CONSERVATION

Regional Water Awareness Handbook

CENTRAL YAVAPAI COUNTY

Water and Climate

Central Yavapai County

Energy and Water Connection

Outdoor Water Connection

Water - Essential for all life

This workbook is a regional resource designed to guide and assist citizens in their efforts to conserve water, with an emphasis on the reduction of outdoor water use. It could not have been written and produced without the dedication, professional advice and financial support provided by numerous individuals and groups.

Special Thank You to the:

Citizens of this region who continue to support the work of water conservation education and the responsible use of our limited resource.

U.S. Bureau of Reclamation for the funding necessary to produce this workbook and continue our regional water conservation efforts.

Prescott Active Management Agency (AMA)
Upper Verde River Watershed Protection Coalition
Includes the member communities:
Yavapai County Water Advisory Committee
Yavapai Prescott - Indian Tribe
Town of Chino Valley
Town of Prescott Valley
Town of Dewey-Humboldt
City of Prescott

Upper Verde River Watershed Protection Coalition

Principal Authors and Project Manager:
Shaun Rydell, Water Conservation Coordinator- City of Prescott
Amelia Ray – Masters Student – Prescott College

U.S. Department of the Interior Bureau of Reclamation

Editor:
Shaun Rydell 2009
Cover Photography by Kim Webb

WaterSmart

Sections

Horticulture Page www.ag.arizona.edu/yavapai/anr/hort/index.html

ARID-SOUTHWEST GARDENING INFORMATION
University of Arizona Gardening Portal www.ag.arizona.edu/gardening/

ARIZONA PLANT CLIMATE ZONES
Introduction to Arizona's Climate with a Map and Zone Descriptions www.ag.arizona.edu/yavapai/anr/hort/climate/intro.html

BACKYARD GARDENER
Weekly newspaper columns by Jeff Schalau, Yavapai County Agriculture & Natural Resources Agent www.ag.arizona.edu/yavapai/anr/hort/byg/index.html

GOPHER CONTROL PAGE
Biology, behavior, and methods of control of backyard pocket gophers
www.ag.arizona.edu/yavapai/anr/hort/gopher/gophercontrol.html

INSECT AND DISEASE IDENTIFICATION
Descriptions, locations, dates, and photos of samples found by Agent or brought to the Yavapai County Cooperative Extension Offices by clientele www.ag.arizona.edu/yavapai/diagnostics/index.html

XERISCAPE PLANT LIST
250 water conserving landscape plants for3,000 to 5,500 foot elevations in Yavapai County
www.ag.arizona.edu/yavapai/anr/hort/xeriscape/

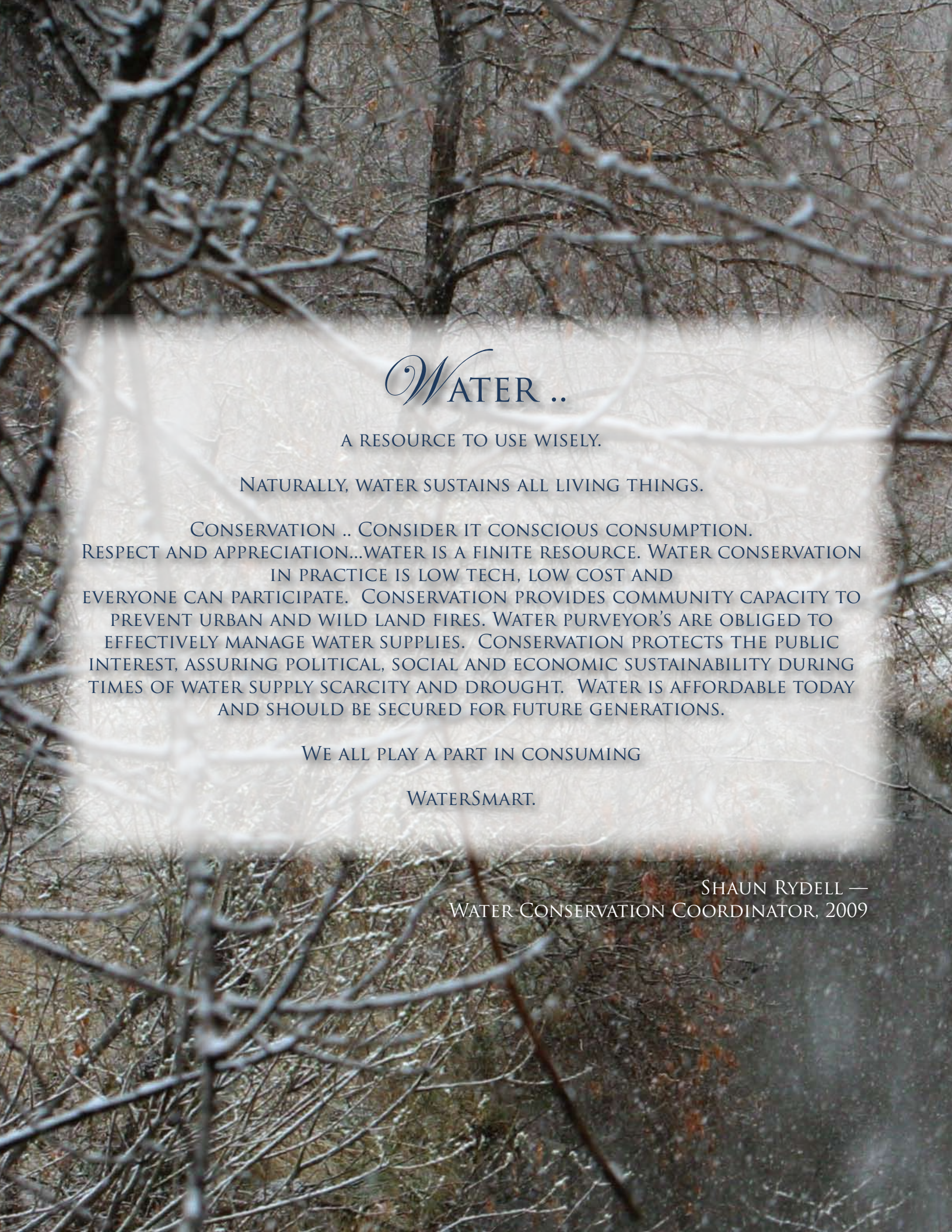
HORTICULTURE LINKS
These sites are informative and reliable www.ag.arizona.edu/yavapai/anr/hort/links/index.html

WILDFIRE DEFENSIBLE/SURVIVABLE LANDSCAPE TOPICS
www.cals.arizona.edu/yavapai/anr/defspace/index.html

ARIZONA MASTER GARDENER MANUAL
Gardening reference guide used to teach the Arizona Master Gardener Course
www.ag.arizona.edu/pubs/garden/mg/

MASTER GARDENER PAGE
Information for Yavapai County Master Gardeners: Newsletter, Reporting, and On-Line Manual
www.ag.arizona.edu/yavapai/anr/hort/mastergardener/

Cooperative Extension is the outreach arm of The University of Arizona College of Agriculture and Life Sciences, Tucson, Arizona.



Water ..

A resource to use wisely.

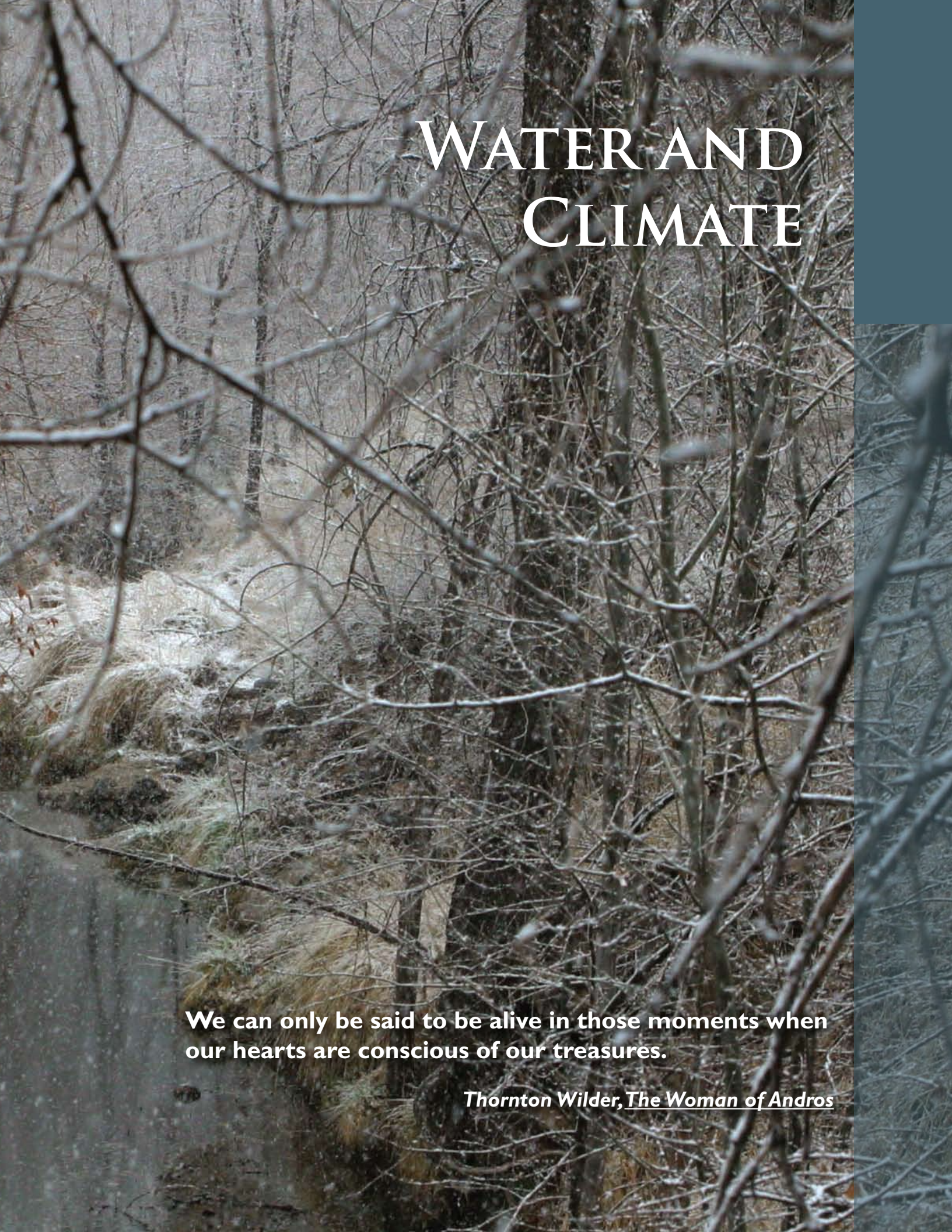
Naturally, water sustains all living things.

Conservation .. Consider it conscious consumption.
Respect and appreciation...water is a finite resource. Water conservation in practice is low tech, low cost and everyone can participate. Conservation provides community capacity to prevent urban and wild land fires. Water purveyor's are obliged to effectively manage water supplies. Conservation protects the public interest, assuring political, social and economic sustainability during times of water supply scarcity and drought. Water is affordable today and should be secured for future generations.

We all play a part in consuming

WaterSmart.

Shaun Rydell —
Water Conservation Coordinator, 2009



Water and Climate

We can only be said to be alive in those moments when our hearts are conscious of our treasures.

Thornton Wilder, The Woman of Andros

A Global Water Primer

Global water consumption has risen tenfold since 1990, and many parts of the world are now reaching the limits of their supply. The United Nations Educational, Scientific and Cultural Organization (UNESCO) predict that by 2020 water shortages will be a serious worldwide problem. One third of the population is already facing crises due to both water shortages and poor drinking water quality. Negative effects include massive outbreaks of disease, malnourishment and crop failure. Excessive use of water has also resulted in environmental degradation costing the world billions of dollars.

How much water is there?

Only three percent (3%) of all water on the earth is fresh water, the rest of earth's water is saline water located in oceans. Two percent (2%) of fresh water is contained in glaciers and icecaps, and located beneath the surface as groundwater. About one percent (1%) of all other fresh water is surface water found in streams, rivers, lakes, wetlands, and swamps.

Earth's Water 100%

Saline Water (Ocean)	97%
Fresh Water	3%

Fresh water 3%

Groundwater	30.1%
Icecaps and Glaciers	68.7%
Other - wetlands and swamps	0.9%
Fresh Surface Water	0.3%

Fresh Surface Water 0.3%

Rivers	2%
Swamps	11%
Lakes	87%

Fresh water is an essential component of the natural environment that supports human, plant and animal life.

Everything in life - food, buildings, vehicles, furniture, and clothing - has embodied water, the amount of water directly or indirectly used during production. "The general public is – although often aware of energy requirements – hardly aware of the water requirements in producing their goods and services." A water footprint is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual, business or nation. The table below lists the amount of water necessary to produce some everyday items.

