long journey from Mexico City to Santa Fe.

Its name points up the village's reason for being: La Cienega means marsh or swamp. The La Cienega Creek, acequias, ponds and wetlands attract people, birds and other wildlife. But there's reason to believe that name might not be so apt forever.

Locals confirm what hydrologists' measurements show: water quantity in La Cienega is dropping. Flow from the El Guico Acequia has been lower in recent years. As the village itself grows and development south and west of Santa Fe progresses, we are draining the swamp.

La Cienega is home to (at least) two very special places that show its natural and cultural heritage. One is El Rancho de las Golondrinas (its name a nod to the swallows that dip over fields and marshes), the living history museum that preserves and demonstrates an 18th Century Spanish Colonial ranch. Its acequia is on New Mexico's Register of Historic Places.

The other is the Leonora Curtin Wetland Preserve. Managed by the Santa Fe Botanical Garden, the preserve is a little green jewel, lush and full of wildlife. It's a rare place in the Santa Fe area: a wetland where one can visit and learn about the plants and animals attracted by New Mexico's rare marshes.

The Bureau of Land Management considers the threats to the water level significant enough to name La Cienega an Area of Critical Environmental Concern, one of only two in New Mexico. What will it say about us if, after people have come to La Cienega for its abundant water for thousands of years, we're the generation that stripped its name of its meaning?

Las Golondrinas welcomes visitors to its exhibits and festivals. Call 505- 473-4169 or visit golondrinas.org for hours and schedules. The Leonora Curtin Wetland Preserve is open on weekends from May 5 – October 28 in 2012, and for groups by appointment. Call 505-471-9103 or email info@santafebotanicalgarden.org for hours or to schedule a group visit.

Faith

by Piper Leigh

white arms lift to praise

the impulse up and out of the bare branched beauty

where cattails rattled above frozen lace and etched glass

acequia roars a river

somewhere a field is grateful for this release

of what has been held

blackbirds are not daunted by spring's fickleness

they sing no matter



Piper Leigh

Bodies of Water

“El agua es la vida!” is an old New Mexico saying meaning “water is life.” Water is the cornerstone of our environment. A safe and abundant supply is essential for the health and well-being of humans and animals.

Less than 1% of Earth's water is available for drinking.

Humans can survive without food for weeks, if they must, but we cannot do without water for more than a few days. Without water, our bodies cannot absorb nutrients, carry the oxygen that powers our cells, flush wastes from our kidneys and liver, or regulate our temperature. Our digestive, circulatory and reproductive systems are all dependent upon access to clean, fresh drinking water.

The human body is 70% water.

Our eyes are 99% water.

*The plants we eat contain
70% to 90% water.*



How Much Water is Enough?

Our use of water reflects our values, what we understand about our world and how it's changing, and what we'll leave behind for future generations. This intimacy with water is true of everyone, everywhere. Life in every community is inextricably bound with the local water supply, its availability, its quality, and the life and culture it supports.

People take in and release water constantly. Every day the average adult loses two-and-a-half liters (over 10 cups) of water through breathing, sweating and waste. For our bodies to function, we must replenish our personal water supply by drinking fluids and eating moisture-rich foods.⁶ About half a liter (about 2 cups) of our daily water intake comes from food, and an additional two liters (a little over eight cups) of fluid is necessary to replace normal fluid loss. While most fluids count toward this total, anything with caffeine in it—most colas, tea and

coffee—are diuretics and will actually deplete the body of water by increasing urination. They not only don't count toward your healthy total fluid intake, they increase your need for water.

Water can play an important role in healing. Warm water pools and mineral baths have long been part of our quest for exercise, relaxation and relief from pain and stress.

Water feeds more than just our bodies. Our connection to water is abundantly clear in Santa Fe's culture, past and present. We are soothed by the sound and sight of water, awed by its power, inspired by its constancy and yet dismayed by its unusual absence.



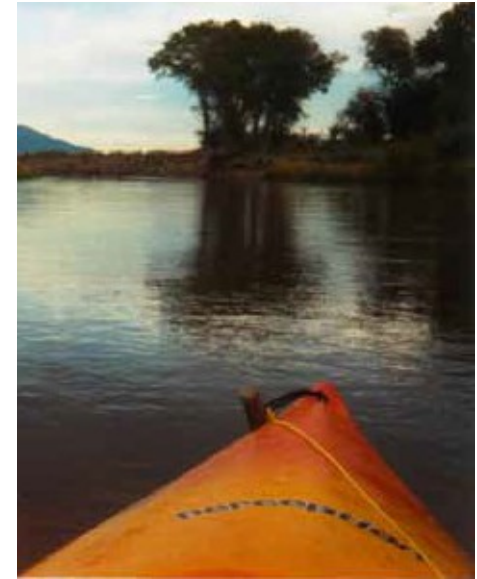
This Glister Basin thundercloud glyph suggests we are not the first New Mexicans to obsess about water. Jerry Willis, 2004



Cochiti canteen.



The Spanish system of Acequia—the gravity-driven ditch system controlled by a series of gates—was more than a water delivery mechanism. It was an organizing principle for the community. Victoria L. Rogers, *Acequia* 1988.



The Rio Grande by kayak



Special Precautions

Santa Fe is lucky to have dependable, high-quality water sources and credible information about what it contains, as are most communities in the U.S. But are federally-established water quality standards for contaminants sufficient? Some people may be more vulnerable to contaminants in drinking water than the general population.

Those with compromised immune systems, such as people undergoing chemotherapy, who have undergone organ transplants, who have HIV/AIDS or other immune system disorders, some elderly and infants may be at risk from infections.

These people should seek advice about drinking water from their health care providers. EPA/Centers for Disease Control guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Water Drinking Hotline (800-426-4791).

In the case of lead, it is wise to be extra-cautious. If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from water utility service lines and home plumbing that leaches into the water when it rests in the pipe. The City of Santa Fe tests for lead and copper from consumer taps once every three years. In June 2009, the City found the amounts of copper and lead were well below the established safety standard.⁷

Enjoy and understand our water supply

- Drink your local tap water.
- Know what's in it. Review the City's water quality report (they're mailed to water customers annually and can be found at www.santafenm.gov/waterquality).⁸
- Consider whether your health concerns are impacted by our water supply. Consult your health care provider and call Safe Water Drinking Hotline (800-426-4791) for advice as needed.
- Filter your water if you don't like the taste or have specific health concerns. When using a pitcher filtration system, refrigerate the water to prevent the growth of micro-organisms.
- Carry a refillable bottle, preferably stainless steel or glass. If using plastic, look for a "BPA-free" label.
- Use phosphate-free, plant-based soaps and shampoos whenever possible. They are less drying for your skin and hair and less damaging to groundwater.
- Contact the City of Santa Fe Water Division at 505-955-4210 with questions and concerns.

What's In Our Water?

Sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs and groundwater. Santa Feans have an excellent, safe source of water in the Santa Fe River, private and public wells, and, most recently, the Buckman Direct Diversion Project, a new source of surface water for the growing region.

As water travels over the surface of the land or through the ground, it dissolves or picks up naturally occurring minerals and, in some cases, radioactive material, and can be easily contaminated by human and animal waste. Federal regulation and good practices require the City Water Division to monitor our water quality by testing for contaminants. (The City tests the municipal water supply; it does not test private wells. Contact the State Environmental Health Epidemiology Bureau of Water Quality for periodic, free private well testing.)

The City publishes a water quality report annually (santafenm.gov/waterquality). In 2012, the City's drinking water met all U.S. Environmental Protection Agency Safe Drinking Water Act standards and state water drinking water requirements. The report contains additional details about where your water comes from, what it contains, and how it compares to standards set by federal and state regulatory agencies.

What Does the City Test For?

In order to ensure that tap water is safe to drink, the U.S. Environmental Protection Agency prescribes regulations that limit the amount of certain contaminants in water provided by public water systems. Contaminants the City tests for include:

- Microbial contaminants, such as viruses and bacteria that may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
- Inorganic contaminants, such as salts and metals, can be naturally-occurring or result from storm-water runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.
- Pesticides and herbicides come from a variety of sources, such as agriculture, urban storm-water runoff, and residential uses.
- Organic chemical contaminants, including synthetic and volatile organic chemicals are by-products of industrial processes and petroleum production, and can also come from gas stations, urban storm-water runoff and septic systems.



Jim Boyers, detail from Winter Shadows

Neighbor Profile: Rod Tweet, Owner and Brewmaster Second Street Brewery

Few of us notice small or gradual changes in our water. Rod Tweet, brewmaster and owner of Second Street Brewery, does. Like all businesses everywhere, his depends on reliable access to high quality water.

But his business is intimately linked to the distinctive quality of our water in a way that few are. “Santa Fe’s water absolutely influences the flavor of our beer. With its high mineral content, high iron, it’s pretty good for brewing most beers. Making really hoppy light beers can be challenging here.”

Santa Fe River and well water is notoriously “hard.” It’s pH is fairly alkaline, while most beers need water that’s fairly acidic, between 5.2 and 5.6. Adding malt to water acidifies the pH of the mash (barley malt and water) somewhat. To adjust it further, Rod treats the mash with various salts; calcium chloride combines with phosphorus to create hydrogen ions that lower the pH to the desired range.

This tinkering has to be handled with care. Too much calcium can make the hops bitter and have an impact on how fast the yeast—that which gives beer its alcohol content and bubbles—settles out.

It’s in the maintenance of his equipment that Rod notices change in our water quality. As we draw down the groundwater beneath us, the concentration of its mineral content is likely to increase. Rod believes our water is becoming harder. He sees it in the amount of scale—hard water deposits—he and his staff are scraping from their equipment.

Second Street Brewery—an employer of about 60 Santa Feans, making it a significant privately-owned local employer—is doing its part to conserve water. They’ve installed low-flow toilets and the thriftiest dishwashers by industry standards.

Products like Rod’s beers give us an interesting perspective on our water supply. You can experience your watershed by visiting Second Street Brewery at its two locations: on Second Street at the rail line crossing and on the Railyard Plaza. Visit them online at secondstreetbrewery.com.

Is Bottled Water Better?

Plastic water bottles are convenient, lightweight and refillable. But is the water inside any safer than tap water?

No, it’s not.

The Natural Resources Defense Council, the Environmental Working Group and others have conducted tests of bottled water quality and found no reason to be more confident that bottled water is safer than tap water. Mostly because it often is tap water. As much as 40% of bottled water sold in the US is simply tap water, often with no additional filtration.

Worse, analysis conducted by the University of Iowa Hygienic Laboratory of 10 brands revealed common urban wastewater pollutants like caffeine, pharmaceuticals, heavy metals, fertilizer and other, tentatively identified industrial chemicals used as solvents, plasticizers, and propellants.⁹

The bottom line is that there are no federally mandated water quality standards for bottled water like there are for tap water supplied by the City of Santa Fe.

Americans use 29 billion water bottles each year, requiring 17 million barrels of crude oil in their manufacture. Now consider that all of that energy is wasted as the product is thrown away after one use.¹⁰

Recycling can turn those plastic bottles into useful things, like carpeting or fleece clothing. Unfortunately, only one in six bottles makes it into a recycling program. The rest end up in landfill, lakes, rivers and the ocean. Plastic bottles take many hundreds of years to decompose.

A stainless steel or glass bottle is better. They are inexpensive and last a long time. They’re also a great way to avoid the danger of Bisphenol A (BPA), a chemical compound used to harden plastic that has been found to leach into water. BPA and similar plastics contain endocrine disruptors which can mimic the body’s hormones and interrupt development and function of the brain and thyroid gland. For all these reasons, it is best to avoid refillable plastic bottles altogether, even those labeled “BPA-free.”

Household Water Filters

Reproduced with permission from the Natural Resources Defense Council's Consumer Guide to Water Filters

The Natural Resources Defense Council recommends that you test your tap water for lead contamination, particularly if you have young kids, are pregnant or thinking about becoming pregnant, since lead is especially dangerous and levels can vary enormously from house to house.¹¹ Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline (800) 426-4791 or at epa.gov/safewater/lead.