Everyday Item	Quantity Consumed	Embedded Water
1 Glass of beer	16 Fl oz	40 Gallons
1 Glass of Milk	8 Fl oz	61 Gallons
1 Cup of Coffee	8 Fl oz	74 Gallons
1 Cup of Tea	8 Fl oz	9 Gallons
1 Slice of Bread	1 oz	11 Gallons
1 Potato	3.5 oz	7 Gallons
1 Apple	3.5 oz	18 Gallons
1 Cotton T-shirt	8.8 oz	526 Gallons
1 Glass of Wine	8 Fl oz	64 Gallons
1 Glass of Apple Juice	8 Fl oz	57 Gallons
1 Glass of Orange Juice	8 Fl oz	51 Gallons
1 Bag of Potato Chips	7 oz	49 Gallons
1 Egg	1.5 oz	36 Gallons
1 Hamburger	5.5 oz	632 Gallons
1 Tomato	2.5 oz	3 Gallons
1 Orange	3.5 oz	13 Gallons
1 Pair of Shoes (Leather)	two	2105 Gallons
1 Microchip	0.07 oz	8 Gallons

Global Perspective on Water Resources:

United Nations Educational, Scientific and Cultural Organization (UNESCO) www.unesco.org/water/

Water Footprint:
www.waterfootprint.org
www.waterfootprint.org/Reports/Hoekstra_and_Chapagain_2007.pdf

Treehugger:
www.treehugger.comfiles/2008/ 02/ carbon-footprint-green-basics.php

Google Maps Walk:
www.maps.google.com/maps

THE SAFE DRINKING WATER ACT (SDWA) OF 1974 REPRESENTS THE FIRST TIME THAT PUBLIC DRINKING WATER SUPPLIES WERE PROTECTED ON A FEDERAL (NATIONAL) LEVEL IN THE UNITED STATES. AMENDMENTS WERE MADE TO THE SDWA IN 1986 AND 1996.

STATES OF WATER

Water can exist as each of the three states of matter: liquid, solid, and gas.

• **Liquid** — the most common form of water. We see it as lakes, streams, and oceans and in the glasses of water we drink.

• **Solid** — also known as ice. Snow and hail also make up the "frozen" or solid water.

• **Gas** — called water vapor or steam.

Water – Always in motion changing forms yet remaining true to its molecular structure, charting its course through an incredible journey.

Evaporation is the process where water changes from a liquid to a gas. When water vapor (or droplets) come together in the sky, they form clouds.

Condensation is the process by which water changes from a gas to a solid or liquid.

Precipitation is the process by which the condensed water in the clouds returns to the earth. Depending on the temperature, precipitation can be rain, snow, ice or hail.

Transpiration is the process by which living plants release water vapor into the atmosphere.

Percolation is the downward movement of water from the surface of the earth into below ground aquifers.

"On the days I use lessons from Arizona Project WET, my classroom becomes alive with curiosity and discovery. These are the days I experience the most joy as a teacher."

Cathy Alger, 7th Science, Bradshaw Mountain Middle School, Dewey, AZ

WATER EDUCATION AND TEACHING RESOURCES

Project Wet – Water Education for Teacher- www.cals.arizona.edu/arizonawet/
Arizona Department of Environmental Health- www.azdeq.gov/ceh/
Arizona Game and Fish- www.azgfd.gov/
Food, Lwand and People- www.foodlandpeople.org/
One World Journeys- www.oneworldjourneys.com/low/resources/
National Parks Service – Tumacacori- www.nps.gov/tuma/forteachers/index.htm
Environmental Kids Club – EPA- www.epa.gov/kids/

WATER

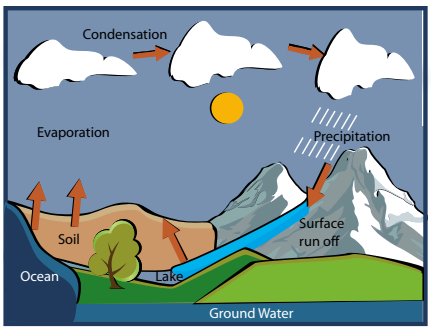
Molecules of water continually move from one state to another, in the air as vapor, as liquid and sometimes as ice. Without this cycle, people and most living things could not survive on this planet.

WATER CYCLE

Earth has a finite amount of water that circulates through the hydrologic (water) cycle with no beginning or end. Powered by the sun's energy, water changes states among **gas**, **liquid**, and **solid** as it moves through the atmosphere, along the earth's surface, and underground.

Precipitation falls from clouds to the surface in the form of rain or snow. Desert areas are prone to a type of precipitation, known as **virga,** which starts out as rain but evaporates before it reaches the ground. Precipitation that falls on land becomes surface runoff, groundwater, or evaporates. Runoff flows along the land surface into streams, lakes, and oceans. Water that seeps into the soil is available to be absorbed by plants or is held beneath the surface as groundwater.

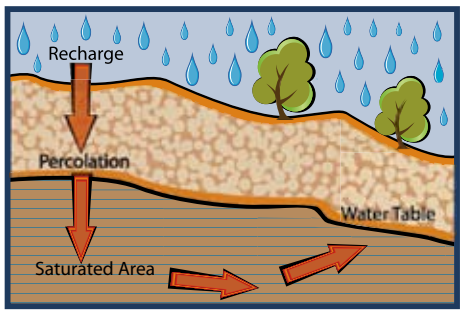
The sun heats surface water turning it into water vapor through **evaporation. Transpiration** occurs as plants lose water from their leaves. Water vapor generated through this process is known as **evapotranspiration. Vapor** enters the atmosphere, cools and condenses to form clouds in a process called **condensation**. Eventually, moisture builds up in the clouds and precipitation falls back to the Earth's surface, and the cycle continues.



GROUNDWATER

Groundwater is water below the land surface. It is replenished by natural recharge that occurs when precipitation **percolates** through the ground into an aquifer. An aquifer is a subsurface layer of earth, gravel or porous rock that yields water.

Gravity pulls the water downward where it fills the spaces between particles of soil, sand, gravel, and rock until it reaches a depth where the ground is filled, or saturated. This area is the **saturated zone** and the top of this zone is the **water table**. The zone above the water table is the **unsaturated zone**; spaces between particles are dry or only partially filled with water.



Groundwater is found in the saturated zone. The water table level rises and falls with the seasons and climatic changes, such as drought or heavy rainfall. Groundwater is stored in the pores and cracks of underground materials. Gravity pulls it slowly through the ground toward places where it can enter a water well, stream or lake as a spring, or be absorbed by a plant root.

The bottom of an aquifer is defined by bedrock or another impermeable surface. Groundwater movement can be interrupted by a layer of clay or impermeable rock.

AQUIFERS

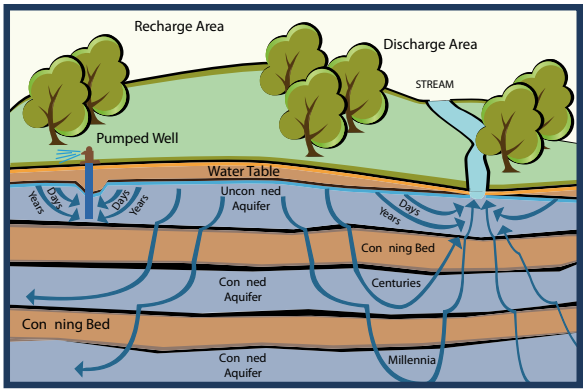
An **aquifer** is an underground layer of saturated material, soil or permeable rock, which yields water to wells and springs in significant and useful amounts. Wells are commonly drilled to pump water from the aquifer to the surface for use by people for drinking, domestic purposes, agriculture, and industry. Aquifers vary greatly in size, shape, and capacity. Some are confined and others unconfined.

Confined aquifers are overlaid by an impermeable, or confining, layer through which water cannot escape upward. Water entering the aquifer from a higher elevation in an unconfined area can apply pressure on the water in the confined portion of the aquifer. Some confined aquifers produce artesian wells if the pressure on the aquifer forces water to surface when the aquifer is penetrated by a well.

Unconfined aquifers do not have an impermeable top layer, are saturated with water to the top of the water table, and are readily pumped for human use.

Aquifers and groundwater can be naturally or artificially recharged.

Natural recharge occurs when precipitation falls to the surface and percolates through the ground into an aquifer. The rate of recharge depends on several factors including the amount of precipitation, topography of the land, type of subsurface material, and aquifer depth. In some cases, recharge can take days and in others, it can takes centuries.



Artificial recharge occurs when people intentionally add water to aquifers through either groundwater injection or infiltration pits. Groundwater injection requires high-pressure pumps to infuse the aquifer with water through injection wells. Water can also be spread over a land area with infiltration pits, furrows, or ditches allowing it to rapidly seep into the aquifer.

SPRINGS AND CREEKS

Springs occur where groundwater meets the land surface. Water that recharges groundwater will fill an aquifer and naturally needs a place to exit. Groundwater, discharged in springs, is largely recycled water, a part of the hydrologic cycle in which rain falls on land. It is stored underground, released to the surface, and returns to the atmosphere by a variety of means, to fall as rain again. A large amount of this water remains beneath the surface for use by plants, and runs off into surface rivers and streams.

Granite Creek and its tributaries begin in the Prescott National Forest at the junction of the Bradshaw and Sierra Prieta Mountains and then flow through the Prescott Basin. Fluctuations in the groundwater levels of the Upper Granite Creek Watershed (a.k.a. Prescott Basin) are directly caused by the intermittent flow of water in Prescott's eight creeks. These creeks are the beginning of the Verde River.

Springs occur where groundwater meets the land surface.

GROUNDWATER RESOURCES

Water Resources of the United States- www.water.usgs.gov/ogw
Water Science for Schools- www.ga.water.usgs.gov/edu/earthgwaquifer.html
Prescott Creeks- www.prescottcreeks.org/index.htm
The Water Cycle- www.ga.water.usgs.gov/edu/watercyclesprings.htm

Drought and Drought planning

Precipitation below average over an extended period of time and resulting in long-term water shortages is known as drought. A dry spell is precipitation below a defined amount for a short duration. Unlike drought, a region can quickly recover from a dry spell after one or several bouts of precipitation.

Droughts are a natural component of the climatic cycle in regions throughout the world. Scientists identify and analyze climatic events that have occurred throughout earth's history to define patterns, better understand how climate has impacted life, and more accurately predict future events. A method used to identify climatic patterns is the study of successive annual tree growth rings, a science known as dendrochronology. Through tree ring analysis, scientists can identify occurrences and determine the severity of past droughts.

The southwestern United States, particularly Arizona as a semi-arid state, is a region characterized by climatic cycles that include drought. It is an area where water is scarce even when precipitation is normal. There is a widely held belief that drought contributed to the collapse of the ancient Anasazi civilization in Chaco Canyon, New Mexico.

Arizona currently is experiencing a significant and ongoing drought; precipitation has been below average for 15 years. Although drought can be disastrous, few consider it a natural disaster since the effects are less noticeable and develop slowly over time. One big rain will not cure drought conditions. It requires numerous, consistent precipitation events, and can take years to reverse the impact.

Planning

Throughout the U.S., emphasis historically has been placed on emergency relief after drought and damage has occurred. Several states, including Arizona, have shifted their focus to preparing for and mitigating the effects of drought with the goal of preventing future emergency situations.

The State of Arizona Governor's Drought Task Force, established to assess and address the impact of current drought conditions on the people of Arizona, published the Arizona Drought Preparedness Plan in 2004. It defines drought as "a sustained, natural reduction in precipitation that results in negative impacts to the environment and human activities."

Goals of the drought preparedness plan are to identify the effects drought has on water users, define drought-sensitive areas, outline monitoring programs, and prepare strategies to reduce the effects of drought. Personnel with the Arizona Department of Water Resources' Statewide Drought Program and Statewide Conservation Offices are responsible for plan implementation.

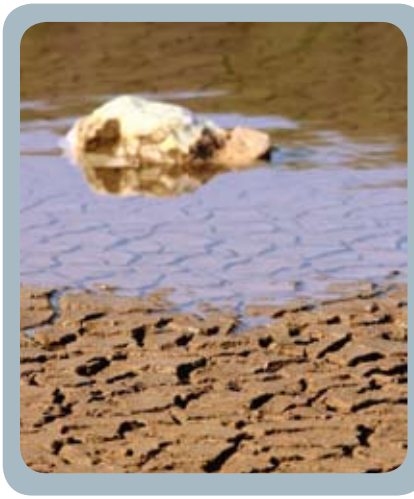
Drought conditions can require communities to enact water use restrictions that are designed to incrementally reduce water use and go beyond typical conservation programs. The ultimate goal of a drought preparedness plan is to address and anticipate future water needs so there is never a need to declare an advanced stage of drought. Conservation, as well as augmenting supplies, are both important in achieving this goal.

Climate cannot be controlled by humans, but through a lifestyle of stewardship and careful planning, the effects of drought on water supplies, people and the environment can be lessened.

What can each of us do?

Be aware of our own household water consumption. If you water outdoor landscape, pay special attention to your outdoor water use. Once plants are established, water deeply and less often. Consider harvesting rainwater to irrigate outdoor ornamental gardens. Provide supplemental water to those trees and shrubs nearest your home.

The Urban Water Cycle and its relationship to Drought. *Water stewardship begins with understanding that water supplies, from source to tap, flow through a series of four inter-related stages in a continuous cycle. Sustaining this cycle is imperative to the health of the community. Urban planning, without consideration of the water cycle, can lead to water supply shortages. All citizens, institutions, agencies and enterprises within a community have a responsibility to use water with the goal of economic, social and environmental sustainability.*



Resources

Drought/Climate/Dendrochronology Research:

University of Arizona Laboratory of Tree Ring - www.ltrr.arizona.edu
Climate Assessment for the Southwest - www.ispe.arizona.edu/climas/
US Geological Survey Arizona Water Science Center - www.az.water.usgs.gov
Arizona Community Water System Drought and Planning Tool - www.azwater.gov/dwr, droughtplan.arid.arizona.edu/showMap.ditt

Climate

Climate is defined by the weather patterns of an area. Yavapai County is characterized by its mild four-seasons, and is classified as a semi-arid region with the majority of precipitation falling from early July through mid-September and January through March.

Winter precipitation falls as moderate rain in the lowlands and snow in the highlands and mountains. Summer precipitation is typified by monsoon thunderstorms during July and August. Thunderstorms vary in intensity and location primarily occurring between noon and 8 p.m. Fall and spring are dry seasons. The elevation range guarantees varied weather including cool winters, warm summers, and moderate humidity. Temperature fluctuations of about 35 degrees from the nighttime low to the daytime high are typical.

Large-scale farming is limited in the local region due to a relatively short growing season. Anxious spring gardeners should note that average freezing temperature (32°F) identified for spring is May 16. Look for the first frost in the fall around October 10. For additional backyard gardener information, refer to the Yavapai County Extension article ***Cold Temperatures Can Harm Plants.***

Records are maintained of annual precipitation rates, including rain and snowfall.

- **The City of Prescott** receives about 19 inches of annual precipitation. Temperatures from November through April range from 20° to 60°F. Temperatures from May through October range from 50° to 90°F.
- **Towns of Chino Valley, Prescott Valley & Dewey-Humboldt** receive 12-14 inches of annual precipitation. Temperatures from November through April range from 25° to 65°F. Temperatures from May through October range from 55° to 95°F.

The National Oceanic and Atmospheric Administration

NOAA was established as part of the U.S. Department of Commerce on October 3, 1970. The mission of NOAA is to assess the socioeconomic impact of natural and technological changes in the environment and to monitor and predict the state of the solid Earth, the oceans and their living resources, the atmosphere, and the space environment of the Earth.

Resources

Backyard Gardener- www.ag.arizona.edu/yavapai/anr/hort/byg/archive/colddamage.html
National Weather Service- www.nws.noaa.

Microclimates

Microclimates play an important role in determining the varieties of plants that will grow in landscapes. A microclimate is the local climate on a small site. They are formed by hills and valleys, structures, paved areas, hedges and windbreaks. These features alter airflow patterns, day length and/or light intensities, as well as trap heat during the day, slowly releasing it at night. Minimum winter temperature, frost occurrence, maximum summer temperatures, and rainfall amount and distribution also impact microclimates.

Urban growth has contributed to the formation of microclimates primarily due to a phenomenon known as the heat island effect. Cities have higher air temperatures than surrounding less populated areas. This is caused by large expanses of concrete and asphalt that collect solar heat. For example, summer high temperatures have increased significantly in both Tucson and Phoenix over the past forty years. The warmer, drier environment of urban heat islands has a strong impact on landscape plant performance.

Evaporation and Transpiration

Evaporation is the return of water to the atmosphere from surfaces such as streams, lakes, puddles, ponds, and soil pores. Plants contribute water vapor to the atmosphere through a process called transpiration. Scientists refer to these processes, that often occur at the same time, as evapotranspiration. The rates of both evaporation and transpiration depend on wind speed, and temperature and humidity, which are influenced by latitude, elevation, and proximity to bodies of water. Transpiration also varies by plant species, growing season and with the amount and type on vegetation.

RESOURCES

www.ispe.arizona.edu/climas/forecasts.html.

Arizona Plant Climate Zones
www.cals.arizona.edu/yavapai/anr/hort/climate/azclimatezonemap.html

www.rainlog.org/usprn/html/main/maps.jsp

Yavapai County Climate Data at the Western Regional Climate Center
www.wrcc.dri.edu.

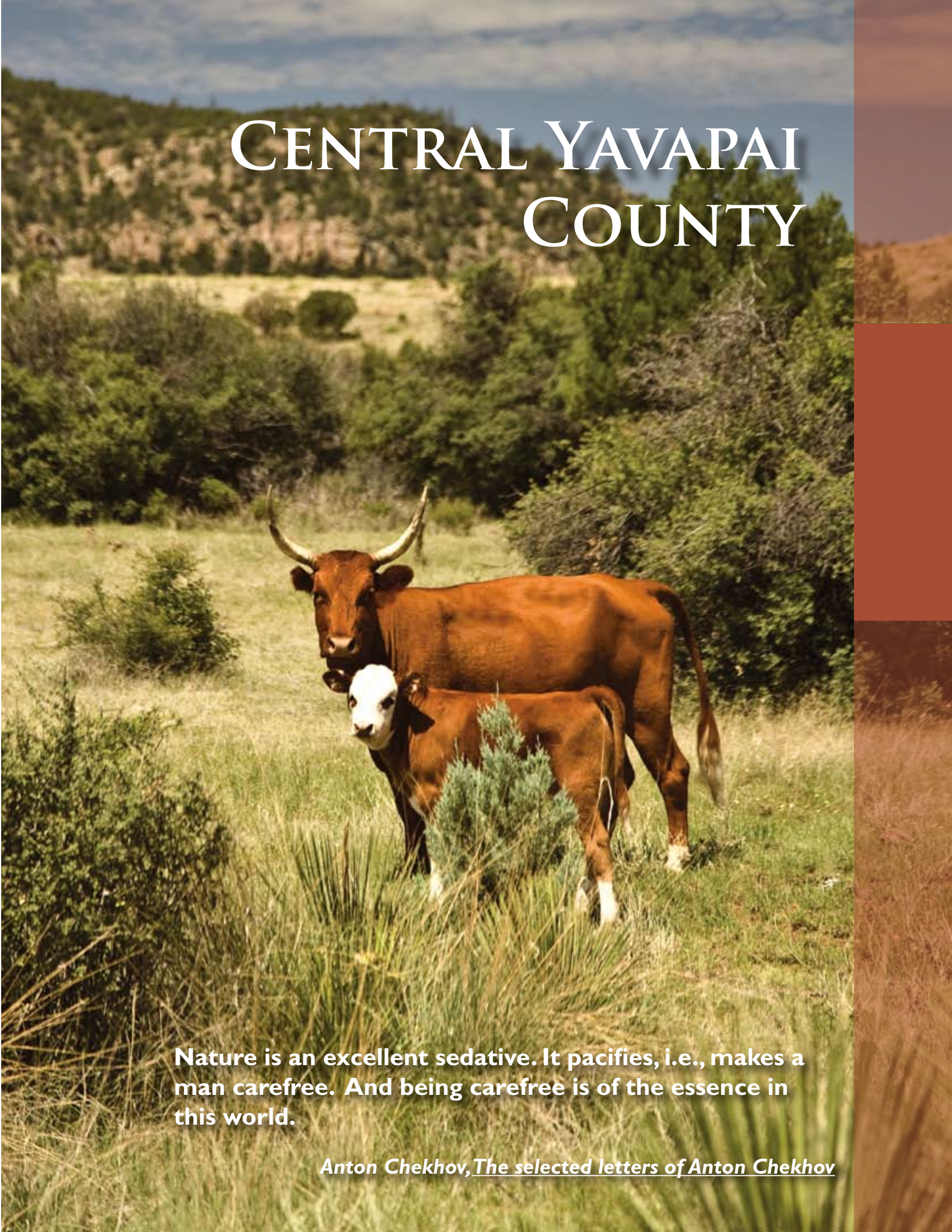
Arizona Climate Data
www.wrcc.dri.edu/summary/climsmaz.html.

National Weather Service
www.nws.noaa.gov

Photo by David Morgan

Plants contribute water vapor to the atmosphere through a process called transpiration. Scientists refer to these processes, that often occur at the same time, as evapotranspiration.

Central Yavapai County



Nature is an excellent sedative. It pacifies, i.e., makes a man carefree. And being carefree is of the essence in this world.

Anton Chekhov, The selected letters of Anton Chekhov

GEOGRAPHY, TOPOGRAPHY, FLORA AND FAUNA

"So it is time to call for a new era of water conservation in our country. We need to start treating water like the most precious resource we have – wherever we live. We need to realize that the more we waste water, the less water is available for our neighbors, as well as the fish and wildlife in our local streams. Ultimately, wasting water hurts not only the environment, but our local economies, recreation opportunities and our quality of life."

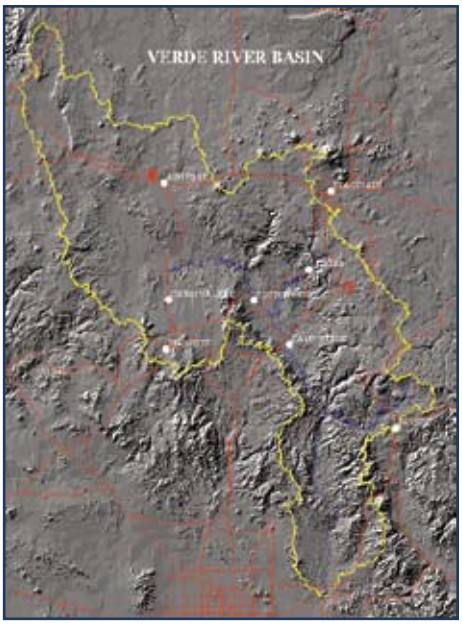
Rebecca Wodder, President-- American Rivers

Yavapai County is a geographic area characterized by elevations from 1,900 to 8,000 feet. Like the state, which is rated as one of the five top biodiverse areas in the country, the county is home to a wide variety of plant and animal species. The 8,128 square mile area is equivalent in size to the State of New Jersey, yet only five of those miles hold water.

Three distinct topographic regions define the area: plateau uplands to the north of the Coconino Plateau; central highlands transition to the east of the Mogollon Rim; and the basin and range of the Sonoran Desert.

Yavapai County is primarily situated in the central highlands region, but extends south to the Sonoran Desert, and is generally characterized by widespread forests of mixed conifers and ponderosa pines. The county lies in the center of a 100-mile strip of Ponderosa pine forest land that crosses the state from its northwest corner to eastern border. It is home to the Prescott National Forest, as well as portions of the Kaibab, Coconino, and Tonto National Forests. Native vegetation includes mixed conifer, pinõn-juniper, chaparral, desert grassland, and flora of the upper Sonoran Desert.

Geographically, the quad cities of the Prescott AMA are located at the foot of the northern end of the Bradshaw Mountains in central Arizona with ranging elevation from 3,500 to 6,000 feet. To the south, mountains rise to peaks of 7,900 feet; to the north terrain slopes gently down the valley of Granite Creek to its junction with the Verde River.



RESOURCES

Chamber of Commerce
www.azcommerce.com/doclib/commune/yavapai%20county.pdf

Extension Service
www.cals.arizona.edu/yavapai/anr/nr/naturalresourcesofyavapaicounty.html

Yavapai County
www.co.yavapai.az.us/

Flood Alert
www.co.yavapai.az.us/FloodALERT.aspx

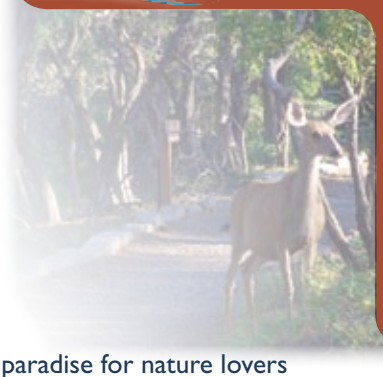
Wikipedia
www.en.wikipedia.org/wiki/Yavapai_County,_Arizona

Geographic descriptors include the high altitude desert (elevation 3,500-5,000 feet) the cool plateau highlands (elevation 4,000-6,000 feet).

Everyday we use water in so many different ways. Civilization would not exist without water. We are just one of many of earth inhabitants that influences the efficient use or waste of water, the precious resource.

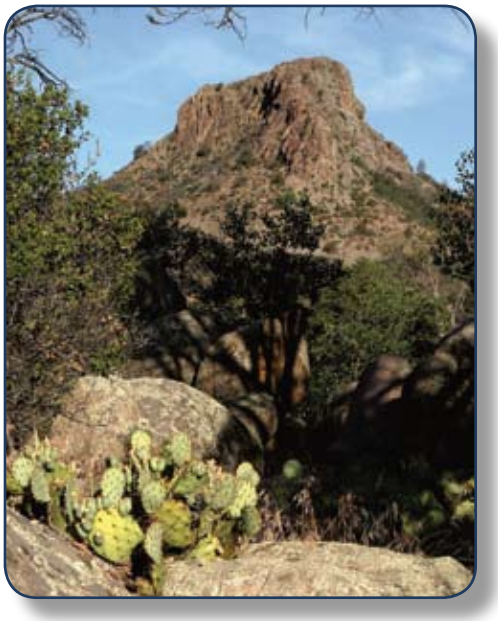
Clarke R. Water: The International Crisis

A Western Gem Set in Central Arizona



Yavapai County was one of four original Arizona Counties created by the 1st Arizona Territorial Legislature. The county territory was defined as being east of latitude 113° 20' and north of the Gila River. Soon thereafter, the counties of Apache, Coconino, Maricopa, and Navajo were carved from the original Yavapai County. Yavapai County's present boundaries were established in 1891.