Some contaminants left after municipal water treatment concern people. Chlorine added as a disinfectant and to reduce water-borne micro-organisms can be removed by household water filtration.

There are two categories of household water filters: point-of-entry units which treat water before it gets into the house, and point-of-use units which include filter pitchers, faucet filters and under-the-sink units. Look for filters labeled as meeting NSF/ANSI Standard 53 and those certified to remove the contaminant(s) of concern in your water. NSF-certified filters have been independently tested to show that they can reduce levels of certain pollutants under specified conditions. Those that meet standard 53 are geared toward treating water for health, not just for aesthetic qualities.

For many people, an activated carbon filter bearing NSF Standard 53 certification will filter out most pollutants of concern. The list at right will help you determine what type of filter will work best for you. For specific concerns, visit the NSF International online database of certified drinking water treatment units at nsf.org/Certified/dwtu/

Filters require regular maintenance. As contaminants build up, a filter can become less effective and even degrade water quality by releasing harmful bacteria or chemicals back into filtered water. To keep a filter working properly, follow the manufacturer's maintenance directions. Some filters only require a cartridge change, while others are better maintained by a certified professional. Many filter distributors offer maintenance and service contracts for their products.

Activated Carbon Filter Countertop, faucet filters and under-the-sink units.

- How it works: Positively charged and highly absorbent carbon in the filter attracts and traps many impurities.
- Removes: bad tastes and odors, including chlorine. Standard 53-certified filters can also substantially reduce many hazardous contaminants, including heavy metals such as copper, lead and mercury; disinfection by-products; parasites such as *Giardia* and *Cryptosporidium*; pesticides; radon; and volatile organic chemicals such as methyl-tert-butyl ether, dichlorobenzene and trichloroethylene.

Cation Exchange Softener Whole-house, point-of-entry units.

- How it works: "Softens" hard water by trading minerals with a strong positive charge for others with less of a charge.
- Removes: Calcium and magnesium, which form mineral deposits in plumbing and fixtures, as well as barium and some other ions that can create health hazards.

Distiller Countertop or whole house point-of-entry units with carbon filter.

- How it works: Boils water and re-condenses the purified steam.
- Removes: Heavy metals such as cadmium, chromium, copper, lead and mercury, as well as arsenic, barium, fluoride, selenium and sodium.

Reverse Osmosis Under-the-sink units; often in combination with a carbon filter or ultraviolet disinfection unit.

- How it works: A semi-permeable membrane separates impurities from water. (Note: This filtration technique wastes a substantial amount of water during the treatment process.)
- Removes: Most contaminants, including certain parasites such as *Cryptosporidium* and *Giardia*; heavy metals such as cadmium, copper, lead and mercury; and other pollutants, including arsenic, barium, nitrate/nitrite, perchlorate and selenium.

Ultraviolet Disinfection Under-the-sink units, often in combination with a carbon filter and sediment screen.

- How it works: Ultraviolet light kills bacteria and other microorganisms.
- Removes: Bacteria and parasites; class A systems protect against harmful bacteria and viruses, including *Cryptosporidium* and *Giardia*, while class B systems are designed to make non-disease-causing bacteria inactive.

Home: Your Own Personal Watershed

In a sense, your home and property are like a mini-watershed. Water comes in through the tap and falls as rain and snow on your land. It flows through you and out through the sewer, into the soil or off your property as runoff.

The Santa Fe River watershed hosts people, plants and animals, all sharing the same water supply. It is important that everyone is aware that their activities impact the watershed as a whole. What you do in your home and on your land has widespread impact beyond the boundaries of your property. We all live downstream from someone and someone lives downstream from us.

Conserving water is as important as keeping it clean. Using less water saves and sustains the supply for the future and saves money on your water bill. Saving hot water also means saving money on your gas or electric bill.¹²

The City of Santa Fe maintains a website on water conservation, including current information about rebates for water-wise appliances and other conservation methods: www.santafenm.gov/waterconservation

The average American uses 65 gallons each day. Most households can decrease water consumption by 15% to 20% by applying easy conservation measures. Forming good water-use habits is among the most important things you can do for Santa Fe's health and economic future. Good water conservation techniques can be as simple as thinking before you turn on the faucet.

- Install low-flow faucet aerators. They cost just a few dollars, are easy to install and reduce our water use on each tap by up to 50%.
- Eliminate leaks in faucets, toilets, hoses, and pipes. A hole in your water line of 1/32 of an inch wastes 750 gallons of water a day.
- Check for leaks by watching the meter or well pump while water is not in use. If the dial moves, or if the pump comes on, there is likely a leak.

The City of Santa Fe's Water Conservation Office offers rebates to help you save water:

- *High-efficiency Toilets (1.28 gallons per flush or less)*
- *Washers (Consortium for Energy Efficiency Tier 3 or higher)*
- *Rainwater Harvesting Systems*
- *Rain Barrels*



Conserving Water at Home

Bathroom

- Check toilets for leaks by adding food coloring to the toilet tank. If color appears in the bowl without flushing, there is a leak. A leaking toilet can waste 200 gallons of water a day without making a sound.
- Flush only when necessary. Each flush in older toilets uses about six gallons of water. Never use the toilet as a wastebasket.
- Replacing old toilets with new, high-efficiency toilets, labeled 'Water Sense' products, can reduce flush volume by 75%. The City of Santa Fe offers rebates for toilet replacements.
- A shower or a bath? Only the shortest shower saves more water than a partially filled tub. A full tub, however, can use 30-50 gallons of water.
- Install water-saving shower heads or flow restrictors. Shower heads with an on/ off valve are also available, allowing the water flow to be stopped and restarted without readjusting the temperature.
- Don't let the water run in the sink while shaving, brushing your teeth or washing your face and hands.

Kitchen and Laundry

- Run the dishwasher only when full. Use the cycles with the least number of washes and rinses. Buy detergents with zero phosphates.
- Wash dishes no more than once a day. Avoid running water continuously when washing dishes in the sink. If possible, use two dishpans when washing dishes by hand: one to wash and one to rinse. Pour the rinse water outside on a thirsty plant.
- Keep a stainless steel or glass bottle of drinking water in the refrigerator to avoid running the tap to get cool water.
- Fill your washing machine to capacity for each load. Front loading washing machines use significantly less water and energy. See the City's water resources website for high-efficiency washer rebates: santafenm.gov/waterconservation.
- Pre-soak clothes only when absolutely necessary. Set the water control level appropriately. Permanent press cycles may use an extra 10-20 gallons of water.
- Avoid garbage disposals. They use a great deal of water and can add grease and solids to your already hard-working sewage and septic systems. Compost all food waste except meat and dairy (egg shells are OK).



Outside

- Landscape with native, drought-resistant plants, including native grasses.
- Water gardens only as necessary and follow City restrictions (no watering between 10am and 6pm from May 1st through October 31st). Water only in the early morning or at night to avoid rapid evaporation.
- Use a broom, not a hose, when cleaning driveways and walkways.
- Water the root areas of plants, preferably with a drip irrigation system which can save up to 60% over other watering techniques.
- Santa Fe water use restrictions limit washing cars to one vehicle per household per month and requires use of a hose with a shut-off nozzle. If possible, wash your car over grass or gravel or visit a car wash that recycles its water.
- If you suspect a major leak or broken pipe, call the City's Water Division at 955-4333 and select "emergency" at the prompt.

Household Haz Mats

Thousands of common household products contain toxic ingredients that should be kept out of water sources. When hazardous chemicals enter the water supply, there are dangers to people and native wildlife. It is important to responsibly store, use and dispose of hazardous products.

Never pour toxic materials down the drain. If they will flow into a septic tank, they can destroy essential bacteria and pass into the groundwater that supplies some of our drinking water. If buried in the ground or dumped into storm drains, the toxins may flow straight into arroyos, acequias, and rivers.

To dispose of these substances, the Santa Fe Solid Waste Management Agency, Santa Fe County, City of Santa Fe and Keep Santa Fe Beautiful hold special hazardous waste collection days most years. The waste is then shipped to an approved disposal site. Check the Santa Fe County Solid Waste and Recycling Department website for scheduled collection dates.

Cleanders

Most phosphate-free soaps and detergents are meant to be washed down the drain. Most are biodegradable and if the wastewater is properly treated, it poses no problem to the environment. Other household cleaners including most drain openers, oven and toilet bowl cleaners, and bleach are poisonous. Furniture polish and spot removers are flammable, and ammonia-based cleansers and disinfectants contain strong chemicals which may be harmful.

- Use only phosphate-free, vegetable-based detergents and soaps.
- Read the labels of cleaning products and avoid those that contain such toxic components as lye, phenols, petroleum distillates, chloride and dichlorobenzene. Note also the words danger, warning, toxic, corrosive, flammable, or poison. These identify products that may contain hazardous materials that should not be poured down drains.
- Use and store these substances carefully. Keep them in their original containers.
- Do not remove labels. Never mix products. Incompatible products might react, ignite or explode. Corroding containers require special handling.

The Santa Fe Solid Waste Management Agency can advise on proper disposal of any material found around a household or business at (505)424-1850 or sfswma.org.

Santa Fe County's Solid Waste and Recycling Department can be reached at (505)992-3010 during business hours, (505)992-3017 any time for pre-recorded information or santafecountynm.gov/public_works/solidwaste.

Chlorine (bleach) is such a common ingredient in household cleaners that many people are surprised to learn that it is highly toxic. Chlorine is corrosive and a strong irritant to the lungs and mucous membranes. Chlorine-based cleaning products can also destroy essential bacteria in septic tanks, eventually causing system failures. Chlorine can combine with other materials present in the home and environment to form new toxic substances. **NEVER mix chlorine (or products that contain chlorine) with ammonia products; the resulting chemical reaction creates a poisonous gas that can be fatal.** If you must use bleach to disinfect household surfaces or kill mold spores, mix one part bleach to 10 parts water in a spray bottle.

Phosphates may boost cleaning power but, in bodies of fresh water, they act as a fertilizer, stimulating excessive plant growth. Ultimately this growth reduces oxygen needed by fish and other aquatic life. Laundry detergents are now required to be phosphate-free. Currently dishwasher detergents are not required to be phosphate-free but some are. When you shop, read the labels and try to buy only phosphate-free products. Plant-based detergents often work just as well and allow you to avoid unnecessary use of petroleum products.

Fluorescent whitening agents, also known as optical brighteners, are ultraviolet dyes contained in many laundry detergents that make fabrics seem brighter and whiter. These brighteners are toxic to fish and other aquatic life and take many years to biodegrade. Laundry product manufacturers are not required to list individual ingredients, so choose one that does not boast a brightening feature.

Disposal Avoid dumping cleansers with the above ingredients or wash water down the drain. Instead dilute well with water and toss onto a gravel driveway or around deep-rooted plants to be absorbed slowly. In the case that these substances must be put down the drain, flush with PLENTY of water. Then start fresh with a nontoxic, inexpensive alternative. For more suggestions on disposal, visit the Santa Fe Solid Waste Management Agency website.

Make A Non-Toxic Cleaning Kit

Water-friendly cleansers are effective and easy to make. They often cost less than commercial products and work just as well or better. Assemble a few spray bottles, empty jars, and the basic ingredients: baking soda (for scouring and deodorizing), white vinegar (removes mildew, odors, bacteria, and scale from hard water deposits), borax (degreases, cleans), citrus solvent (cleans oils and grease, some stains), lemon juice (removes gums, tarnish and dirt), and lavender, lemon and tea tree oils (acts as a disinfectant). Any of the above ingredients can be safely mixed together. Label clearly and store out of the reach of children and pets. There are also many non-toxic commercial cleaners available on the market made with these same ingredients.

All Purpose Cleanser Mix 1/4 cup white vinegar, 2 tsp. borax and 1-2 tsp. tea tree oil or lemon in 1 quart spray bottle of very hot water. Shake vigorously. Add more borax for disinfecting.

Bleach Use oxygen bleaches, borax, or let the sun bleach your fabrics on an outdoor clothesline. Also try an old-fashioned bluing product to whiten whites.