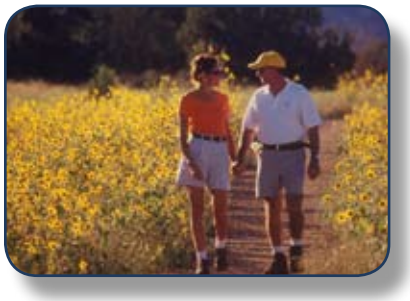
The county is named after the Yavapai people, who were the principal inhabitants at the time that this area was annexed by the United States.



Yavapai County, Arizona is one of the jewels of the west. It is a region of breathtaking natural beauty dotted with quaint, mountain communities. Nestled amid this magnificent scenery, and steeped in Old West and Native American history is the quad city area of Prescott, Prescott Valley, Chino Valley and Dewey-Humboldt. In addition to the quad city area the county includes such magnificent surrounding communities as the Verde Valley, Cottonwood, Camp Verde, Clarkdale and Sedona.

Blessed with clean air, a mild year round climate, endless blue skies and majestic views, residents of the quad cities enjoy a superior quality of life. This place has an allure all its own, where people come to visit and decide to stay and call this area home. Wide expanses of open space, miles and miles of hiking trails, stunning natural beauty, superb recreational activities, thriving economies, and all of the amenities one would associate with a larger urban area, make north central Arizona one of the most desirable areas to live in the country.

The region is home to Yavapai College, a multi-campus community college system; three four-year colleges, Embry-Riddle University, Prescott College and Northern Arizona University; a state-of-the-art hospital with locations in Prescott and Prescott Valley, and Bob Stump Veteran's Administration Medical Center.



This is a paradise for nature lovers and outdoor enthusiasts with limitless opportunities for golf, hiking, backpacking, camping, fishing, biking, horseback riding, bird watching, star gazing, rock climbing, boating, and picnicking. Residents revel and live in awe and appreciation of the natural wonders that permeate the area.

History buffs will also find Yavapai County to be a region of wonders with its passed down lore and historical sagas. It is the stuff of legends; rich Native American ancestry and intricate tales of mining, ranching, farming and the cowboy life. Residents can explore old mines, visit Indian ruins, participate in archaeological digs, stroll around the grounds of Sharlot Hall Museum, comb through the museum's exhaustive archives, visit an old homestead, pan for gold or marvel in the mystical red rocks.

Reprinted in part from Building Yavapai 2008, YCCA

Prescott

Prescott (pronounced Preskit) is perhaps the most well known and, with a population of about 43,280 the largest of the communities. With its historic downtown, famed Whiskey Row and picturesque courthouse square, this small city exemplifies the Old West. Surrounded by the Prescott National Forest and tucked into the pines, Prescott is routinely included among the top places to live in the United States. Thumb Butte, Granite Mountain and Granite Dells are among the region's most famous natural features. One never ceases to be amazed by this splendid natural backdrop and the boundless views that characterize the mile high city. Known as "everyone's hometown," Prescott continues to be a community of neighborhoods with tiny streets secluded in the pines, such as the picture perfect postcard Pinecrest Historic District. Residents and tourists alike spend hours strolling through art galleries, combing the antique stores, and shopping in the boutiques that line the charming downtown streets.

Prescott Valley

Prescott Valley, incorporated in the 1970s, boasts a new civic center that is home to the Arizona Sundogs hockey team, a bustling, pedestrian-friendly downtown and entertainment district, 10 public parks and a recently developed community recreation area that includes softball and soccer fields, a public swimming pool, and basketball and tennis courts. Residents are surrounded by the beauty and majesty of the towering Bradshaw Mountains to the south and Mingus Mountains to the north. Glassford Hill, the town's most notable landmark, is an extinct volcano that sits at an elevation of 6,177 feet. People who make the trek to the top are rewarded with amazing panoramic views. With a population of just over 38,962, Prescott Valley is known for its progressive planning and attention to family focused development, guaranteeing the area never loses its rural flavor and small town appeal.

Chino Valley

Chino Valley is a land of wide expanses of open space, the pronghorn antelope, mountain views and the most amazing sunsets to be seen anywhere. This sleepy ranching and farming community is typified by larger home lots and ranches where horses and livestock of all kinds are welcome.

According to the most recent census data, Chino Valley's population is around 13,069. It is a rural town where residents cherish their simpler, slower pace of life. The community is not without its amenities geared toward family enjoyment, outdoor recreation and education. A 37-acre community center includes a new aquatic park, picnic areas, lighted ball fields, an amphitheater, and miles of trails. The Yavapai College Agribusiness & Science Technology Center is a high-tech, environmentally efficient education facility located at historic Old Home Manor. Bring the horses!

Dewey-Humbolt

Dewey-Humboldt is known as Arizona's Country Town. Characterized by blue-green rolling hills folded into the foothills of the picturesque Bradshaw Mountains in the Aqua Fria Valley, this is a quiet, rural and predominantly residential community with a population of about 4,444.

Dewey-Humboldt became Yavapai County's newest town in 2004 with the melding of the previously unincorporated areas of Dewey and Humboldt. Residents maintain an independent spirit. They take pride in and celebrate the area's pioneering past and a long history of ranching, farming and mining.

There is plenty of space in this town, the smallest in population and least developed of the quad cities. Travel along meandering country roads that lead to nowhere in particular. Take a quick drive to visit the picturesque mining town of Jerome, explore the Indian ruins at Montezuma's Castle, just a 20-minute road trip away, or spend a day in downtown Prescott, only 15 miles to the west. This is an area of multiple acre homesteads where people like to spread out and come home to a quiet place with little traffic where they can still hear the sounds of nature in all of its glory.

Verde Valley

Jaw dropping rock formations, weathered mining towns with houses perched high atop hills, fascinating Indian ruins, and quaint communities all are uniquely set into the beautiful, historic **Verde Valley.** Located about a 30 minute drive from the quad-cities and 90 minutes from the hustle and bustle of Phoenix, the Verde Valley is the geographic center of Arizona. It was settled in the 19th century along the banks of the 180-mile Verde River when mining was the business and bootlegging was king. Communities include the City of Cottonwood and Towns of Camp Verde and Clarkdale interspersed with the smaller, eclectic unincorporated areas of Jerome, Rimrock, Cornville, Lake Montezuma, McGuireville, and Page Springs.

Cottonwood

Cottonwood, named for the majestic cottonwood trees that dot the landscape, is the business hub of this mostly rural area. The city, with a population of just over 11,000, is engulfed on three sides by soaring mountains and bounded to the north by buttes and mesas. It is home to Historic Old Town and the ever popular Verde Canyon Railway where riders travel back in time with their eyes transfixed on the stunning scenery and wildlife.

Visitors and residents take pleasure in Cottonwood's many natural and man-made attributes. This appealing little city, at an elevation spanning 3,300 to 3,900 feet above sea level, is centrally located and a favored home base for visitors traveling to take in the varied attractions of northern and central Arizona.

Residents enjoy outdoor activities made possible by the adjacent pristine lands of the Prescott and Coconino National Forests. And at the end of a perfect day in this mild year round climate, they take pleasure in the colorful desert sunset and spectacular star-filled night sky.

Known as the "gateway to the Verde Valley," Camp Verde is the area's southernmost community. The valley's oldest settlement, is home to historic Fort Verde, built in 1865 to protect settlers from raids by neighboring Indian tribes.

Today Camp Verde is a small, tight knit community, known for its quiet, safe and worry-free lifestyle. With a population bordering 11,000, the town has maintained its rural atmosphere, western flavor, and historic character. Montezuma's Castle, one of the most well-preserved cliff dwelling sites in North America, attracts nearly one million visitors a year.

Camp Verde is completely surrounded by mountains with 18 miles of Verde River flowing through the town limits. Its base is the Lower Sonoran Desert. Winters are pleasant and summer days are hot and dry with cool nights. The temperate climate allows for all manner of outdoor activities including camping, hiking, horseback riding, picnicking, fishing and canoeing.

Clarkdale

Clarkdale is the smallest of Verde Valley's incorporated communities with a population of 4,200. It is a historic mining community and the state's first planned community developed to provide housing for employees who were working at the nearby copper smelter.

Located at the base of Cleopatra Hill, Clarkdale's streets are tree-lined with charming, lovingly-preserved bungalows. This bedroom community is characterized by a tranquil setting and historic downtown with quaint boutique shops, antique stores and a diverse assortment of restaurants.

Residents of this throwback to days gone by enjoy amenities of much larger communities including four town parks and a lighted, state-of-the-art ball field. They attend concerts in the main gazebo park at the center of town, and watch little league games at Selna Field. The town is the entry to Sycamore Canyon, a rugged and beautiful national wilderness area characterized by a deep 25-mile gorge surrounded by towering formations of layered red rocks.

Sedona

Sedona is a wonder of Mother Nature. The city of about 11,500 residents is silhouetted in a dramatic setting of striking red rock formations so beautiful as to defy description. Every possible step has been taken to preserve the natural beauty and serenity that is Sedona. Located at the base of Oak Creek Canyon and surrounded by national forest, the city limits straddle both Coconino and Yavapai Counties.

Despite being one of the state's top tourist destinations attracting about three million visitors a year, Sedona remains a quiet, residential municipality popular among active retirees who are entranced and enthralled by the spectacular setting. The city is known for its lively, diverse art scene and varied cultural activities, including the famous Jazz on the Rocks, held in the fall each year.

Red Rock Country is simply stunning. Residents enjoy an unequaled quality of life in this natural backdrop. They hike the red rocks, wade in the water and picnic at Red Rock Crossing, enjoy the simmering colors of a dazzling sunrise, and traverse Oak Creek Canyon at the north end of the city.

Yavapai County communities are conveniently located to allow access to universities, airports, shopping, golf, and world-class medical facilities.

It is small town living with a wild-west flavor amid the most stunning wonders nature has to offer. And in only a several hour drive is the most visited World Wonder, Arizona's majestic Grand Canyon. There truly is something for everyone in this magical place.

The region is a business-casual environment with the resources and expertise to generate growth in a comfortable relaxed lifestyle.

Community Resources

Yavapai County Contractors Association- www.ycca.org/
City Data- www.city-data.com/city/Arizona2.html,
Wikepedia on line encyclopedia- www.en.wikipedia.org/wiki/Yavapai_County
Center for Business Outreach NAU- www.nau.edu

Safe Yield

The purpose of Arizona Department of Water Resources - Active Management Areas (AMA) is to provide long-term management and conservation of designated areas' limited groundwater supplies. In order to accomplish this the AMAs administer state laws, explore ways of augmenting water supplies to meet future needs, and routinely work to develop public policy in order to promote efficient use and an equitable allocation of available water supplies.

In 1980, the Arizona Department of Water Resources (ADWR) was created to ensure a long-term, sufficient and secure water supply for Arizona's growing communities. Among other things, ADWR administers state water laws (except those related to water quality), explores methods of augmenting water supplies to meet present and future demands, and works to develop public policies that promote efficient use and equitable distribution of water.

Because of the safe-yield goal and the Assured Water Supply program, new subdivisions are not allowed to use groundwater pumped from within the Prescott AMA. To reach safe-yield, existing and future water demand must be augmented by renewable supplies. Current water demand can be reduced through conservation and recharge in all water use sectors reducing the volume of augmentation needed.

If you would like to learn more about Arizona Department of Water Resources or the Prescott AMA visit: www.azwater.gov.

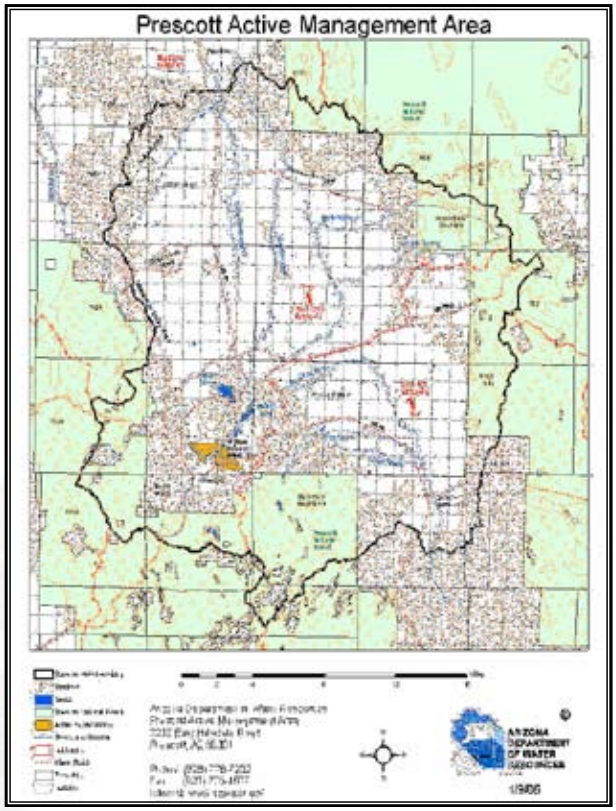
Prescott AMA

To address groundwater depletion in the state's most populous areas, the state legislature created the Groundwater Management Code in 1980 and directed ADWR to implement it. Areas where groundwater depletion was most severe were designated as Active Management Areas (AMAs). There are five AMAs: Prescott, Phoenix, Pinal, Tucson, and Santa Cruz. These areas are subject to regulation pursuant to the Groundwater Code, administrative rule and management plans.

The purpose of the AMAs is to provide long-term management by encouraging replacement of existing groundwater supplies with renewable supplies, recharge and efficient use of all water supplies.

The primary management goal of the Prescott AMA is safe-yield by the year 2025.

The Prescott AMA covers over 485-square miles in Yavapai County and contains two groundwater sub-basins: the Little Chino and Upper Agua Fria.



The Prescott AMA was officially declared in a state of groundwater overdraft in January of 1999, although it is thought that the AMA had been in a state of overdraft many years prior. Overdraft occurs when more groundwater is withdrawn than is recharged. The declaration resulted in the implementation of the Assured Water Supply rules within the AMA – rules that restrict access to groundwater supplies for new subdivisions.

The Prescott AMA has a legislative goal to achieve safe-yield by the year 2025. Safe-yield is a groundwater management goal that attempts to achieve and maintain a long-term balance.

THE UPPER AND MIDDLE VERDE RIVER

The Upper and Middle Verde River watersheds include an area that drains approximately 6,188-square-miles in north-central Arizona. Traversing a total distance of about 190 miles, the Verde River flows freely through this area for 136 miles before encountering Horseshoe and Bartlett Reservoirs en route to the Salt River. It flows through lands managed by the U.S. Forest Service, private and tribal lands, and the population centers of Cottonwood, Clarkdale and Camp Verde.

Within the **Upper and Middle Verde River** watersheds, the Big Chino, Little Chino and Redwall-Muav, C and Verde Valley aquifers play a significant role in sustaining stream flows. The C aquifer occurs mainly in the eastern and southern parts of the 10,300-square-mile Coconino Plateau area, and the Redwall-Muav aquifer underlies the entire area.

The **Upper Verde River** (that portion of the river in the upper watershed) flows intermittently through the Big Chino Valley, becoming perennial near its confluence with Granite Creek. (See the Upper Verde River Watershed map.)

The **Little Chino aquifer** is located within the Prescott Active Management Area (PrAMA), which has a safe yield goal to achieve and maintain a long-term balance between the amount of groundwater withdrawn and the annual amount of natural and artificial recharge.

Steam flow in the **Middle Verde River** (that portion of the Verde River that flows through the Middle Verde watershed) is sustained by surface runoff, base flow from the Upper Verde River, base flow in the mainstream Verde River canyon at Perkinsville and Mormon Pocket, groundwater discharge from the Verde Basin aquifer, and contributions from the major tributaries within the Middle Verde River watershed (e.g. Sycamore, Oak, Wet Beaver and West Clear creeks). The latter are largely comprised of groundwater discharge from the C aquifer at the Mogollon Escarpment and Coconino Plateau.

Most groundwater pumping that occurs in the **Verde Valley aquifer** is in proximity to the Middle Verde River and associated with individual well owners, and several large private and municipal water providers. Direct diversion from streams supplies a number of irrigation companies and ditch associations with water for agricultural irrigation.

Adapted from Case Study #3- Upper Middle Verde River, 2007, Sonoran Institute, Sustainable Water Management: Guidelines for meeting the needs of people and nature in the arid west, (pg. 34)

Watershed and Riparian Resources

Prescott Creeks Preservation Association: 928-445-5669 (Voice)
www.prescottcreeks.org

Sonoran Institute:- www.sonoraninstitute.org/

American Rivers- www.americanrivers.org

This Sonoran Institute guide explores the relationship of groundwater and surface water to rivers and streams, and proposes a framework for sustainable water management. It takes an in-depth look at Arizona, applies the sustainable water management framework to three case studies - the San Pedro, Santa Cruz, and Verde rivers - and recommends water policies to meet the needs of people and nature. Find the complete guideline on the web, www.sonoran.org/index.php?option=com_docman&task=doc_view&gid=131&Itemid=5

Great Horned Owl chicks in a Cottonwood tree near the Agua Fria River. (Rogers)

Riparian vegetation along a perennial stretch of the Agua Fria River. (Rogers)

Water in the Upper Agua Fria River Basin

Garry Rogers, Agua Fria Open Space Alliance, Inc.

September , 2008

The Agua Fria River's watershed consists of an upper section that extends from Glassford Hill east of Prescott to Lake Pleasant near the Yavapai County—Maricopa County border, and a lower section that extends south through urban and agricultural areas to the Gila River. Only the upper portion of the basin is considered here. Land ownership and management responsibility is shown on the map. (page 17)

The upper watershed's 1,300 square miles are mostly covered by shallow mineral soils atop thin sedimentary deposits of permeable material underlain by igneous rock, and some metamorphic and sedimentary rock. Water availability is limited by the region's small amounts of rain and snow, high temperatures, dry air, and limited groundwater storage capacity.

During winter there is sometimes enough water to fully saturate the soil and allow water to move beyond the reach of plant roots into underground aquifers composed of sediments, sedimentary rocks, and fractured igneous rock. Some of the stored groundwater moves down slope until it is released at springs or soaks into and follows river channels. The steady release of groundwater maintains perennial flow in about 10 percent of the basin's stream channels.

Remaining groundwater is a relatively permanent resource that can be "mined" just as if it were a mineral deposit. Use of the groundwater resource is sustainable as long as pumping and associated increases in evaporation and plant use do not exceed the natural rate of accumulation.

Groundwater pumping in the basin is widespread. The many private wells are distributed along stream channels and in areas where sediments and rock fractures hold accumulated water. Capacity of the basin's individual aquifers is not well known, but the largest is probably the Lonesome Valley or Upper Agua Fria aquifer in the southern portion of the Prescott Active Management Area (PrAMA). Water accumulation there is an important contributor to perennial flow in the Agua Fria River for several miles from just south of State Highway 169 on through the town of Dewey-Humboldt and farther south. A relatively large sediment deposit occurs near Castle Hot Springs in the south end of the basin. The greatest volume of flow from a spring in the basin has been reported there. Perennial stream segments are shown on the accompanying map. (page 17)

Soil moisture accumulated in the Agua Fria River basin during winter evaporates or is used by plants during spring and early summer. Soil moisture accumulation during summer is limited because runoff and stream flow after intense summer rains are rapid. Thirsty plants and evaporation use up most of the rest of the incoming water. The rate of runoff and amount of sediment carried into and down stream channels is influenced by the nature of the slopes—their steepness, soil texture, and vegetation cover. Watershed is a term used to refer to the slopes within the basin, and the term "healthy watershed" means that the natural vegetation cover is as complete as it can be under the influence of the prevailing climate, and, as a result, soil surfaces are protected and stable without excessive erosion.

Agua River Watershed Resources

Agua Fria Open Space Alliance PO Box 940, Dewey, AZ 86327
www.aguafriaopenspace.org/

Agua Fria History- www.aguafriaopenspace.org/Natural%20History.pdf

The University of Arizona's Guide to the State's Water Information and Organizations:
www.arizonawater.org/azwater/html/index.jsp

The Watershed Report by Arizona NEMO:
www.srnr.arizona.edu/nemo/index.php?page=characterization#agua

The Arizona Water Atlas:
www.azwater.gov/dwr/Content/Find_by_Program/Rural_Programs/content/water_atlas/default.htm

The Report on the Big Bug Creek Area near the center of the Upper Agua Fria River Basin
www.srnr.arizona.edu/nemo/characterizations/UpperAguaFria/WaWb_w.pdf

Vegetation of the Agua Fria River basin watershed is made up of slow-growing drought tolerant plants. Small forests of Ponderosa Pine are present at the highest elevations in the Bradshaw Mountains to the west and Black Hills to the east.

Woodlands and shrublands composed of Pinyon pines and Juniper trees, evergreen Oaks, and other shrubs cover the intermediate mountain slopes. Patches of shrubs and expansive desert grasslands cover the broad, more gently sloping valley floors. Riparian vegetation with dense stands of Cottonwood trees, Willows, Mesquite, Salt Cedar, and numerous other tree, shrub, and herb species occurs in narrow ribbons along perennial and intermittent streams throughout the basin.

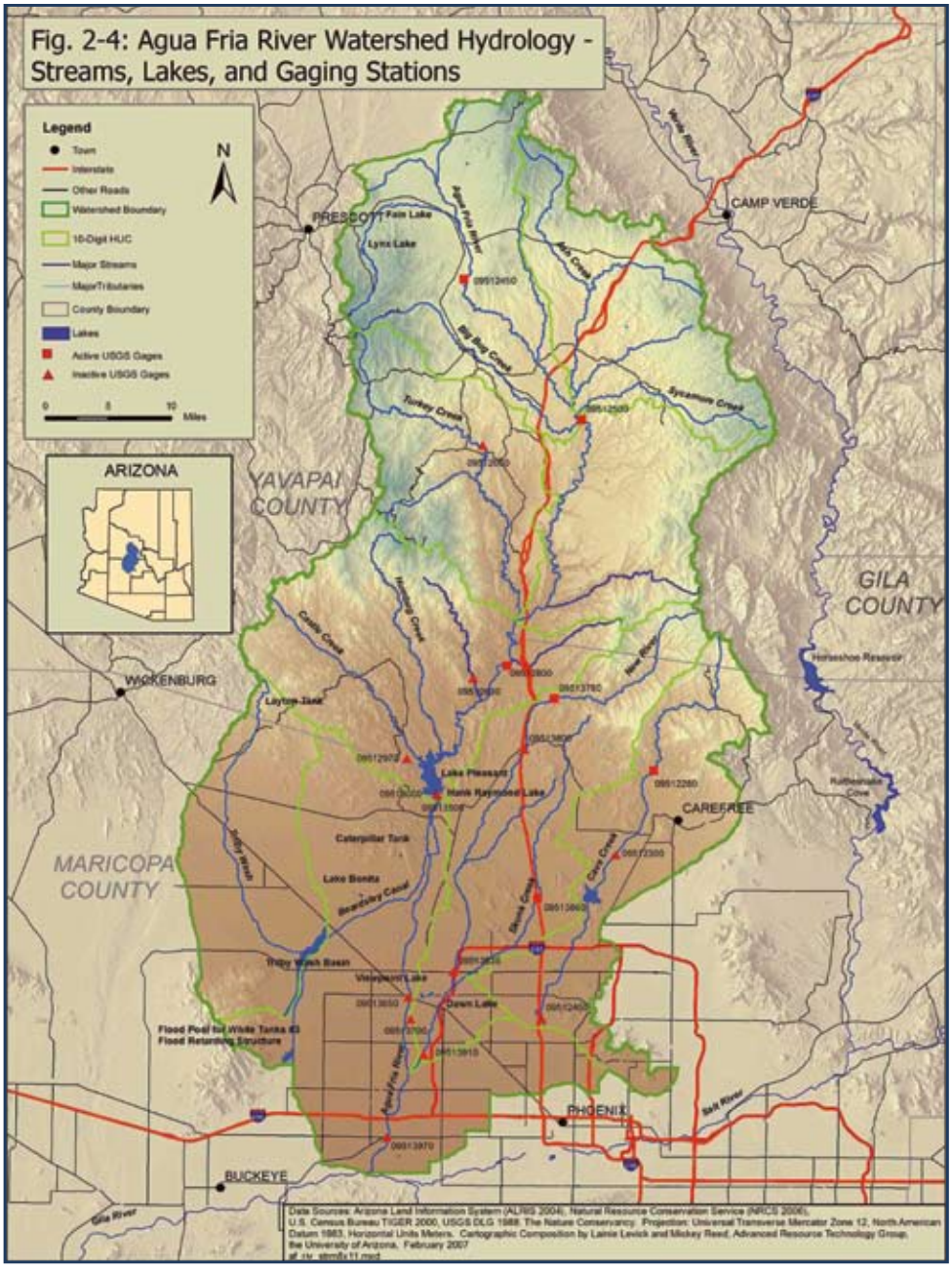
Riparian habitat covers less than one percent of the surface area of the basin, yet is the most critical source of water, food, and cover for the basin's native animals. Researchers have found that more than half of the animals in the basin are fully or partially dependent on riparian habitats.

The water future of the Agua Fria River basin depends on climate, watershed protection, and water use by people. Groundwater levels are declining near wells in some areas, and various forms of rationing to conserve water are coming into play. At present there is no evidence that any of the perennial stream reaches within the basin have declined. As the human population of the area grows, the preservation of riparian habitats will require adoption of wise conservation strategies. One of the most important and easiest techniques is to plant drought-tolerant native plants in yards and use drip irrigation in gardens. Green building techniques that further reduce use of groundwater will also help.