Carpet Stains Immediately apply club soda or equal parts white vinegar and water, blot dry, repeat, then clean with a brush or sponge using warm soapy water.

Deodorizers In your refrigerator and other closed spaces, use an open box of baking soda. Sprinkle it on carpets and upholstery, wait 15 minutes, then vacuum. Simmer cinnamon and cloves, or place white vinegar in open dishes.

Drain Cleaners Instead of chemical cleaners, use a plunger or a plumbers snake. Then add 1/4 cup baking soda followed by 1/4 cup vinegar. Wait 15 minutes, and rinse with 2 quarts of boiling water. **Caution: do not use this method after trying a commercial drain opener; the vinegar can react with the chemicals to create dangerous fumes.**

Dusting Use 1/4 cup white vinegar per quart of water and apply with a tightly wrung soft cloth. Or use a micro-fiber dusting cloth.

Floor Cleaner Add 1/4 cup baking soda and 1/4 cup borax to hot mop water; rinse with 1/2 cup white vinegar in clear water. For vinyl floors, simply add 1 cup vinegar to mop water.

Glass Cleaner Mix 2 Tbsp. vinegar and 2 tsp. lemon juice and 1 tsp. liquid soap in 1-quart warm water. Shake well, spray on, then buff with crumpled newspapers.

Scouring Powder Make a paste of baking soda and vinegar. Rub gently.



Nancy Silvia, Lavender Fields

Mildew Remover Make a solution with 1/2-cup vinegar, 1/2 cup borax and 1 quart of very hot water. Spray on and leave for 10 minutes. Wipe clean. Or add 2 tsp. tea tree oil in 2 cups hot water to a spray bottle, shake to blend, and spray on problem areas. Do not rinse. For grout, mix one part hydrogen peroxide (3%) with two parts water in a spray bottle and spray on mold. Wait at least one hour before rinsing.

Toilet Bowl Cleaner Mix 1/4 cup baking soda and 1/2 cup vinegar, pour into bowl, let stand, and brush well.

Silver Polish Line a pan with aluminum foil and fill with water; add 2 tsp. each of baking soda and salt. Bring to a boil and immerse silver. Polish with soft cloth.

Brass or Bronze Polish Polish with a soft cloth dipped in a lemon juice and baking soda solution.

Copper Polish Soak a cotton rag in a pint of boiling water with 1 Tbsp. salt and 1 cup white vinegar. Apply to copper while hot; let cool, then wipe clean.

Wood Polish Rub with 1 Tbsp. of lemon oil mixed with one pint olive oil. Buff with soft cloth.

Paint Brush Cleaner For oil-based paints, use citrus-based solvents.

Solvents and Paints

Oil-based paints and preservatives, paint thinners and removers, rust removers, furniture strippers and even nail polish and polish remover are highly toxic to aquatic life and can contaminate groundwater.

Disposal Solvents and oil-based paints should never be burned or put down any drain, sewer or septic system. Bring oil-based paint to a hazardous waste collection or use it up on a basement wall or inside a closet. Give away partly filled cans; they make a good freebie at garage sales. To dispose of latex paints, just take the lid off the can and let the liquid evaporate. Or fill it with kitty litter and put the dried solids in your regular trash. You can also dry it by painting a piece of plywood, and peeling it off and disposing of dried paint; latex paint can go in the regular garbage, but oil-based should go to the hazardous waste collection. Set aside used paint thinner in a closed jar until the paint particles settle out, then pour off the clear liquid and reuse. When the remaining paint sludge is dry, wrap it in plastic for hazardous waste disposal.

Alternatives Use water-based paints and stains wherever possible. Look for products labeled Low VOC or No VOC. VOCs (volatile organic compounds) are gases released by a variety of common products, including paints, stains and lacquers (they give such products their characteristic smell). Some VOCs are highly toxic and can cause a variety of short- and long-term health problems, including eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system. Most paint companies now carry low- and no-VOC products that protect the air quality in your home after you paint (they have almost no scent so you don't have to leave the house for a day after painting) and the groundwater after you dispose of your paint materials.

If low- or no-VOC products are unavailable, choose latex paints instead of oil-based. Latex cleans up with soap and water and does not require thinner. Buy unused paint from garage sales. Use a citrus-based solvent to clean up oil paint and brushes. Look for citrus-based paint removers. They work well without the fumes and don't require hazardous waste disposal.

Neighbor Profile: Rudolf Reitz Founder and Owner Bioshield Healthy Living Paints

"Choosing what products to use is more than picking those that are labeled water-based or low- or no-VOC," says Rudolf Reitz, owner of Bioshield Healthy Living Paints. "Truly non-toxic paints combine nothing more than a water or alcohol ester base with a filler (clay, marble and calcium are common) and a naturally derived color such as iron, ultramarine or ochre."

While protecting air quality is the main reason for choosing non-toxic paints, stains and cleansers, they play an important role in protecting water quality too. When conventional paints are washed down the drain, they can clog and damage plumbing and disturb the biological process that breaks down solid waste in septic and sewer systems. If wastes are not thoroughly broken down, they can wash into the groundwater and contaminate our water supply.

Bioshield is a manufacturer of non-toxic paints, stains and cleaning products. Based in Santa Fe, Bioshield and its six employees provide an evolving range of products to care for and decorate your home without releasing toxic compounds into our air and water for 25 years.

Visit Bioshield at 3005 South St. Francis or online at www.bioshieldpaint.com/. Be sure to request one of their informative catalogs.

Hormones and Pesticides

Pesticides can harm more than just the pest, they often kill the natural predators that would otherwise help keep them in check. Since many of these compounds are especially harmful to fish and other aquatic creatures, they are not approved for use near water. Choose traps over sprays for household insects. For pet care, buy ecologically responsible brands of products.

67 million pounds of pesticides are used on American yards every year.

Pesticides can be carried indoors on shoes and paws and can persist for months in your home.

Disposal If you must use pesticides, try to use up the entire product on target areas, or share what you don't need with neighbors or friends. Dispose any remaining product as hazardous waste. For instructions, contact the Santa Fe County Solid Waste and Recycling Department (see page 26 for contact info).

Alternatives For years, pest control meant chemicals. Once viewed as safe and effective, chemical pesticides are now considered ecologically harmful. They can poison wildlife, contaminate water and soil, and harm humans, especially children, and pets. Many pesticides last a long time and they can enter the water supply. Fortunately, there are effective alternatives.

- Encourage natural predators like the lacewing, ladybug, praying mantis and spiders.
- Prune infested areas.
- If watering by hand, use water spray to physically remove some pests from plants.
- Set out pans of beer or brewer's yeast to attract slugs and snails.
- Cut down on the number of mosquitoes breeding in your area by removing old tires and other areas of standing water.
- Provide plants with the growing conditions that they like to help them resist pests and disease.
- A variety of plant types are less susceptible to insect damage.
- Use organic products if possible. Your local garden center can suggest useful products; look for the OMRI label for organic solutions.
- Encourage insect-eating birds by providing bird houses and baths.

Use Special Care With

- Mothballs
- Flea powders
- Pet shampoos
- Slug bait
- Wood preservatives
- Weed and brush killers



Erika Wanenmacher, Hawk Moth II

Each of us is part of the watershed

Even if you don't live right next to a river, acequia or arroyo, your everyday activities impact your watershed through runoff. As the groundwater beneath your property makes its journey to our rivers it carries along your contributions in the form of nutrients or hazardous compounds.

- What you do on your land may have widespread impact beyond the boundaries of your property. We all live downstream from someone, and upstream from someone else.
- Dumping pollutants in your yard may not harm anyone now, it may contaminate the groundwater from which our wells draw water.
- Our watershed is part of an even larger regional watershed—the Rio Grande. This makes the protection of our Santa Fe water resources important for people in two states and two countries.

Car Care Products

Vehicles require a lot of toxic chemicals to run and to be maintained. Never dispose of these substances at home. When these fluids are poured on the ground or down storm drains they flow directly into our waters. When put into the trash, they can contaminate groundwater. One gallon of oil can render undrinkable up to a million gallons of drinking water. The oil from one engine can produce an eight-acre oil slick.

Keep all cars and other vehicles in good running order. Fix leaks promptly and clean up puddles of leaked fluids immediately. When washing or servicing a car, park on grass or gravel with a pan below to catch any fluid leaks. Use a mild soap and water and use a bucket or pistol-grip nozzle to minimize runoff into storm drains.

Disposal Treat antifreeze as hazardous waste. It contains ethylene glycol, which is poisonous to people, pets and wildlife. Many cats and dogs have died after drinking the sweet-tasting puddles of antifreeze left on driveways. Buy ecologically responsible brands and winterize plumbing with a plumber's antifreeze made with propylene glycol. It is safer for living things and non-toxic to a septic system.

Store car care products—separately, not mixed—in sturdy, lidded containers, out of the reach of children and pets. Many auto supply stores and gas stations will recycle waste oil. The Santa Fe County Solid Waste and Recycling Department accepts car care products and batteries on household hazardous material collection days (see page 26 for contact info).

Use Special Care With

- Antifreeze (use one that contains less toxic propylene glycol instead of ethylene glycol)
- Battery acid
- Brake fluid
- Degreasers
- Engine cleaners
- Gasoline and diesel
- Liquid car wax
- Motor oil
- Radiator flushes
- Rust preventatives



Jennifer Schlesinger, Earth Map VI

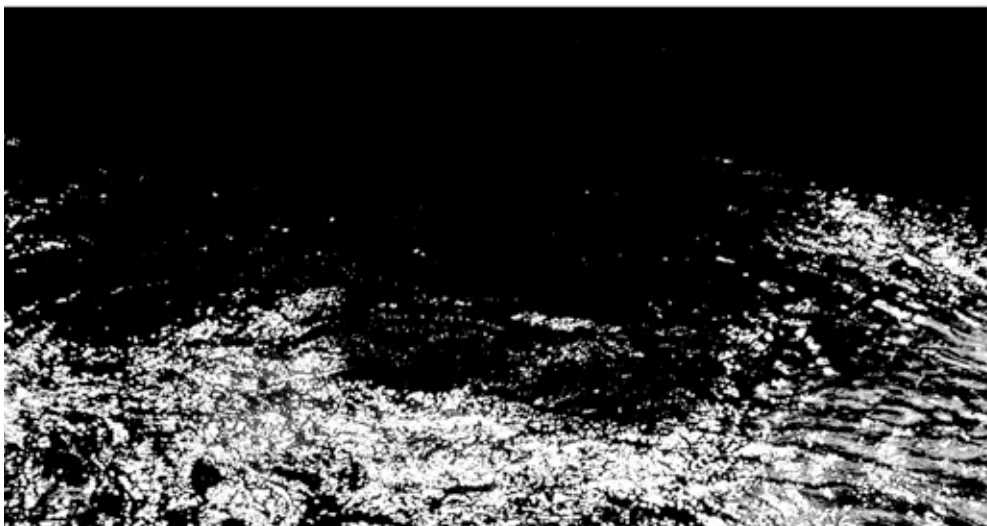
E-Waste

Many common household items—TVs, computers, cell phones, compact fluorescent light bulbs, batteries, thermometers and thermostats, etc.—contain heavy metals like mercury, cadmium, arsenic and lead. These metals are dangerous, particularly to fetuses and children, and they should also be treated as hazardous waste.

Disposal The Santa Fe County Solid Waste and Recycling Department accepts car care products and batteries on household hazardous material collection days. They can be reached at 505-992-3010 during business hours or 505-992-3017 for recorded information.

Recycling Many companies will accept returns of your used computer and other equipment. Some organizations will accept donations of such equipment. Visit the EPA's e-waste recycling site at www.epa.gov/osw/conservation/materials/recycling/donate.htm for a comprehensive list. Consider donating useful items to the Partners in Education Foundation for the Santa Fe Public Schools' Teacher Warehouse. Visit sfpartnersineducation.org for hours and accepted items.