Perhaps most important is the growing recognition by people living in the area that conservation guarantees water will remain available for people, plants and animals in the Agua Fria River Basin.

"The wildlife and its habitat cannot speak. So we must and we will."

President Theodore Roosevelt

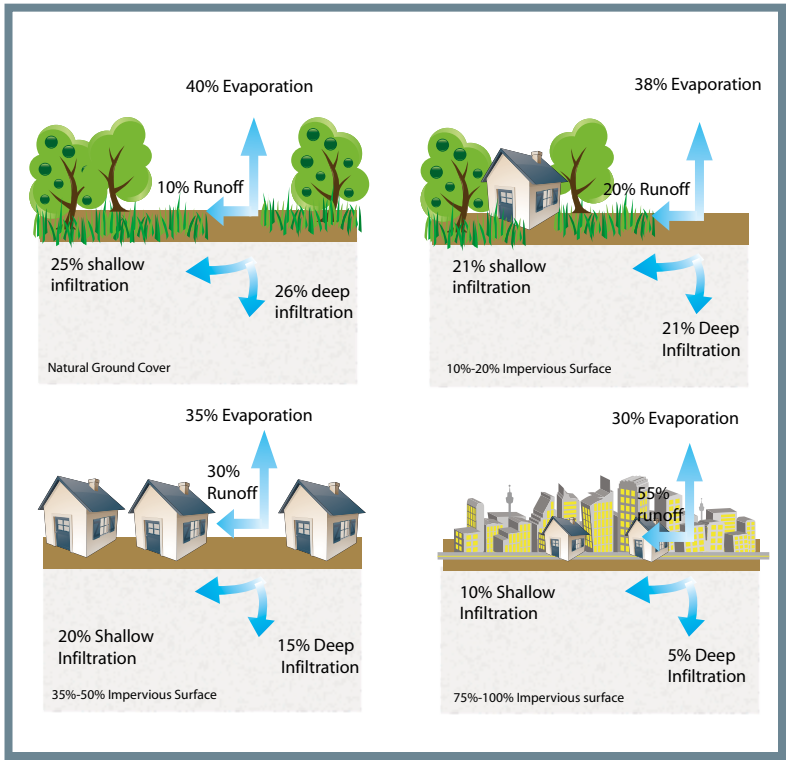


Data Sources Arizona Land Information System (ALRIS 2004), Natural Resource Conservation Service (NRCS 2006), U.S. Census Bureau TIGER 2000, USGS DLG 1988, The Nature Conservancy. Projection: Universal Transverse Mercator Zone 12. North American Datum 1983. Horizontal Units Meters Cartographic Composition by Lainie Levick and Mickey Reed, Advanced Resource Technology Group, the University of Arizona, February 2007 af_riv_strm8x11.mxd

"Simply put, we protect, restore, and celebrate riparian ecosystems by providing people meaningful interactions with the creeks."

Simplified Mission Statement - Prescott Creeks Preservation Association

STORMWATER RUNOFF



Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater runoff from naturally soaking into the ground. Stormwater runoff can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is, most often, untreated when discharged into bodies of water. These are community places which provide character, recreation and support ecologic balance.

Polluted stormwater runoff has adverse effects on plants, fish, animals and people. ***Sediment*** can cloud the water and make it difficult or impossible for aquatic plants to grow. It can also destroy aquatic habitats. ***Excess nutrients*** can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms cannot exist in water with low dissolved oxygen levels. ***Bacteria and other pathogens*** can wash into swimming areas and create health hazards. They can impair water in lakes and recreation areas, in some cases resulting in closure.

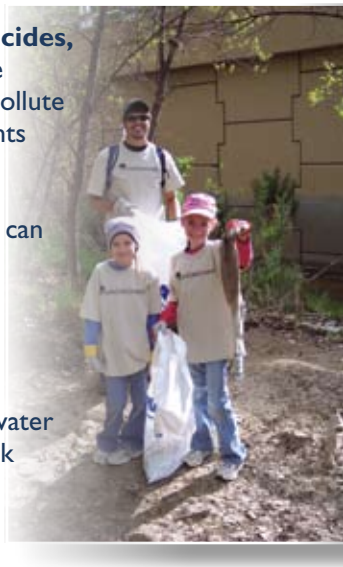
• ***Debris -*** plastic bags, six-pack rings, bottles, and cigarette butts - washed into waterbodies can choke, suffocate, or disable aquatic life, such as ducks, fish, turtles, and birds. ***Household hazardous wastes*** like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life.

• ***Stormwater impacts*** depend on the types of development. Urban areas that develop with conservation standards, which preserve or plan for green space with parks, trails, ball fields, grassed or cobble waterways, and maintain large functional riparian areas, will have significantly fewer negative impacts.

• ***Growing Green*** is a comprehensive way of establishing protocol. The federal government has established standards that make it important to implement ***stormwater best management practices*** in urban settings including infiltration systems, low impact development, on-site rain gardens, detention basins, ***minimization of impervious surfaces***, and dispersion of the concentrated flow to green areas.

Project WET is a comprehensive teacher-tested water education program. Teachings are topic-centered curriculum that is correlated to the Arizona Academic Standards. This successful water education program serves several Yavapai County Schools. This water education for Teachers is supported by the Yavapai County Water Advisory Committee member communities (WAC) and Arizona Department of Water Resources

Storm Water Management



☐ **Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids.** Do not pour them onto the ground or into storm drains. Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute damaging nutrients and organic matter to streams.

☐ **Control parking lot and site drainage**. Strategic grading of parking lots and other outdoor spaces can prevent runoff from reaching creeks and sensitive areas.
When building or grading parking areas, consider designing native rain gardens or install oil-water separators in catch basins. Clean parking lots regularly using street sweepers and dry clean up methods.

☐ **Check rain gutters** and other pipes to see where they drain. Make sure they do not directly carry water onto streets or into creeks. Runoff from roof surfaces contributes to the decline of stormwater and creek health. Pipes directly projecting onto a street or creek bank or flexible pipes draping down banks cause erosion. Consider using cisterns, on-site filtration or gray water systems to capture roof runoff and use this harvested water for landscape areas.

☐ **Do not over water the lawn.** Consider using a subterranean drip irrigation system or soaker hose instead of overhead sprinklers. Use pesticides and fertilizers sparingly. When use is necessary, apply only manufacturer's recommended amount. Control soil erosion by planting ground cover and stabilizing erosion-prone areas.

☐ **Compost or mulch lawn clippings and other yard waste.** Do not leave yard debris in the street and never sweep it into storm drains or streams. Cover piles of dirt or mulch used in landscaping projects to prevent it from eroding off site or blowing in the wind.

☐ **Inspect , maintain with activated yeast monthly and pump septic systems** every two to three years to insure proper operation**.**

☐ **Research Low-Impact Design (LID) strategies,** the growing movement toward low-impact development, a lot level approach to storm water management.

ARIZONA Project WET Water Education for Teachers

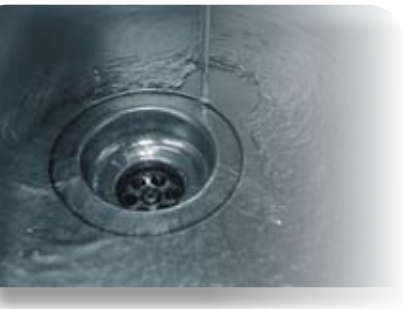
Nonpoint Source Pollution Resources

Environmental Protection Agency (EPA)- www.epa.gov/owow/nps/prevent.html
Do's and Don'ts Around the Home- www.epa.gov/owow/nps/dosdont.html
Master Watersheds Stewards- www.ag.arizona.edu/oals/watershed/programs/mws/masterws.html
Stormwater- www.stormh2o.com/may-june-2006/stormwater-management-watershed.aspx
Urban Design Tools- www.lid-stormwater.net/raincist_construct.htm
Permeable Surface - Landscaping With Gravel- www.sunset.com/sunset/garden/article
Prescott Creeks- www.prescottcreeks.org
Arizona Project WET, Water Education for Teachers- www.ag.arizona.edu/arizonawet/

Private Wells

Every new well is required by law to be registered with the state. The well owner or the well driller reports all of the well information to ADWR.

Photo Credit: Kim Webb



Water users not connected to a municipal or private water distribution system likely receive their water from a private well. In Arizona, there are two categories of wells: exempt and non-exempt. Exempt wells are those that pump less than 35 gallons per minute. Non-exempt wells are allowed to pump more than 35 gallons per minute and are required to file more stringent water reports records with regulatory agencies. The Arizona Ground Water Management Act of 1980 identifies wells used for domestic or household purposes as "exempt wells" because owners are not required to report how much water they pump. Owners of exempt wells are permitted to pump no more than 35 gallons a minute, or 18.4 million gallons a year. As the number of exempt wells increase in state active management area, the accumulated volume of unregulated extraction is causing concern. It is expected that future regulations may require monitoring of exempt wells to more effectively manage safe yield goals.

Private Wells

Most common in Yavapai County are thousands of exempt wells which are drilled by piercing the bedrock to a depth of 100-400 feet. Arizona state law requires that all wells be constructed in compliance with standards described in the Arizona Department of Water Resources (ADWR) rules governing well construction and the licensing of well drillers (A.A.C. R1215801 through R1215822, and A.A.C. R1215850 through R1215852.)

All new wells proposed in Yavapai County are permitted through Yavapai County Development Services. Working in cooperation with ADWR during the permitting process, ADWR maintains data on groundwater conditions in areas where wells are commonly drilled. Well drillers may also provide anecdotal information pertaining to an area's historic groundwater supplies.

Areas of land in Yavapai County may have little or no significant groundwater supplies. Residents in these areas must consider alternative water delivery systems. Some residents haul or pay to have potable water delivered. Rainwater harvesting systems are another water resource for non-potable (no consumption) uses. Residents who choose alternate water delivery systems are often model water conservationists.

Well owners are not trained as well operators and are often unfamiliar with water quality standards and testing. The University of Arizona has developed a **Well Owner's Guide** on the web which provides detailed sections to assist the well owners with water quality concepts, drinking water guidelines, well system operation, maintenance, and water testing. Consumers can also learn more about Arizona's aquifers, and conditions and activities that affect ground water quality. Well owners learn about well construction, well components, and well maintenance needed for the safe and proper function of their wells.

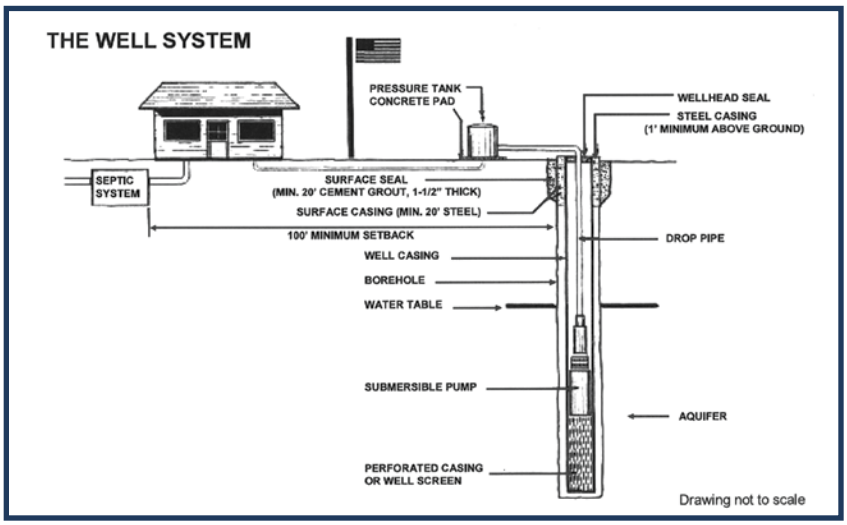


Illustration and Terms Credit: Arizona Department of Water Resource

Water Well Terms

Aquifer: An underground formation capable of yielding or transmitting usable quantities of water.

Borehole: The hole that is created by any one of a number of well construction methods, i.e., drilled, dug, jetted or driven.

Cap: A tamper resistant watertight cover that is affixed to the top of the casing to help prevent contaminants, as well as small animals and children, from entering the well.

Casing: A steel or plastic (PVC) pipe installed in the hole during or after drilling to support the sides of the well and prevent caving.

Drop pipe: The pipe that hangs in the well and is attached to the pump. Water travels through the drop pipe to the surface.

Open well: A well that is not equipped with either a cap or a pump.

Perforated casing: A series of openings in a casing, made either before or after installation of the casing, to permit the entrance of water into the well.

Pressure tank: A tank used to store water under pressure for household use.

Pump: The part of the well that mechanically draws water up to the surface. There are many different types of pumps. The diagram on the previous page shows a submersible pump, typical for domestic wells.

Surface seal: A cement grout seal that is installed around the top 20 feet of the steel casing to prevent surface contaminants from entering the well.

Water table: The point where groundwater is encountered below the land surface. To withdraw water, a well must be drilled deep enough to reach below the water table.

Well depth: The total depth of a well. This will vary depending upon the depth to useable water in an area.

Well screen: A factory manufactured steel or PVC screen that keeps sand and gravel from being drawn into the well as water is pumped. The perforated casing or well screen is usually located at the bottom of the well or in the water producing zone.

Wellhead seal: A device used to seal the area between the drop pipe and the casing.

Arizona's Public Water Supplies

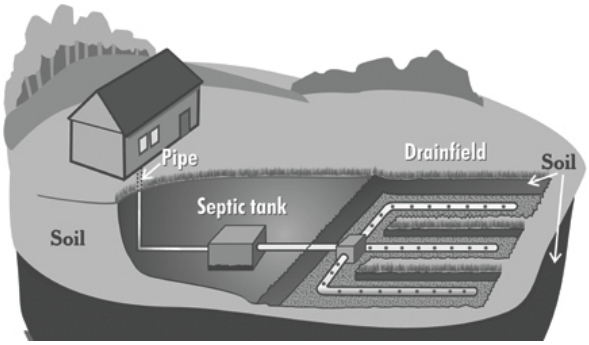
Arizona Department of Environmental Quality has a water quality division with a specific mission to protect and enhance public health and the environment by ensuring safe drinking water and reducing the impact of pollutants discharged to surface and groundwater. Community water suppliers throughout the state are required to issue an annual water quality report that informs customers about their drinking water, including any contaminants that have been found in their supply and what they can do to help protect it. Water system suppliers issue or mail these consumer confidence reports in July.

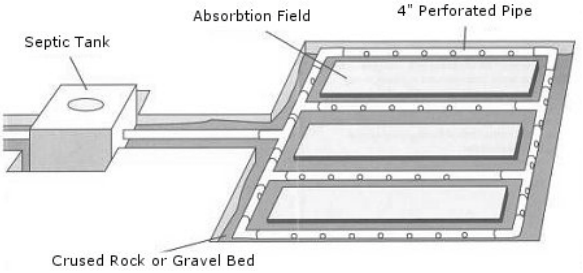
Water quality is excellent in most of the county. Water pH is usually between 6.5 and 8.5. Total dissolved solids (TDS) are usually at or below 500 parts per million (ppm). Water in drilled wells may be high in sodium salts, particularly near salt mines. Some components of sewage are also mobile and become contaminants once they enter the soil. Nitrate contamination of wells is a concern for thousands of households. Throughout this region wells often contain high levels of naturally occurring arsenic. Yavapai Cooperative Extension is able to direct and support private well owners and kits are available to test water for contamination.

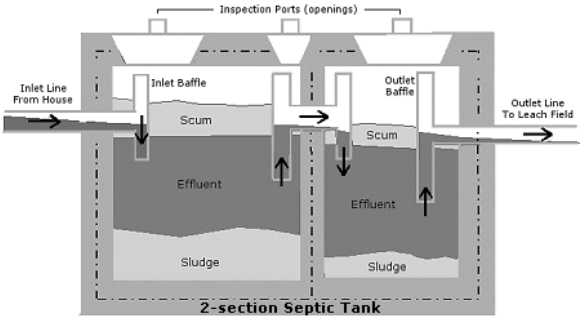
Arizona Department of Environmental Quality
www. azdeq.gov/environ/water/index.html

On-site Septic Systems

Private Wastewater Treatment







A septic system is an excellent means of treating household wastewater. On proper soils, and where dwellings are spaced well apart, septic systems can operate reliably for years. Treating sewage on-site, they eliminate the need for costly municipal sewer plants and infrastructure development.

On-site Septic System application and procedures are regulated by Arizona Department of Environmental Quality (ADEQ). An on-site system is a septic system that disposes domestic waste on the property. By far, the most common type of on-site system is the septic tank, which is sometimes called a conventional system. ADEQ has developed the Type 4.02 general permit for septic tanks. Systems other than conventional septic tanks are called alternative systems. These include technologies such as Wisconsin mounds, composting toilets, and pressurized systems.

Wastewater Cycle Onsite System

There are four major components to septic systems: a pipe from the house, a septic tank, a leaching bed or drain field, and the soil treatment zone. Household wastewater travels from the drain pipe directly into the septic tank. Greywater systems are often considered by homeowners and are good companions to water management when utilizing septic systems.

Generally, septic tanks are made out of concrete, fiberglass, or polyethylene. Within the tank, solids settle out (forming sludge) to the bottom of the tank where it partially breaks down naturally by bacteria, and the oil and grease (scum) float to the top. Periodically, the sludge and scum need to be pumped out to insure proper system operaton. Partially treated liquids are discharged into a leach bed or fields for further treatment by the soil. Every time new wastewater enters the tank, partially treated wastewater is pushed out into the leach field.

Perforated pipes connect from the tank and are buried to drain out onto gravel beds developed to be a leach field. Leach fields need to be carefully placed so draining water does not percolate into nearby groundwater sources or drinking wells. Wastewater percolates at an accepted rate into the soil where naturally occurring microorganisms biodegrade and remove contaminants, bacteria, viruses, and nutrients from the wastewater before it reaches groundwater.

Some septic systems do not have leach fields and wastewater must be pumped from the septic tank and delivered to and treated at a municipal wastewater facility.

It is important to properly dispose of household synthetic and hazardous materials such as cleansers, pesticides, oil, antifreeze, paint, and solvents, which cannot biodegrade. Toxic substances are not good for the environment or the live bacteria inside the septic tank.

Care and Maintenance of On-Site Septic Systems

Septic or on-site systems require general care and maintenance to ensure proper function. Septic tanks and leach fields require periodic inspection with septic tanks pumped out, as necessary. After about 10 years, leach fields may clog and lines may need to be replaced. In neighborhoods where there is a high density of septic systems, the ability of the soil to process all that wastewater is diminished because the leach field is overloaded. In that case, leach fields may be relocated to ensure proper filtration of wastewater.

Septic pumping frequency factors:

1. Capacity of the tank
2. Volume of wastewater
3. Amount of solids in wastewater

Tabled guideline is for maintenance pumping and inspection estimate purposes only. Every system is different and more or less frequent pumping and inspection may be required. Pumping estimates are based on full time residency. Contact a septic system professional for more information.

Guideline for Septic Pumping Frequency

Tanks Size (gallons)	Number of Persons living in the Household						
	1	2	3	4	5	6	7
	Years Between Tank Pumping or System Inspections						
500	5.8	2.6	1.5	1.0	0.7	0.4	0.3
750	9.1	4.2	2.6	1.8	1.3	1.0	0.7
1000	12.4	5.9	3.7	2.6	2.0	1.5	1.2
1250	15.6	7.5	4.8	3.4	2.6	2.0	1.7
1500	18.9	9.1	5.9	4.2	3.3	2.6	2.1
2000	25.4	12.4	8.1	5.9	4.5	3.7	3.1
2500	31.9	15.6	10.2	7.5	5.9	4.8	4.0

Table Source: Roger E. Machmeier, Ph., P.E

A few warning signs that a septic system may be failing include:

- The ground around the septic tank or over the leaching bed may be soggy or spongy.
- Toilets, showers and sinks may back up or may take longer than usual to drain.
- Occasional sewage odors may become noticeable, particularly after a rainfall.
- Gray or black liquids may be surfacing in your yard or backing up through fixtures into the house.
- When nearby wells are tested, E. coli or fecal coliform indicator bacteria may be found in well water or in a surface ditch close to the leaching bed.
- The water level in the septic tank is higher than the outlet pipe (this indicates that the water is ponding in the distribution lines)—inspection should be conducted by a qualified septic system professional.

Water conservation is an important aspect of septic systems. The more efficient consumers are with household water use, the more efficient the septic system will work. This means that the proper operation of the septic system will improve and reduce the risk of failure, saving a lot of money. Whenever possible, try to regulate the amount of water entering the septic system. Spread laundry over several days during the week and only run the washer or dishwasher when full. Install water saving plumbing fixtures and appliances. Fix leaky faucets and listen for running toilets—a running toilet can waste thousands of gallons of water, an amount that can wash out a septic tank.

Septic system treated wastewater is considered a 100 percent water loss – though treated wastewater from septic systems seeps into the ground nearly all water evaporates. In contrast, over half of the wastewater treated at a wastewater plant or facility is treated to meet a reuse standard to market as effluent , nonpotable water or recharged at an approved pond to cycle back to the aquifer. Recharge supports the long-term goal to balance the regions water withdrawals while working to reach the Prescott AMA safe-yield requirements.

Well and Septic Resources for Arizona

Arizona Department of Water Resources- www.azwater.gov/dwr/Content/Find_by_Program/Wells/default.aspx
Extension Agency, Arizona Well Owners Help- www.wellownerhelp.org/
Well Owners Guide- www.azwater.gov/dwr/Content/Find_by_Program/Wells/WELL_OWNERS_GUIDE_9-22-06.pdf
Arizona Department of Environmental Quality- www.azdeq.gov/environ/waste/index.html
Arizona Department of Environmental Quality Water Division- www.azdeq.gov/environ/water/index.html
Center for Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA)- www.sahra.arizona.edu
U.S. Geological Survey (USGS)- www.az.water.usgs.gov/
Home Inspections Wells and Septic- www.axiomhomeinspection.org/wt.html
Glossary of Inspection Terms- www.nachi.org/glossary
Great Site- www.ewashtenaw.org/living/environmental_health_and_services/environmental_portal/image_map.html

Community Supported Agriculture (CSA)

Community Supported Agriculture (CSA) is an alternative social and economic arrangement to conventional industrial food production. The community makes a bold statement when choosing to support local, sustainable agriculture. Area farmers receive a sense of security. The community gains a greater sense of responsibility and a closer connection to their food source. Participating vendors are required to sell products that contain a minimum of 10 percent Arizona grown ingredients.

Four Great Reasons to Grow and Buy Community Supported Agriculture

1. Enjoy fresh, healthy, safe and locally grown produce every week.
2. Invest in the success of environmentally conscious farmers.
3. Support the local economy.
4. Greatly reduce the wastes produced in transportation and packaging.

Market Products

Vegetables: A wide variety of fresh vegetables are available for purchase throughout the season at local farmer's markets. All produce is brought to the market and sold by the farmer who grew the vegetables.

Organic Produce: Vendors offer organic produce that has been grown without synthetic pesticides and fertilizers. Check with specific vendors for more information on their farming practices.

Fruit: When in season, grapes, apples, pears, berries and other kinds of fruit are available at the market.

Meat and Dairy: Farmers' cheese and local meat are available at the market.

Baked goods: Customers can buy a loaf of bread to take home, or get something sweet to snack while walking around a bakery.

Specialty Items: Some vendors specialize in products, such as preserves, candies, honey, salsa, tamales or pasta. They also produce natural body and health products, such as lotion and soap.

Flowers and plants: Since customers are going to cook something wonderful, why not pick up something colorful for the table?

Prescott College Community Supported Agriculture- PCCSA Model: PCCSA members sign up for a share, (either seasonal or year-long) and then pick up their produce once a week. Since PCCSA is a cooperative CSA, food is produced from more than one farm, members support several farmers around the state who in turn, provide a variety of produce throughout the year. Depending on the season this includes vegetables, fruits, nuts, and honey, as well as the option to buy eggs, meat, goat milk, and cheese.

PCCSA
220 Grove Ave.
Prescott, AZ 86301

Direct all questions on PCCSA to: (928) 350-1401 or learn more on the web at www.prescott.edu/csa

Farmers Market Vendor Index : www.prescottfarmersmarket.org/vendors/index.htm

COMMUNITY SUPPORTED AGRICULTURE LINKS

www.prescott.edu/csa
The Prescott College Community Supported Agriculture program is another way for local farmers to sell directly to the consumer. Year-round, member-owned, local food originates within 100 miles!

www.foodconnect.org
Community Food Connections lists all of the farmers' markets in Arizona with times, location, and contact information.

www.afdma.org
Arizona Farmers Direct Marketing Association provides services and gets you connected with other direct market growers and producers in Arizona.

www.prescott.org:
Prescott Chamber of Commerce provides information about what is happening in everybody's hometown.

www.prescottacf.org
American Culinary Federation, Prescott Arizona Chapter. Find out what the wonderful chefs who cook at the market are up to.

www.environment.nau.edu
The Center for Sustainable Environments at Northern Arizona University provides information on a wide variety of food, water, and environmental issues, as well as many great links to sustainable agriculture sites.

www.agriculture.state.az.us
Arizona Department of Agriculture houses the Arizona Grown program and offers other products and services for Arizona producers.

www.localharvest.org
Local Harvest is a search engine that lists thousands of family farms, u-pick farms, farmers markets, and other local sources of sustainably grown food across the U.S.

www.slowfoodusa.org
Slow Food U.S.A. is an educational organization recognizing the enjoyment of wholesome food as essential to the pursuit of happiness and is dedicated to living a slower and more harmonious rhythm of life.

www.sunset.com/garden/fruits-veggies/
Sunset Magazine – a gardening resource for the west

www.underwoodgardens.com
Grow with the Best, Terroir Seeds LLC, Vegetable, Flower and Herb Seeds- hard to find and often endangered heirloom and open-pollinated seeds– gardening supplies and more – member specials.