You can recycle empty printer cartridges at local office supply stores. Check the New Mexico Recycling Coalition's excellent recycling directory at www.recyclenewmexico.com/search/ for locations that accept specific types of waste. Your local office supply store may also accept old printers, computers, monitors, laptops and fax machines.



Use Special Care With

- Computers, monitors
- Thermometers, thermostats and smoke detectors
- Televisions and computer monitors
- Cell phones and hand-held devices
- Refrigerators
- Fluorescent light bulbs

Taking Action at Home

Household activities can have a big impact on water quality. Many household products are known to be toxic and the list keeps growing as more research is done.

- Be aware that many common items we use every day are highly toxic and must be disposed of in specific ways to protect health and water quality.
- Read labels, choose what to buy carefully, and understand what the potential hazards are.
- Follow the directions on the label. Use the least toxic products sparingly. Never use more of the product than the manufacturer recommends.
- Use non-toxic or less toxic alternatives whenever possible.

Dispose of unwanted household hazardous materials properly. Check the New Mexico Recycling Coalition's excellent recycling directory at www.recyclenewmexico.com/search/ for locations that accept specific types of waste and the Santa Fe County Solid Waste and Recycling Department for dates of household hazardous material collection days (see page 26 for contact information).

Wastewater Treatment: After the Flush

It's important to be aware that what is flushed down the toilet can re-enter the water and food supplies. Human waste carries viruses, bacteria, pharmaceuticals, and nutrients that must be disposed of with care. Waste bacteria don't survive for long outside the human body; however, the pharmaceuticals, viruses and nutrients can remain. If not carefully disposed of, wastes can contaminate drinking and irrigation water.

Toxic materials should never be poured down a drain, not even a septic system. These materials could seep into groundwater, contaminating drinking water and the food chain. Call the Santa Fe County Solid Waste and Recycling Department (see page 26 for contact info).

Modern wastewater systems contain two components, the tank and the soil absorption field. The septic tank was a step forward from the cesspool because it provided a watertight tank to store the solid wastes and release the liquid slowly to infiltrate into the ground. Separating the solids from the liquids is called primary treatment. It helped prolong the life of the soil absorption system by removing grease and solids that once clogged the soil around cesspools.

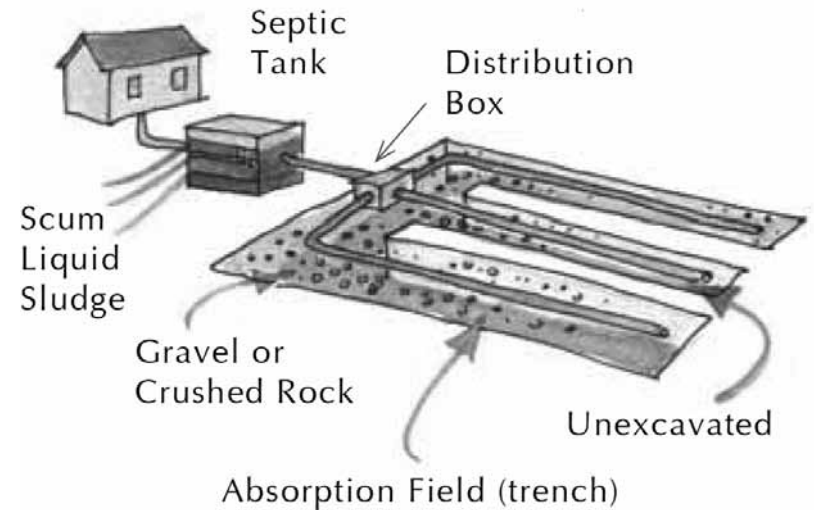
Densely settled areas with municipal water supplies need wastewater management. Wastewater is collected and piped to a facility that separates the solids from the liquids, kills almost all of the human waste bacteria while using other bacteria to further digest the waste and release a clear effluent into the ground. This process is called secondary treatment.

Rural backyard disposal: The septic system and how it works

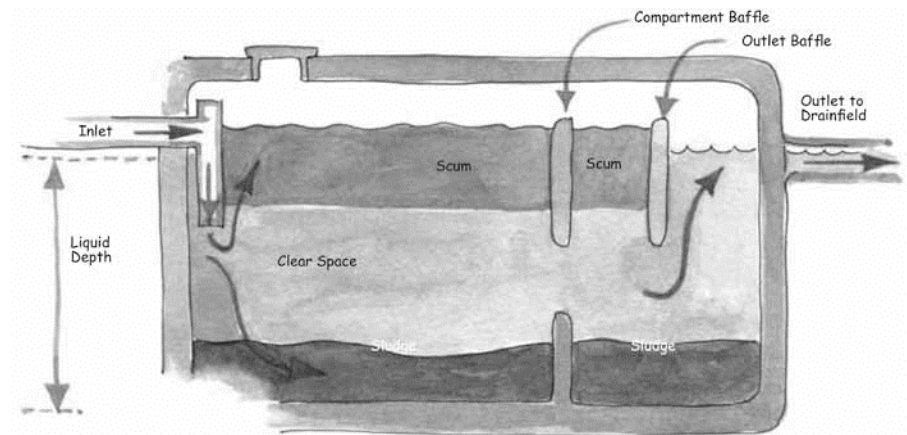
The septic system is an adequate disposal technique where housing density is low and groundwater does not carry the dissolved chemicals into surface waters. However, septic systems are still used by the vast majority of homes surrounding Santa Fe even though population densities are increasing. Newer systems consist of the tank—a cement or fiberglass container with a T-shaped outlet pipe that keeps the floating grease layer in the tank—and a soil absorption system that draws the liquid portion of the wastes into the ground. Older systems, cesspools and leach pits perform similar functions.

Septic systems effectively eliminate almost all bacteria and many viruses. The effluent leaving the tank contains tens of thousands of fecal bacteria, but after percolating through soil, the bacterial count is reduced. Nutrients like nitrogen are not completely removed during their transit through a typical septic system, so it proceeds into the groundwater. The septic tank serving a family of three releases enough nitrogen to contaminate hundreds of gallons of water each day.

Septic System



Typical Septic Tank



Maintaining your Septic System

Conserve water Reducing water flow through your system will reduce the movement of solids and scum into the soil absorption system.

Don't overload the system A dripping faucet or a leaky toilet can add hundreds of gallons of water to the system each week. If you are going to have a large gathering, rent a portable toilet to reduce the demand on your septic system. Stagger your washing machine and dishwasher use to spread out the flow.

Don't install or use a garbage disposal They add large amounts of grease and organic matter to the system and will shorten the life of your soil absorption field.

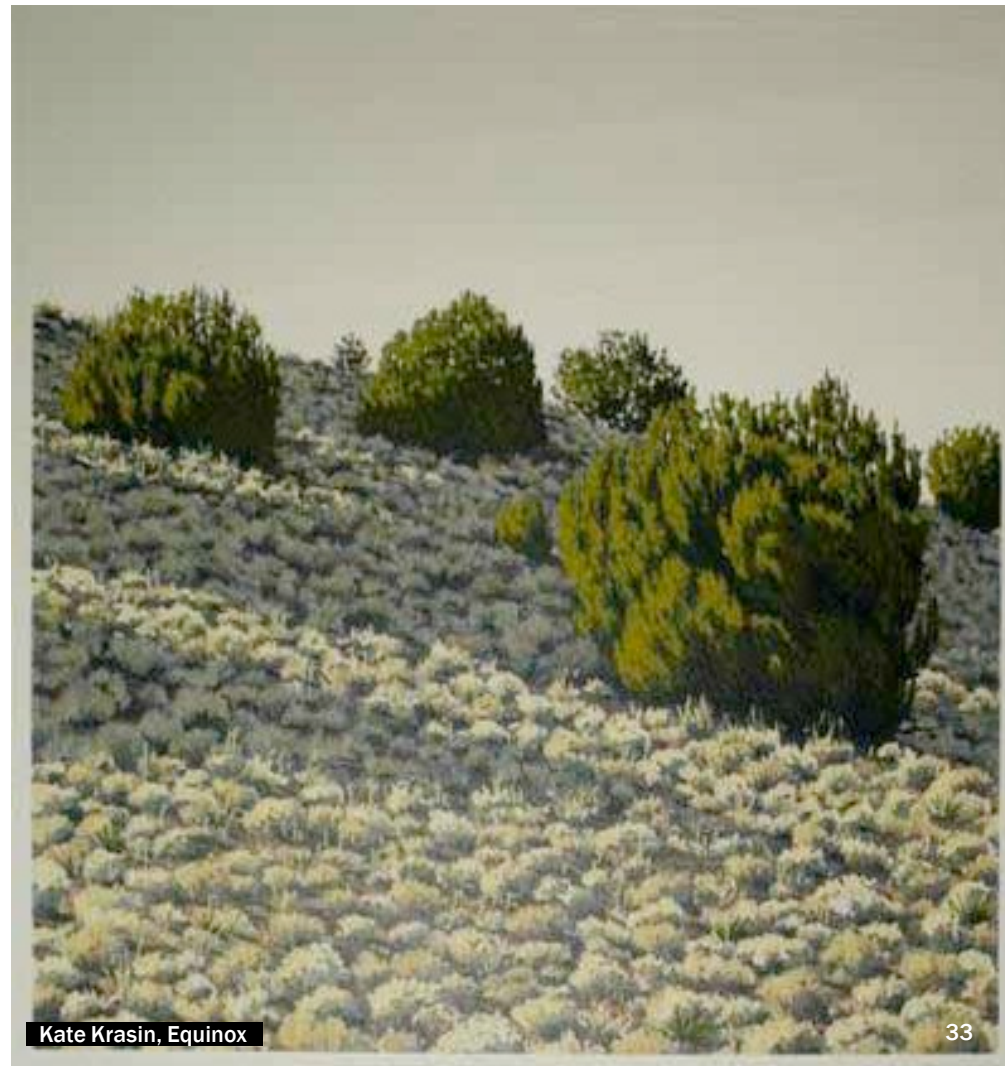
Don't kill the bugs Flushing chemicals down the drain can kill bacteria in your septic tank. When these bacteria stop working, the sludge accumulates and is more likely to escape the tank and clog your leaching system.

Don't flood the soil absorption system Canales and stormwater runoff should be diverted away from your system to prevent periodic flooding. To drain a hot tub, slowly release the water over a period of three days. This will allow the water temperature and the chlorine levels to drop, and the abrupt passage of hundreds of gallons of water won't flush solids out into your leach field.

Don't compact the soil absorption area Don't park your car on or drive over the system. The compaction of the soil from the weight of the vehicle will reduce the system's capacity.

Compost it Don't use the sink as a garbage disposal. This will add solids and grease to the tank that may exceed the ability of the bacteria to digest it. Compost most food waste and dispose of meat or dairy waste in the regular trash.

Pump your septic tank regularly Maintenance is the single most important consideration in making sure a septic system will work well over time. What goes down the drain or toilet either finds its way into the soil or stays in the septic tank until it is pumped out. The system should be regularly pumped to remove the sludge and the floating scum. The frequency depends on how you use your system and what goes down the drain. All systems should be pumped every three to five years to avoid septic system failure. A septic system pump-out and sludge disposal usually costs about \$200. Replacing a septic system may cost well over \$20,000.



Your Land and Your Community's Water Quality

Wind, snow and rain are as much a fact of life in Santa Fe as summer sunshine. When rain hits the high desert soil, it either sinks into the ground or runs over land fast, picking up pollutants and soil before draining into arroyos, acequias, the Santa Fe River and, eventually, the Rio Grande. Harvesting water and promoting growth of natural vegetation is the best way to have a lush, healthy yard, control runoff from your land and protect our water supply.

Dealing with Surface Runoff On natural landscapes, most rain soaks into the ground and drains to nearby surface waters. But as land is cleared for development and solid surfaces are built—roofs, roads, parking lots and driveways—more of the water runs off these solid surfaces and is carried straight into arroyos, acequias and the Santa Fe River.

Runoff carries concentrated pollutants such as metals, paints, oils, grease, nutrients from fertilizers, detergents, animal waste and litter into Santa Fe's waterways. By keeping the water that falls on your property in place, you can irrigate your plants and prevent pollution from entering our water supply.

Landscaping for a Healthy Watershed

Heavy wind, rain and snowmelt can carry off our fragile soils but plants can slow erosion. Native species of shrubs, trees and some grasses slow runoff, hold soil particles in place and help maintain the soil's capacity to absorb water. The roots of plants also help filter pollutants from the water before it enters the groundwater.

- Preserve established trees and shrubs and plant new ones to encourage excess rainwater and snowmelt to filter slowly into the soil.
- Plant and maintain a vegetated buffer strip at the base of steep slopes.
- Choose native plants whenever possible.
- When removing unhealthy trees, leave the stump and roots in place to hold the soils.
- Use spaced paving stones, gravel or pervious asphalt instead of solid pavement.
- Avoid using chemical fertilizers, pick up litter and animal waste and keep automobiles in good shape to avoid leaks.

Alternative paving materials

Choose paving materials that allow water to sink into the soil. Bricks and flat stones make an attractive, durable driveway and, if placed on well-drained soil or on a sand or gravel bed, allow rainwater to filter into the ground.

Wood decks, usually installed for their functional good looks, can also serve as a form of porous pavement. Redwood and cedar are as durable as most other paving surfaces.

The space between the deck boards allows rainwater to drain directly onto the soil surface and soak into the ground. Maintaining a distance between the soil surface and the decking will minimize the risk of wood rot.



Nate Downey, Santa Fe Permaculture

The Power of Plants and Shrubs

Shrubs, trees and groundcovers cool our surroundings, provide habitat for wildlife and increase the value of our properties. Plants with strong root systems help stabilize soil. Thoughtful landscaping can change the amount, speed and quality of the water that flows away from our properties. Native plants thrive with less water and care and reflect our natural heritage.

- Install gravel trenches or planted areas along driveways, patios and other paved surfaces to collect water and allow it to filter into the soil.
- Use grass-lined swales, berms, and basins to control runoff on your property, reduce its speed and increase the time over which the runoff is released.
- Plan for landscaping before beginning new construction and leave as much of the original vegetation as possible on site. Before the start of construction, make sure that straw bales and a silt fence are installed around the work site to contain sediment and control erosion.

Native Plants Save Water, Soil and Money

Well-planned landscaping offers many benefits. It is possible to reduce heating and cooling costs by as much as 30% just by planting and clearing wisely. Passive cooling is likely to become a serious issue as global climate change brings drier, hotter weather to New Mexico. Trees, shrubs, and groundcover also attract wildlife and require much less maintenance, fertilizers, and pesticides than grass.

*City of Santa Fe Summer Water Restrictions
are in effect from May 1st through October
31st; all outdoor watering is prohibited
between 10 am and 6 pm.*

Before you go to the nursery, consider the growing conditions and choose the best plants for your location. Different plants require different kinds of soil, nutrients and exposure to the sun. Parts of your property may also be subject to sun, shade, wind and foot traffic, which will affect the plants you choose.

Check the soil The soil in much of Santa Fe is clay or a clay blend. (determine soil type by taking a handful of moist soil and squeezing it into a ball. If it holds together slightly before breaking up, it is sandy loam; if it stays together, it is clay or a clay blend.) Better yet, test soil samples type, pH, nutrient availability, and mineral content using a home test kit.

Consider your conditions Matching the needs of plants to the conditions of the landscape decreases the need for extra water and fertilizer and increases the plant's resistance to disease and pests. Plants native to northern central New Mexico are well adapted to the arid climate, soil, and water supply; they are less bothered by alkaline soils, low water, disease and pests than plants introduced from other areas. Local nurseries will help you select plants appropriate for the property and soil type.

Plants to Avoid Some plants introduced to Santa Fe are invasive and spread quickly, choking out the native plants and reducing habitat for native wildlife. These include Russian olive, Siberian elm, tree of heaven and salt cedar. The New Mexico Department of Agriculture maintains a list of invasive plants that pose a danger to our native species: www.nmda.nmsu.edu/animal-and-plant-protection/noxious-weeds.

Growing Food at Home

People have grown fruits, flowers and vegetables in our community for thousands of years. Whether our garden is in a window box or on a large farm, growing some of your own food connects you to the long history of New Mexico and our present environment. Effective gardening techniques can produce healthy plants and preserve the soil and protect arroyos and the Santa Fe River system from sediments and chemicals.

Choose the best location Choose a sunny location (south facing is best) with good natural drainage. You may have to amend your soils to improve the slow drainage of our clay soils; visit one of our excellent local nurseries for advice on soil amendments. Whenever possible, avoid disturbing sloping areas that let topsoil wash away during heavy rains.

If your garden is on a slope, one strategy is to terrace the site or plant across the slope rather than up and down it. Each terrace or row helps keep soil and plant nutrients from washing downhill. On long slopes, it's a good idea to leave strips of groundcover or grass running across the slope. This will slow the flow of runoff, allowing it to soak into the soil. Make strips wide enough to allow easy access to plants and vegetables.

Mulching Mulch is a protective covering of compost, straw, grass clippings or leaves placed around plants. Mulch can add nutrients, make the soil more workable, aid rainwater penetration, help control weeds and improve the moisture-retaining capacity of the soil near roots. Mulch also minimizes losses of nutrients and topsoil.

8 Rainwater Harvesting Principles

Adapted with permission from Rainwater Harvesting for Drylands and Beyond, Volumes 1 and 2, Brad Lancaster, HarvestingRainwater.com.¹³

1. Observe how and where water flows on your land. What is working, what is not? Build on what works.
2. Water flows downhill, gaining volume and speed as it flows. Start at the highest point of your property, where there is less volume and speed, and work your way down.
3. Start small and simple. Work at the human scale so you can build and repair everything. One thousand small strategies are far more effective than one big one.
4. Spread and slow the flow of water. Rather than having water run off the surface, encourage it to stay on your land and sink into the soil.
5. Always plan for an overflow route for water from heavy rains and use that overflow as a resource and manage that overflow water as a resource. Always have an overflow.
6. Use groundcover plants and mulch as a living sponge. They will help prevent your harvested water from evaporating (and cool your surroundings) while the soil's ability to soak and hold water steadily improves.
7. Maximize efficiency by using your water-harvesting strategies to do more than hold water. Berms or swales can double as raised, dry paths. Plantings can be placed to cool buildings. Trees can be selected to provide food.
8. Continually observe your system and learn from what works and what doesn't. Apply these principles from the beginning to fix what doesn't work.

Rainwater Harvesting

Precipitation in Santa Fe often comes in hard, fast storms, leaving lots of water all at once. On average, Santa Fe receives 14 inches of precipitation. Our clay-dense soils and the caliche layer beneath it makes it difficult for rainwater, when falling fast, to soak in. Make the most of what falls by harvesting water. By capturing and storing what falls from your roof and slowing and spreading the water that falls on your property, you'll save money on your water bill, help conserve our water supply and create a lush landscape around your house.

Water harvesting is the capture, diversion and storage of rainwater for plant irrigation. System design ranges from simple to complex. There are opportunities to harvest water on existing buildings and a water harvesting system is an important part of the design phase of any new construction.

In Santa Fe County, new construction of residences of 2,500 square feet of heated area or more must use rain barrels, cisterns or other catchment basins.

There are many benefits to water harvesting. It creates a more lush, cooler landscape and provides habitat for native plants and animals. It saves money by providing irrigation water at no cost. Using rain water and snow melt helps conserve the drinking water supply and prevents the use of chlorine-treated water on fragile soils. Slowing water and keeping it in the soil helps prevent erosion and recharges the groundwater. There are three models for the simplest water harvesting systems:

- A planted area with amended soils that allow the water to sink into the soil and flow away from the house foundation—directly below a roofline or canale. The planted area should be slightly lower than the surrounding area and planted along the edges that retain water where it can be used.
- A French drain is a hole or channel filled with gravel in which stormwater drains away from a building's foundation to a better location such as the base of a tree.
- A water barrel beneath a canale can store water for later use.



Ruthanne Greeley

Grey Water for Home Landscaping

Grey water is an alternative source of water for irrigation. Using grey water saves our fresh water supplies by not applying drinking water to the landscape. Grey water is defined as untreated household wastewater that has not come in contact with toilet waste such as wastewater from bathtubs, showers, bathroom sinks and washing machines.

Black water should not be reused without highly specific treatment systems because of the high risk of contamination by bacteria, viruses and other pathogens.

Grey water may contain fats, oils, grease, hair, lint, soaps, cleansers, fabric softeners and other chemicals. Grey water can also contain elevated levels of chlorides, sodium, borax, and sulfates, and have a high pH (is alkaline) that may be harmful to some plants. So it is important to know what is contained in products that are put down household drains.

Grey Water Irrigation Guide

According to the City of Santa Fe and the federal Water Quality Act, a permit is not required to apply less than 250 gallons per day of private residential grey water for the resident's gardening, composting, or landscape irrigation if the following conditions are met:

- The grey water distribution system must be constructed so that overflow from the system drains into the sewer or septic system. In some cases, a liquid waste permit may be necessary if an on-site septic system is modified.
- A grey water storage tank must be covered to restrict access and to eliminate habitat for mosquitoes or other disease vectors.
- Grey water is discharged only in areas where there is vertical separation of at least five feet between the point of discharge and the ground water table to protect ground water resources from possible contamination. Current Liquid Waste Disposal Regulations require that grey water is not applied within 100 feet of a domestic well or within 200 feet of a public water supply.
- Grey water pressure piping is clearly identified as carrying non-potable water.
- Grey water is used on the site where it is generated and may not run off the property.
- Grey water is applied in a way that minimizes potential contact with people or pets.
- Grey water application methods that reduce contact include drip irrigation, shallow piping systems or mulch trenches.
- Ponding of grey water is prohibited and application of grey water must be managed to minimize standing water and to prevent saturation of the soil.
- Grey water must not be sprayed. Low pressure drip irrigation or bubblers located under mulch help to prevent misting and exposure to grey water.
- Grey water must not be discharged to a watercourse. Current liquid waste disposal regulations require that discharges of grey water be at least 100 feet from streams or lakes or 25 feet (plus the depth of the arroyo) from an arroyo.
- Grey water use shall comply with all municipal or county ordinances and local codes.
- Use biodegradable and environmentally friendly soap products—avoid soaps that contain borax and are high in salts and sulfates.
- Avoid using chlorine bleach. Add white vinegar to the laundry's rinse cycle to lower the pH of grey water.
- Mulch plants to reduce evaporation and encourage natural soil-building processes.
- Avoid dispersing hot water on plants—use a temporary storage tank if necessary.

Picture a Living River

Our elders remember when the Santa Fe River ran through downtown, frequently throughout the year. While historical information is scant, in the period of time before 1881, when the first Old Stone Dam reservoir was built on the Santa Fe River, the river probably flowed consistently to the settlements in the Agua Fria area, though acequia ditch diversions from the river for farm irrigation probably reduced in-channel flows. When Santa Fe was largely a farming community, these acequia irrigation diversions throughout the growing season spread water away from the river channel, helping water seep into shallow groundwater. Even after the growing season and acequia diversion ended in the fall and winter, and normal stream flow would be at its lowest point, this shallow groundwater would continue to return to the river.

I grew up playing on the sandy bank of the Santa Fe River in the Village of Agua Fria. We children built sand castles, digging holes with our bare hands in the sand, experiencing the joy of seeing the water gush upward. The giant cottonwood bosques, more than 100 years old, were the ideal environment for children to bond with the beauty of nature. In those meadows and jarrales (willow thickets) we could play, dream, and be creative.

Melinda Romero Pike



caption

As the city grew and more agricultural land was developed for homes and businesses, municipal water demand increased. To meet the growing community need, new, larger dams were constructed, and groundwater wells were dug. For the period between about 1950 and 2008, the river channel was largely dry except for monsoon season stormwater flows and brief reservoir spill events in years with exceptional snowpack. Beginning in the fall of 2008 with the passage of several resolutions¹⁴, the City committed to maintaining the river's ecology through downtown Santa Fe by allowing up to 1,000 acre-feet of water per year to flow in the river channel. If the watershed receives less than average snowpack, releases into the river are limited by the same amount.

Support a commitment to a living river

In 2012, the Santa Fe City Council unanimously voted to allow 1,000 acre feet of water to bypass the municipal reservoirs and flow into the Santa Fe River in wet or normal years. This is a giant step to reviving the Santa Fe River to a flowing, vibrant perennial stream that brings life to our community.

The Santa Fe Watershed Association, its members, and many others advocate for measures that would return water to the urban reach of the river. While the definition of a “living river” varies widely, proponents agree that significantly more water, perhaps an additional 3,000 acre-feet from Santa Fe’s sources—including a further drain on expensive groundwater sources—would have to flow through the channel.

The Watershed Association and the entire community won a significant victory with the passage of the Target Flow for a Living River Ordinance in February 2012. After more than a decade and five years of intense advocacy by the Watershed Association, the City Council unanimously voted to let 1,000 acre feet of water bypass the reservoirs into the Santa Fe River on wet or normal years. This is a giant first step to reviving the Santa Fe River to a flowing, vibrant stream that brings life to our community.

What would a healthy Santa Fe River with a consistent flow of water be like? A more natural channel shape would curve and bend, slowing the water and widening its path. Stately Rio Grande cottonwoods would shade the channel, cooling the water and shore. Their leaves would begin as a bright green haze in the spring, clattering and dark green in the summer, turning bright golden yellow in the fall before falling to the channel floor where they would feed the soils. Coyote willow would grow thick along the river’s edge, their new twigs red in spring, narrow leaves rustling in the wind in summer and slender branches bare in winter. Further from the shores, globemallow and aster would greet late summer with bright spots of orange and lavender. From a stand of cholla, bright with blossoms in spring, a curved-billed thrasher might watch a visitor with a sharp red eye.

Among the trees, mobs of tiny, bushtits would flit from branch to branch, picking off insects and spider eggs. Perhaps the endangered Southwest willow flycatcher would nest among the willows. Forked-tailed swallows would glide through the air, nipping fluttering moths in flight. Fearless Rufous hummingbirds zip overhead with their characteristic buzz. Harmless wandering garter snakes slide across the sand between blades of grass. In the evening, little Western pipistrelle bats would do their part to reduce our mosquito population by eating their weight in flying insects each night.

People would return to the river to cool off, play, exercise and relax. Commuters would ride along the River Trail from home to work and back while tourists explore the city where it meets the river’s banks. Toddlers could chase water striders across the stream while, if the water is deep and cool enough, Rio Grande cutthroat might watch from beneath the shadow of a boulder. Older brothers and sisters might look for tiger salamanders and red-spotted toads among the plants along the shore, while their parents watch and spread a picnic. Throughout the year, Santa Feans, visitors and the plants and animals that make up our natural heritage would use the river for sustenance of every kind.

Benefits of a Living River

Other than the beauty of a living river, what are the benefits?

Connection to the past and a healthier way of living together Santa Feans have always felt a close connection to the land, whether from the memory of a more rural way of life, by observing its changing light as an artist, or through recreation in our spectacular landscapes. Can we claim to honor the ways of life of those who came before us while ignoring one of the most important facets of life here for 12,000 years? The return of Santa Fe River would restore a living thread to this community, uniting us in a deep appreciation of all that our small high desert city offers.

Habitat for pollinators and other native wildlife Bees, butterflies and birds, as they move pollen from one plant to the next, are all critical to plants’ ability to reproduce. Without water, these animals cannot survive and keep our landscape and farms green. Without water in the river, all the birds, mammals, insects and other creatures that evolved with the river will struggle to survive here.

Aquifer recharge Public and private wells draw water from below the surface by tapping porous rock that holds water like a sponge. This water has been there a long time and is sometimes referred to as fossil water. Since the Santa Fe River has been dry, residents note that wells have to be dug deeper and deeper, indicating that the level of the water below us is dropping. We risk using up our groundwater at an unsustainable rate, but releasing water to the river channel provides important groundwater recharge.

Santa Fe’s economy Tourism dollars are our city’s major economic driver. Santa Fe consistently ranks in the top 10 North American cities to visit by Travel & Leisure magazine, among many other rankings.¹⁵ You may not work in the hospitality industry, but many people who support your industry—whatever it is—do. Visitors to Santa Fe spent \$1 billion at tourism-related businesses and attractions in 2002, employing 12,567 workers (17.5% of total employment in Santa Fe County), and paying \$231.5 million in wages and salaries.¹⁶ If Santa Fe is drab and match-box dry, with forest fires in summer and no snow in winter, it is not as attractive a destination for visitors worldwide.

Pogeh (Waterplace)

by A. Kyce Bello

At the archive, I trace the dry lines of the riverbed
through a folder fat with obituaries for her waters.

Marshes, trout, floodplains that once spread like pearls
on a necklace worn by the woman dressed in blue

and starlight, her song the rustling willow,
the plastic bag trapped by a water worn branch,

the sand blowing silently downstream. Thirteen people
gather to mix the waters of the world into a bowl.

Here is the Amazon River, here a spring on Crete,
here a cupful of our river drawn from the tap

of a kitchen sink. Summer 1883, the river rose above
its banks, flooded the dirt streets of the plaza, carried

cottonwood logs downstream. A century and some
years later, I carry a cup of that holy water to the bloodless

gash of our river. Poured over the head of my infant
daughter, it darkens the sand, brightens a dull rock

until it is a gleaming jewel. Pogeh. Her song rippling
through parched air, satiating forgotten thirst.



To achieve this goal of restoring a living river, the Santa Fe Watershed Association, its volunteers, the City of Santa Fe, and others have made tremendous strides in stabilizing the riverbank, cleaning the channel, removing invasive plants and restoring natives like cottonwoods and willows. You can visit and see some of this work at the San Ysidro River Park near San Ysidro Crossing, along Frenchy's Field, and a long stretch through downtown between Camino Alire and Camino Cabra. Restoring the Santa Fe River requires more than running water. In developing Santa Fe, more and more impermeable areas such as roadways and rooftops have been created. These areas, rather than encouraging rain and snowmelt to sink into the soil, create significant runoff which then drains to the town's lowest point—the Santa Fe River channel. In the past, heavy storm flows often overtopped the river's banks, flooding nearby homes and businesses. In response to the floods, the community constructed high, straight retaining walls along the river. While this moved the water quickly away from this section of river, the high walls also sped up the water, causing further incision of the river channel. We are left with a river in downtown Santa Fe that more closely resembles a storm drain than the vital mountain stream it once was.

As agriculture and natural river flows disappeared further downstream in the more rural part of Santa Fe, the river channel and degraded banks were often mined for sand and gravel, which further straightened and deepened the channel. The Santa Fe Watershed Association and its partners (The City and the County) have made great strides in reshaping the streambed to create a more meandering channel that slows running water, when present, allowing it to sink and spread, soaking more water into the ground for plants, animals and people, and the aquifer below.

With these restoration victories, we catch a glimpse of a living river when spring and summer releases from the reservoirs flow through the channel. People return to the river, to play in the water, to cool off, to walk their dogs and greet their neighbors, to watch the Sangre de Cristos blush at the setting sun. In these moments, the river returns to its central place in the lives of Santa Feans. This water is why the city is here, why we're here, why people visit Santa Fe. It is our natural heritage, and that of those who come after us.

What would it take to bring the river back to life?

In order to answer this question, it's important to understand several key points. The river has flowed at different rates throughout its history, depending on whether or not humans were present and the degree to which they irrigated gardens and crops. Historically, in the pre-settlement era, as much as 4,000 acre-feet may have flowed in the river channel only periodically—reaching a peak during snowmelt runoff—and these flows may have extended beyond the old community of Agua Fria. If little



summer rain fell, the river may have run only in isolated stretches, charged with groundwater inflow.

Native American agricultural diversions from the river were probably small and probably didn't significantly alter in-stream flows. After Spanish settlement, though prior to 1881 when the first dam and reservoir was constructed, the same amount probably flowed both in acequia irrigation ditches and the river channel to about Agua Fria.

As we attempt to balance our current human needs with our responsibility to the environment, we need to be mindful that the Santa Fe River has functioned differently over time and what we ultimately decide will be a value judgment based on our current circumstances and perspective. For example, we'll need to decide what kinds of plants and animals we want to support in the riparian corridor and over what length of the river.

The Santa Fe River, like all mountainous rivers, flowed in response to seasonal precipitation patterns. As snow fell and accumulated in winter and water within the stream froze, river flow tended to be at its lowest point. As temperatures increased



in the spring and snow began to melt river flows rose. As temperatures continued to rise in summer, snow disappeared in the high-country, dramatically decreasing river flows. While there may have been trickles of water in the river as shallow groundwater was released into the river, flows were likely low until monsoon rains sent water churning through the channel. Native western plants, insect and animal species have evolved in response to this stream flow pattern, relying on more water in the spring when they do the most of their growing and are more active, and less in the fall and winter when they are dormant or inactive. To be consistent with historic flows and ecological requirements, any planned releases to the river should mimic the natural flow pattern: higher springtime flows followed by lower/intermittent flows as the seasons progress into winter.

Santa Fe's citizens have already demonstrated their support for a living river in three enormously important ways: significant conservation of water at home, volunteer restoration efforts in the river channel and cash donations for the purchase of water rights. The people of Santa Fe, through a combination of City water-demand-offset requirements for new development and conservation incentives for current water customers, have reduced the city's per capita water use almost 50% since 1995—from 190 to 100 gallons per person per day. This important conservation success and the City's efforts to diversify and expand its sources of water supply have allowed up to 1,000 acre-feet to bypass the reservoirs each year and flow into the river channel at periodic intervals. It's not enough water to wet the entire urban reach of the river; it flows to Frenchy's Field depending on contributing rainfall. However, these flows benefit the lower part of the urban channel as well by providing groundwater recharge, the process of water seeping into the ground where it is held by the soil and rock formations, and allowing any rainfall in the channel to progress further downstream.

Additional access to water to support a longer and more robust living river could come from the acquisition of Santa Fe River water rights. Santa Feans donated \$75,000 by rounding up payments on their water bills, matched by \$75,000 from the City, for the purchase of water rights. The City is banking these funds until water rights become available or other beneficial projects are identified.

Taking Action in Your Community

The situation seems overwhelming until we realize that just as many problems stem from our individual actions, the solutions spring from our individual actions as well.

Support the City's efforts to protect the Upper Watershed Review the City's Upper Watershed Plan at www.santafenm.gov/index.aspx?NID=2442

Contact the Santa Fe Watershed Association The association can help you understand the complex issues facing the City in its efforts to provide us all with a safe supply of water and those who advocate for conservation and a closer connection to the natural world.

Become familiar with your watershed Visit the sites listed on page 45. The Santa Fe Watershed Association hosts hikes, river stewardship and celebration events, educational activities and other ways of being involved.

Think about the resources the watershed provides What does water mean to your daily life? How would your life be changed if you didn't have clean water to drink and wash in? Talk to your children about how important our water is and how easy it is to overlook it. Listen to them too. Children have an innate curiosity about the natural world and a love for living things.

Advocate for a living river Visit the Santa Fe Watershed Association website for opportunities to stand up for the Santa Fe River and protect the Upper Watershed.

Take care of your river, acequia and arroyo Don't dump garbage or hazardous materials in the river, acequias or arroyos. Always carry out your own trash and any other trash you find. The Santa Fe Watershed Association hosts river clean-up days; visit sfwa.org for more information.

Watch your water Check for leaky faucets and turn off the water while brushing your teeth or washing dishes. Install water-saving devices such as low-flow shower heads and appliances—they'll save water and money on your water bill.

Get Your School Involved Talk to your teacher about taking a field trip. The Santa Fe Watershed Association and other environmental organizations provide outings for students.

Practice as many of the suggestions offered here as you can You don't have to adopt them all at once. Start with one or two. When they become part of your routine, add a few more. Talk with your family, friends and neighbors about what you're doing to conserve water and preserve Santa Fe's way of life.



Santa Fe's Water History Park and Museum

Santa Fe's long, rich history isn't merely charming, it has a lot to teach us about living more sustainably. In summer 2010, Santa Fe debuted the Water History Park and Museum, a shady spot for relaxing and contemplating our ongoing relationship with our water supply. Near the intersection of Upper Canyon Road and Camino Cabra, the park is on the site of Santa Fe's 19th Century hydroelectric power plant. Creation of the park included restoration of the original power plant building, where a wheel turbine turned with the power of the Santa Fe River, generating Santa Fe's first electricity.

The restored building, once opened as the Water History Park and Museum, will feature exhibits about our water history and is neighbor to a hydroelectrical renaissance. Next door to the museum, a new 100 kilowatt power plant is now generating about \$20,000 worth of savings in electrical operating costs for the water utility and another \$8,000 in additional revenue from Renewable Energy Credit sales. The new hydroelectric project is funded by American Recovery and Reinvestment Act federal economic-stimulus and New Mexico Financing Authority.¹⁷



Photo courtesy of the Palace of the Governors photo archives, MNM Negative # 010599



Alan "Mac" Watson

Go Outside and Play

Santa Fe is an extraordinary place in many ways, not least in the opportunities it offers for outdoor recreation. One of the best ways to learn about and appreciate your watershed is to visit its more obvious elements.

Contact the Santa Fe Watershed Association to learn about programs, events and hikes, including periodic visits to the Santa Fe Municipal Watershed, which is otherwise inaccessible to the public. Other places to go include:

- Audubon New Mexico's Randall Davey Audubon Center and Sanctuary
- The Nature Conservancy's Santa Fe Canyon Preserve

Recent Restoration The Santa Fe Watershed Association and its volunteers, WildEarth Guardians and other contractors, the City of Santa Fe and Santa Fe County and others have made significant efforts to restore sections of the Santa Fe River through changes to a more natural channel, trash collection, pulling non-native plants and reintroducing native grasses, flowers, shrubs and trees. You can see the results of recent efforts southwest of the San Ysidro Crossing in the Village of Agua Fria and at Frenchy's Field. An extensive planting of willows and cottonwoods between Frenchy's Field and Camino Alire is going forward this year.

Progress in Trail Building The City of Santa Fe and Santa Fe County have made great strides in building a more integrated urban trail system in recent years. The paved River Trail now extends from Frenchy's Field to St. Francis Drive (system of sidewalks and walkways continues up river to Palace Avenue). A new foot and bike bridge links Ricardo Road on the West Alameda side to the Paseo de la Conquistadora neighborhood. A stretch of the trail is in place from the San Ysidro Crossing to Hwy 599. In partnership with the City, Santa Fe County intends to complete this southwestern segment and link it with Frenchy's Field.

New segments of the Acequia Trail run from Palomino Street (behind the Indian School), across Baca Street, through the area behind the School for the Deaf and on to the Railyard Park and the Rail Trail. Improvements are ongoing in Ashbaugh Park to link the Casa Alegre neighborhood with the Acequia Trail. The City website's River, Watershed and Trails section has continually updated information about these and other improvement projects, including maps of current and proposed trails sections.

The Santa Fe Watershed Association

The Santa Fe Watershed Association works to return the Santa Fe River to a living river, from the headwaters in the Sangre de Cristo Mountains to the Rio Grande, balancing human uses with natural resource protection and restoring the heart to our community.

- Our goal is to protect the long-term integrity of the Santa Fe River's watershed.
- We engage in education, research, and on-the-ground projects of riparian and watershed restoration, as well as provide input into governmental planning, permits and projects.
- We strive to find common ground among different points of view regarding uses of the river and its watershed.
- We advocate surface and groundwater resource management that balances human use with natural resource protection.
- We encourage government and community leaders to place high priority on sustaining seasonal stream flow in the Santa Fe River, yielding hydrologic, recreational, aesthetic and environmental benefits to the community. We believe that this goal can coexist with providing a reasonable supply for human use.

The Sangre de Cristo Water Division

Mission

Efficiently manage and deliver an adequate, reliable, safe and sustainable water supply to meet community and customer needs in accordance with City of Santa Fe policy.

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Resources and Organizations

Government Agencies and Partners

City of Santa Fe Water Division santafenm.gov/water (look for links to information about conservation practices and incentives, water quality and quantity, education, rates, watershed management, pipes maintenance information, etc.) or (505) 955-4210

City of Santa Fe Water Conservation Office santafenm.gov/waterconservation (offers rebates to help you save water) (505)-955-4225

City of Santa Fe Water Conservation Office Water Waste Hotline (505)-955-4222

Buckman Direct Diversion Project bddproject.org or (505) 955-4206 or (505) 660-5696

City of Santa Fe Wastewater Division santafenm.gov/wastewater or (505) 955-4650

City of Santa Fe Environmental Services / Solid Waste Division santafenm.gov/index.aspx?NID=273 or (505) 955-4201

City of Santa Fe River, Watershed and Trails Division santafenm.gov/index.aspx?nid=336 or (505) 955-6631

Santa Fe County Water Conservation Plan http://www.santafecounty.org/public_works/water_conservation

Santa Fe County Open Space and Trails Program santafecounty.org/public_works/open_space_and_trails_program or (505) 992-9873

Santa Fe County Solid Waste and Recycling Department santafecounty.org/public_works/solidwaste or 505-992-3010 during business hours or 505-992-3017 for recorded information.

New Mexico Environment Department nmenv.state.nm.us/index.html (look under “Programs” for links to drinking water, groundwater quality and surface water quality bureaus) or (505) 827-2855

New Mexico Office of the State Engineer ose.state.nm.us (look for links on water resource management, water use and conservation and water rights) or (505) 827-6091

US Geological Survey Water Resources of the United States water.usgs.gov or 1-888-ASK-USGS (1-888-275-8747)

US Environmental Protection Agency Ground Water and Drinking Water water.epa.gov/drink/index.cfm or 800-426-4791

US Environmental Protection Agency WaterSense epa.gov/watersense/index.html

The following community organizations and businesses represent only some of the people engaged in natural resource protection and related services. Their being listed here in no way constitutes an endorsement of these groups or businesses by the City of Santa Fe. Because Santa Fe’s environmental community is extensive and diverse, residents are encouraged to explore the many different groups and businesses to help them learn more about our natural resources and obtain appropriate services.

Community Organizations

The Santa Fe Watershed Association santafewatershed.org/ or (505) 820-1696

The Nature Conservancy New Mexico nature.org/newmexico or (505) 988-3867

Santa Fe Conservation Trust sfct.org or 505-989-7019

Audubon New Mexico nm.audubon.org or 505-983-4609

Rio Grande Return www.riograndereturn.com or 505-466-1767

Santa Fe Alliance santafealliance.com or 505-989-5362

Wild Earth Guardians wildearthguardians.org or 505-988-9126

Water Quality and Health

Illinois Department of Health Radium in Drinking Water Fact Sheet www.idph.state.il.us/envhealth/factsheets/radium.htm

US Environmental Protection Agency Water on Tap: What you Need to Know water.epa.gov/drink/guide/upload/book_waterontap_full.pdf

Aqua Therapy Center of Santa Fe nmnaturalhealing.com/businesses/view/Aqua_Therapy_Center_of_Santa_Fe

Rainwater Harvesting, Grey Water and Other Irrigation

American Rainwater Catchment Systems Association arcsa.org

HarvestH2o HarvestH2o.com or 505-603-5498

New Mexico Environment Department’s Gray Water Irrigation Guide 2003 www.aquaverdeinc.com/docs/NM-gray-water-irrigation-guide-1-2003.pdf

New Mexico Office of the State Engineer New Mexico Gray Water Guide www.ose.state.nm.us/water-info/conservation/pdf-manuals/NewMexGWGuide.pdf

New Mexico Office of the State Engineer Roof Reliant Landscaping: Rainwater Harvesting with Cistern Systems in New Mexico www.scribd.com/doc/74340226/New-Mexico-Roof-Reliant-Landscaping-Rainwater-Harvesting-With-Cistern-Systems-In-New-Mexico

New Mexico Office of the State Engineer Using Gray Water in New Mexico’s Residential Landscapes www.ose.state.nm.us/water-info/conservation/pdf-manuals/GrayWaterBrochure.pdf

New Mexico Office of the State Engineer Water Reuse in New Developments www.ose.state.nm.us/water-info/conservation/pdf-manuals/WaterReuseBrochure.pdf

Oasis Design oasisdesign.net

Rainwater Harvesting for Drylands and Beyond HarvestingRainwater.com

Sonoma Valley Groundwater Management Plan Slow it, Spread it, Sink it: A Homeowner’s and Landowner’s guide to Beneficial Stormwater Management sscrd.org/rainwater.php

University of Arizona Cooperative Harvesting Rainwater for Landscape Use ag.arizona.edu/pubs/water/az1052/harvest.html

Xeriscaping and Nurseries

Agua Fria Nursery aguafrianurserynm.net
Flora of North America fna.huh.harvard.edu
High Country Gardens highcountrygardens.com
Native Plant Society of New Mexico npsnm.unm.edu
New Mexico Energy, Minerals and Natural Resources Department Santa Fe Pinon Initiative www.emnrd.state.nm.us/fd/santafetrees/future.html
Payne's Nurseries and Greenhouses paynes.com
Plants of the Southwest plantsofthesouthwest.com
Santa Fe Greenhouses santafegreenhouses.com
Xeriscape Council of New Mexico www.xeriscapenm.com

Education

Earthcare International www.earthcare.org or (505) 983-6896
New Mexico State University Cooperative Extension Service extension.nmsu.edu
(look for links on energy and water, natural resources, yard and garden, etc.)
or 575-646-3015
Permaculture Institute permaculture.org or 505-455-0514
Santa Fe Botanical Garden santafebotanicalgarden.org or 505-471-9103
Southwest Environmental Center Restoring Desert Waters program
wildmesquite.org/what-we-do/desert-waters or 575-522-5552
US Department of Agriculture Natural Resource Conservation Service PLANTS Database plants.usda.gov
US Geological Survey Groundwater and Surface-Water Interactions water.usgs.gov/ogw/gws.html
US Geological Survey Water Science for Schools ga.water.usgs.gov/edu

Media

City of Santa Fe Green Guide santafenm.gov/DocumentView.aspx?DID=6679
Green Fire Times greenfiretimes.com
New Mexico Tech New Mexico Earth Matters Newsletter geoinfo.nmt.edu/publications/periodicals/earthmatters/home.html
Permaculture Magazine permaculture.co.uk
Santa Fe New Mexican The Green Line santafegreenline.ning.com
Santa Fe Reporter sfreporter.com/santafe/tag-0-1-Environment.html
Sustainable Santa Fe Guide earthcare.org/resources/sustainable-santa-fe-guide

Climate Change

350.org A grassroots climate crisis resource
City of Santa Fe Basin Climate Change Study santafenm.gov/index.aspx?NID=2577
or (505) 955-4203
New Mexico Climate Change Advisory Group nmclimatechange.us or (505) 827-0351
The Nature Conservancy New Mexico Climate Change Adaptation Project
nmconservation.org/projects/new_mexico_climate_change or 505-988-3867
Southwest Climate Change Network southwestclimatechange.org or (520) 792-8712
Carpe Diem West carpediemwest.org

Water Conservation and Land Management

City of Santa Fe Municipal Watershed Management Plan 2010-2029 santafenm.gov/DocumentView.aspx?DID=4354
City of Santa Fe Planning and Land Use Division Water Use in Santa Fe: A Survey of Residential and Commercial Water Use in the Santa Fe Urban Area February 2001
santafenm.gov/DocumentView.aspx?DID=1427
Johnson Foundation Charting New Waters: A Call to Action to Address US Freshwater Conservation Challenges johnsonfdn.org/aboutus/chartingnewwaters
New Mexico Office of the State Engineer A Water Conservation Guide for Commercial, Institutional and Industrial Users www.ose.state.nm.us/water-info/conservation/pdf-manuals/cii-users-guide.pdf
New Mexico Office of the State Engineer The New Mexico Water Manual: A Water Conservation Guide for Public Utilities www.ose.state.nm.us/water-info/conservation/pdf-manuals/nm-water-manual.pdf
New Mexico Wilderness Alliance El Rio Grande del Norte National Conservation Alliance www.nmwild.org/our-work/el-rio-grande-del-norte-campaign/
Santa Fe Watershed Association Santa Fe River Watershed Restoration Action Strategy, January 2002 http://www.nmenv.state.nm.us/swqb/Santa_Fe_WRAS-2002.pdf
Southwest Hydrology Sustaining the Santa Fe River, pg 29, Jan/Feb 2010 http://www.swhydro.arizona.edu/archive/V9_N1/feature6.pdf
US Environmental Protection Agency Water Pollution Prevention and Conservation Education Toolbox epa.gov/region5/waste/solidwaste/p2pages/toolbox.htm
World Business Council for Sustainable Development Water Facts and Trends V.2 www.unwater.org/downloads/Water_facts_and_trends.pdf
The World Conservation Union Flow: The Essentials of Environmental Flow cmsdata.iucn.org/downloads/flow_the_essentials_of_environmental_flow_dyson_et_al.pdf

Glossary

Adapted with permission from US Geological Survey's Water Science Glossary of Terms

Acequia Acequias are gravity-driven waterways. Most are simple ditches with dirt banks, but they can be lined with concrete. They were important forms of irrigation in the development of agriculture in the American Southwest.

Acid A substance that has a pH of less than 7, which is neutral.

Acre-foot (acre-ft) The volume of water required to cover one acre of land (43,560 square feet) to a depth of one foot. Equal to 325,851 gallons or 1,233 cubic meters.

Alkaline Sometimes water or soils contain an amount of alkali (strongly basic) substances sufficient to raise the pH value above 7.0.

Alluvium Deposits of clay, silt, sand, gravel, or other particulate material that has been deposited by a stream or other body of running water in a streambed, on a flood plain, on a delta, or at the base of a mountain.

Aquifer A geologic formation that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs.

Artificial recharge A process where water is put back into ground-water storage from surface-water supplies such as irrigation, or induced infiltration from streams or wells.

Bedrock The solid rock beneath the soil and superficial rock. A general term for solid rock that lies beneath soil, loose sediments, or other unconsolidated material.

Capillary action The means by which liquid moves through the porous spaces in a solid, such as soil, plant roots, and the capillary blood vessels in our bodies due to the forces of adhesion, cohesion, and surface tension. Capillary action is essential in carrying substances and nutrients from one place to another in plants and animals.

Catastrophic Fire A wildfire that covers more than 100,000 acres of contiguous forestland during the course of a single event.

Condensation The process of water vapor in the air turning into liquid water. Water drops on the outside of a cold glass of water are condensed water. Condensation is the opposite process of evaporation.

Drainage basin Another term for watershed. Land area where precipitation runs off into streams, rivers, lakes, and reservoirs. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large drainage basins, like the area that drains into the Rio Grande, contain thousands of smaller drainage basins.

Drawdown A lowering of the ground-water surface caused by pumping.

Drip irrigation A common irrigation method where pipes or tubes filled with water slowly drip onto crops. Drip irrigation is a low-pressure method of irrigation and less water is lost to evaporation than high-pressure spray irrigation.

Effluent Water that flows from a sewage treatment plant after it has been treated.

Erosion The process in which a material is worn away by a stream of liquid (water) or air, often due to the presence of abrasive particles in the stream.

Evaporation The process of liquid water becoming water vapor, including vaporization from water surfaces, land surfaces, and snow fields, but not from leaf surfaces.

Evapotranspiration The sum of evaporation and transpiration.

Flood An overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, lake or ocean.

Flood plain A strip of relatively flat and normally dry land alongside a stream, river, or lake that is covered by water during a flood.

Freshwater Water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids; generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses.

Giardiasis A disease that results from an infection by the protozoan parasite Giardia Intestinalis, caused by drinking water that is either not filtered or not chlorinated. The disorder is more prevalent in children than in adults and is characterized by abdominal discomfort, nausea, and alternating constipation and diarrhea.

Greywater Wastewater from clothes washing machines, showers, bathtubs, hand washing, lavatories and sinks.

Ground water (1) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturate zone is called the water table. (2) Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust.

Hardness A water-quality indication of the concentration of alkaline salts in water, mainly calcium and magnesium. If the water you use is "hard" then more soap, detergent or shampoo is necessary to raise a lather.

Headwater(s) (1) The source and upper reaches of a stream; also the upper reaches of a reservoir. (2) The water upstream from a structure or point on a stream. (3) the small streams that come together to form a river.

Hydroelectric power water use The use of water in the generation of electricity at plants where the turbine generators are driven by falling water.

Hydrologic cycle The cyclic transfer of water vapor from the Earth's surface via evapotranspiration into the atmosphere, from the atmosphere via precipitation back to earth, and through runoff into streams, rivers, and lakes, and ultimately into the oceans.

Impermeable layer A layer of solid material, such as rock or clay, which does not allow water to pass through.

infiltration A flow of water from the land surface into the subsurface.

Irrigation The controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall.

Kilowatthour (KWH) A power demand of 1,000 watts for one hour. Power company utility rates are typically expressed in cents per kilowatt-hour.

Leaching The process by which soluble materials in the soil, such as salts, nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

Maximum contaminant level (MCL) The designation given by the U.S. Environmental Protection Agency (EPA) to water-quality standards promulgated under the Safe Drinking Water Act. The MCL is the greatest amount of a contaminant that can be present in drinking water without causing a risk to human health.

Municipal water system A water system that has at least five service connections or which regularly serves 25 individuals for 60 days; also called a public water system

Organic matter Plant and animal residues, or substances made by living organisms. All are based upon carbon compounds.

Osmosis The movement of water molecules through a thin membrane. The osmosis process occurs in our bodies and is also one method of desalinating saline water.

Outfall The place where a sewer, drain, or stream discharges; the outlet or structure through which reclaimed water or treated effluent is finally discharged to a receiving water body.

pH A measure of the relative acidity or alkalinity of water. Water with a pH of 7 is neutral; lower pH levels indicate increasing acidity, while pH levels higher than 7 indicate increasingly basic solutions.

Parts per million The number of "parts" by weight of a substance per million parts of water. This unit is commonly used to represent pollutant concentrations.

Pathogen A disease-producing agent; usually applied to a living organism. Generally, any viruses, bacteria, or fungi that cause disease.

Percolation (1) The movement of water through the openings in rock or soil. (2) The entrance of a portion of the streamflow into the channel materials to contribute to ground water replenishment.

Permeability The ability of a material to allow the passage of a liquid, such as water through rocks. Permeable materials, such as gravel and sand, allow water to move quickly through them, whereas impermeable materials, such as clay, don't allow water to flow freely.

Point-source pollution Water pollution coming from a single point, such as a sewage-outflow pipe.

Porosity A measure of the water-bearing capacity of subsurface rock.

Potable water Water of a quality suitable for drinking.

Precipitation Rain, snow, hail, sleet, dew, and frost.

Prescribed Burn A vegetative management tool that is used to maintain fire dependent ecosystems and restore those outside their natural balance. Generally, low intensity prescribed fire is applied by trained experts to clear ground of dangerous fuels like dead wood and brush.

Public supply Water withdrawn by public governments and agencies, such as a county water department, and by private companies that is then delivered to users. Most U.S. household water is delivered by a public water supplier.

Recharge Water added to an aquifer. For instance, rainfall that seeps into the ground.

Reclaimed wastewater Treated wastewater that can be used for beneficial purposes, such as irrigating certain plants.

Reservoir A pond, lake, or basin, either natural or artificial, for the storage, regulation, and control of water.

River A natural stream of water of considerable volume, larger than a brook or creek.

Runoff (1) That part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or ground-water runoff. (2) The total discharge described in (1), above, during a specified period of time. (3) Also defined as the depth to which a drainage area would be covered if all of the runoff for a given period of time were uniformly distributed over it.

Sediment Usually applied to material in suspension in water or recently deposited from suspension. In the plural the word is applied to all kinds of deposits from the waters of streams, lakes, or seas.

Seepage (1) The slow movement of water through small cracks, pores, Interstices, etc., of a material into or out of a body of surface or subsurface water. (2) The loss of water by infiltration into the soil from a canal, ditches, laterals, watercourse, reservoir, storage facilities, or other body of water, or from a field.

Septic tank A tank used to detain domestic wastes to allow the settling of solids prior to distribution to a leach field for soil absorption. A settling tank in which settled sludge is in immediate contact with sewage flowing through the tank, and wherein solids are decomposed by anaerobic bacterial action.

Sewage treatment plant A facility designed to receive the wastewater from domestic sources and to remove materials that damage water quality and threaten public health and safety when discharged into receiving streams or bodies of water. The substances removed are classified into four basic areas:

- (1) Greases and fats;
- (2) Solids from human waste and other sources;
- (3) Dissolved pollutants from human waste and decomposition products; and
- (4) Dangerous microorganisms.

Most facilities employ a combination of mechanical removal steps and bacterial decomposition to achieve the desired results. Chlorine is often added to discharges from the plants to reduce the danger of spreading disease by the release of pathogenic bacteria.

Sewer A system of underground pipes that collect and deliver wastewater to treatment facilities or streams.

Solvent A substance that dissolves other substances, thus forming a solution. Water dissolves more substances than any other, and is known as the “universal solvent.”

Spring A water body formed when the side of a hill, a valley bottom or other excavation intersects a flowing body of groundwater at or below the local water table, below which the subsurface material is saturated with water.

Storm sewer A sewer that carries only surface runoff, street wash, and snow melt from the land. In a separate sewer system, storm sewers are completely separate from those that carry domestic and commercial wastewater (sanitary sewers).

Stream A general term for a body of flowing water; natural water course containing water at least part of the year. In hydrology, it is generally applied to the water flowing in a natural channel as distinct from a canal.

Surface water Water that is on the Earth’s surface, such as in an arroyo, stream, river, lake, or reservoir.

Transpiration Process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface, such as leaf pores. See evapotranspiration.

Tributary A smaller river or stream that flows into a larger river or stream. Usually, a number of smaller tributaries merge to form a river.

Wastewater Water that has been used in homes, industries, and businesses that is not for reuse unless it is treated.

Wastewater-treatment return flow Water returned to the environment by wastewater-treatment facilities.

Water cycle The circuit of water movement from the oceans to the atmosphere and to the Earth and return to the atmosphere through various stages or processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transportation.

Water quality A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Water table The top of the water surface in the saturated part of an aquifer.

Watershed The land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large watersheds, like the Mississippi River basin, contain thousands of smaller watersheds.

Water treatment The act or process of making water more potable or useful as by purifying, clarifying, softening or deodorizing it.

Well An artificial excavation put down by any method for the purposes of withdrawing water from the underground aquifers. A bored, drilled, or driven shaft, or a dug hole whose depth is greater than the largest surface dimension and whose purpose is to reach underground water supplies or oil, or to store or bury fluids below ground.

Xeriscaping A method of landscaping that uses plants that are well adapted to the local area and are drought-resistant. Xeriscaping is becoming more popular as a way of saving water at home.

Sources Cited

1. Cherie Scheick and Frances Levine, "Introduction to the Archaeology of the Santa Fe River Valley," in *Return of the River*, ed. A. Kyce Bello (Santa Fe: Sunstone Press, 2010), 28.
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The Sangre de Cristo Water Division delivers reliable and safe drinking water to the residents of Santa Fe.



The Santa Fe Watershed Association works to return the Santa Fe River to a living river, from Lake Peak to the Rio Grande, balancing human uses with natural resource protection and restoring the heart to our community.



Santa Fe
WATERSHED
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