MARKETS IN THE TRI-CITY AREA!
Visit community farmers market throughout the year. Find the season's best bounty of fruits, vegetables and homemade, homegrown, local products. In order to better serve communities, locations and hours may be subject to change annually. Please contact the area market managers to determine community Farmers Market locations.

Prescott Farmers Market
May - October
Saturdays 7:30 a.m. to 12:00 noon

Chino Valley Farmers Market
June - October
Thursdays 3:00 - 6:00 p.m.

Green living in yavapai county

Green building is about resource conservation. It is about construction that has minimal impact on the environment, and buildings that are more efficient, safer and healthier.

Thinking ahead is the key to building an eco-friendly, energy efficient home. The perception that green living is more expensive is not necessarily true. Green can cost more; there is always more that can be added, but there are many improvements that will make a home more comfortable and result in lower utility bills with little or no additional cost.

Several ideas include orienting a home on the lot to take greatest advantage of sunlight. Plant deciduous trees on the south side of the house; they provide shade in the summer, and allow sunlight in during the winter. Correctly design overhangs, and insulate corners where roof lines meet. Design windows and their placement for maximum airflow and energy efficiency. Select high quality windows and window shades, and install awnings.

Homeowners can also consider the installation of photo voltaic panels, domestic hot water panels, the purchase of highly efficient fixtures and appliances and rainwater harvesting systems. It will pay off in the long run with a home that is less expensive to maintain and operate.

The green approach continues long after a house is constructed. By building with the environment in mind, property owners will have homes that are not only built with minimal impact, but are also operated with minimal impact.
Even remodels and small home improvements can be green. Paint outgases for a long time. When buying paint; select low voc. There is almost no difference in price, so why not choose the variety with minimal toxins? It is much healthier for people, pets and the environment. Almost all home improvement stores stock a variety of 'green alternatives' to traditional products; ask what is available.

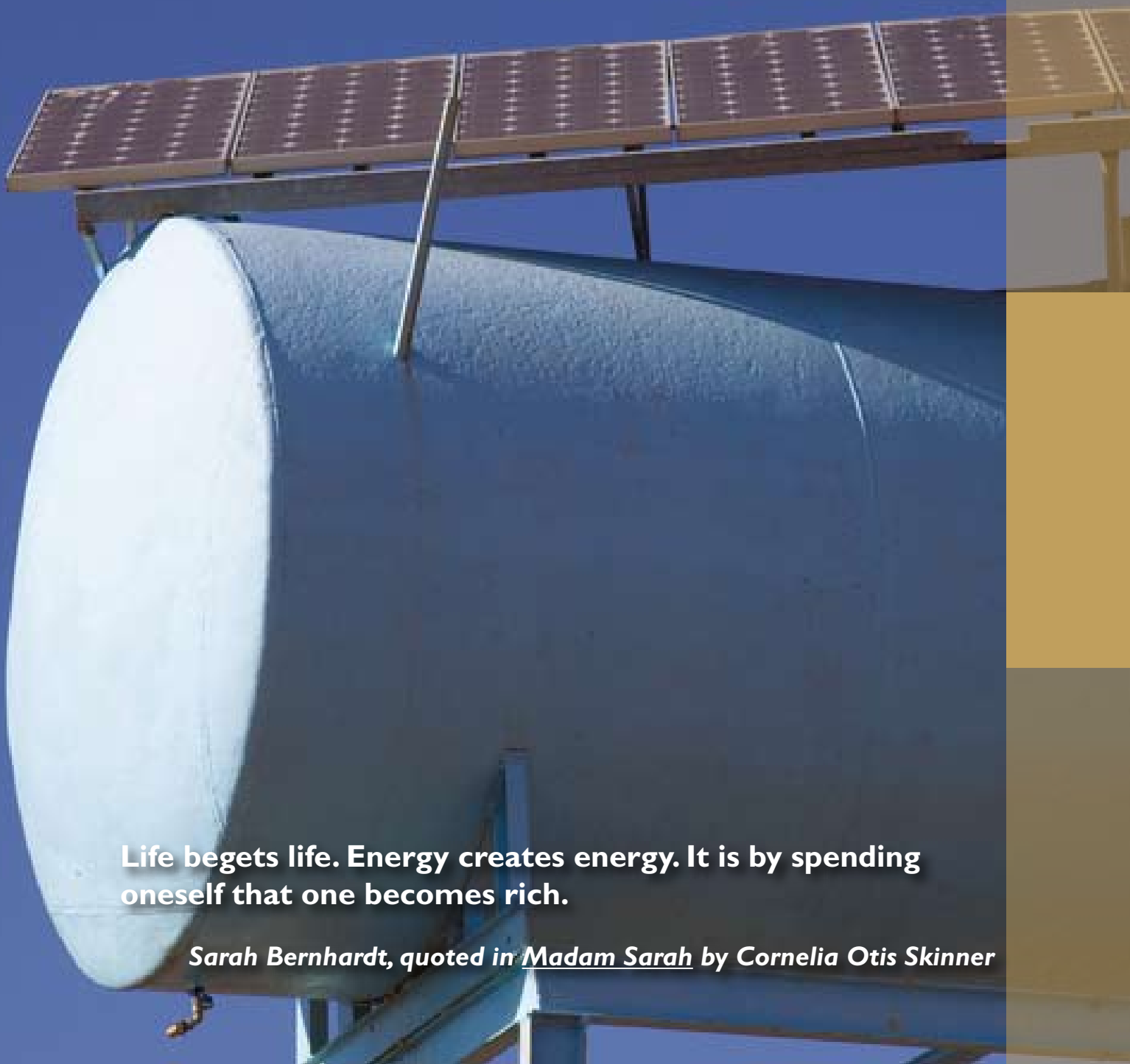
Green improvements can be incorporated into a building at any stage, but when constructing new, it is more efficient and less costly to integrate those components into the original planning and design.

These suggestions will result in a home that is more efficient with lower utility bills and less strain on limited natural resources. And remember to do research on available tax breaks and incentives, as well as savings available from local power companies. They will help offset additional costs.

Green Building Resources

U.S. Green Building Council- www.usgbc.org
Whole Building Design Guide- www.wbdg.org
Ecological Building Network- www.ecobuildnetwork.org
Ecosa Institute- www.ecosainstitute.org
Center for Maximum Potential Building Systems (CMPBS)- www.cmpbs.org
Center for Resourceful Building Technology (CRBT)- www.www.crbt.org
Center for Renewable Energy and Sustainable Technology (CREST) - www.crest.org
Center of Excellence for Sustainable Development www.smartcommunities.ncat.org
Urban Land Institute- www.uli.org

Energy and Water Connection



Life begets life. Energy creates energy. It is by spending oneself that one becomes rich.

Sarah Bernhardt, quoted in Madam Sarah by Cornelia Otis Skinner

'Energy and water conservation' Eco smart in the home

Energy Star

According to information provided by Department Of Energy, the use of ENERGY STAR rated appliances in 2006 added up to a utility savings of $14 billion and the avoidance of greenhouse gas emissions equivalent to 25 million cars.

Energy and water efficient appliances are readily available at home improvement outlets, appliance and plumbing retailers, and department stores. Read the tags; appliances will have two, one displaying the cost and the other its energy and water efficiency, including estimated annual operating cost.

If in doubt, purchase appliances with an ENERGY STAR and WATERSENSE rating. ENERGY STAR and WATERSENSE labeling is a joint effort between the United States Department of Energy (DOE) and Environmental Protection Agency (EPA) to rate and promote the use of energy and water efficient appliances. Install fluorescent light bulbs today for affordable and immediate energy savings.

Tankless or On-Demand Water Heaters

It is estimated that tankless water heaters are as much as 50 percent more efficient than traditional water heaters. The compact size allows for easier installation. These point-of-demand hot water circulators eliminate the need to let water run while waiting for it to heat. Plan shorter plumbing line runs for low-tech water and energy savings.

Washing Machines

Look for washing machines that spin on a horizontal axis. They reduce water consumption by 20 to 50 percent per load, require less detergent, and consume 50 to 60 percent less energy. Efficient spinning cycles will reduce drying time for clothes.

Clothes Dryers

There is little difference in energy efficiency between brands. Purchase one with a moisture sensor; it automatically shuts off when clothes are dry. Clothes dryers are not rated by ENERGY STAR.

High Efficiency Toilets HET Fixtures

The HET is defined as a fixture that flushes at 20 percent below the 1.6-gallons-per-flush (gpf) U.S. maximum or less, equating to a maximum of 1.28-gpf. It often includes dual-flush fixtures. Many different toilet manufacturers are marketing fixtures. HETs are NOT a new phenomenon, but have existed in the marketplace for years.

Refrigerators

Refrigerators use the most energy of any kitchen appliance. The larger the unit, the more energy it consumes. Typically, refrigerators between 16 and 20 cubic feet are the most efficient, and refrigerators with top freezers use less energy than side-by-side models.

Dishwashers

Energy efficient dishwashers consume six to10 gallons of water per cycle, compared to nine to 12 gallons for less efficient models, and use about 40 percent less energy. Dishes will require little or no pre-rinsing.

Check with local utility companies before purchasing appliances to find out what brands are approved for an incentive, a rebate or credit. Tax incentives may also be available from the state and/or federal government.

GREEN SOURCES

ENERGY STAR- www.energystar.gov
WATERSENSE- www.watersense.gov
Consortium for Energy Efficiency- www.cce1.org.

Promoting Sensible Water use

The Environmental Protection Agency (EPA) recently launched the national WaterSense™ campaign designed to provide consumer information and education. Similar to its well-known counterpart, Energy Star™, the new initiative offers access to information on the latest technology, and product labeling to identify the most water efficient appliances and fixtures on the market.

WaterSense is a voluntary public-private partnership that aims to help consumers save water, offer practical tips for conservation conscious citizens, and serve as a comprehensive resource on environmental issues. The EPA WaterSense website, www.epa.gov/watersense, is a wealth of information on a variety of topics, including an explanation of WaterSense and its applications.

WaterSense Message

WaterSense offers people a simple way to make product choices that use less water—with no sacrifice to quality or product performance.

- Conserve supplies for future generations.
- Protecting and preserving the nation's water supply is critical to the economic future and human health.
- WaterSense labeled products perform as well as or better than their less efficient counterparts.
- Purchasing WaterSense labeled products can help consumers protect the environment and help you save money on utility bills.

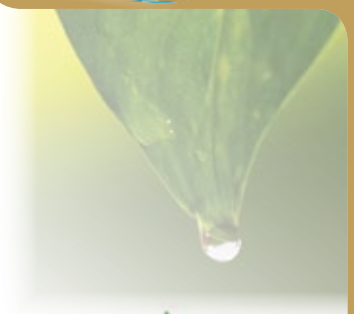
All products that carry the WaterSense label are tested by an independent third party to verify efficiency claims. Categories of fixtures and appliances to be labeled through WaterSense include:

* Bathroom faucets and showerheads
* Landscape irrigation services
* Sensor-based irrigation control technologies
* Toilets/urinals

Another WaterSense initiative is the labeling of new homes that meet WaterSense standards "to reduce water consumption through efficient plumbing fixtures, hot water delivery, appliances, landscape design, and irrigation systems."

According to information provided on the EPA website, a WaterSense home is 20 percent more efficient than comparable new homes resulting in an estimated annual water savings of 10,000 gallons.

Consumers can take the WaterSense pledge on line and sign up to receive WaterSense Current (a quarterly e-mail update). Learn how to reduce use by a few gallons every day. Encourage community leaders to become a WaterSense partner and share information on the EPA - Water Sense program.



EPA WaterSense

WaterSense website,
www.epa.gov/watersense

WaterSense Pledge

I pledge to do my part to save water this year and beyond. By taking just a few small steps, I can save a significant amount of water, which will help me protect the environment, save money, and preserve water supplies for future generations.

Water leaks in the home

How to Read Your Water Meter

It's Only a Small Drip... Wrong?

Slow drips of water add up quickly. A toilet that "continues running" after you flush or a sink that drips after it is turned off will waste thousands of gallons of water a year. If the drip is hot water, you are paying for energy too.

Fix leaks as soon as you find them.

DO YOU HAVE A WATER LEAK?

Leaky pipes and drips when undetected waste thousands of gallons of water and result in higher monthly water bills.

Dripping faucets and running toilets are pretty easy to detect. Underground leaks are invisible but can literally wash away the structural integrity of your home. Read your water meter to find out if you have a "hidden" water leak.

5 steps to detecting a water leak

1. Locate your water meter.
2. Turn off all indoor and outdoorwater-using devices including the evaporative cooler, water softeners and icemaker.
3. Record the read from your water meter.
4. Wait 30 minutes read and record the meter again.
5. If you have a different reading, you have a leak!

The Toilet

CHECK YOUR TOILETS FOR LEAKS

If your water meter test indicates a possible leak, begin your search with the toilet. A leaking toilet can waste thousands of gallons of water. To check yours, put 10-15 drops of food dye into the tank. After 5-10 minutes, check the bowl for color. If there is color in your bowl, your toilet is leaking. The most likely culprit…the "flapper".

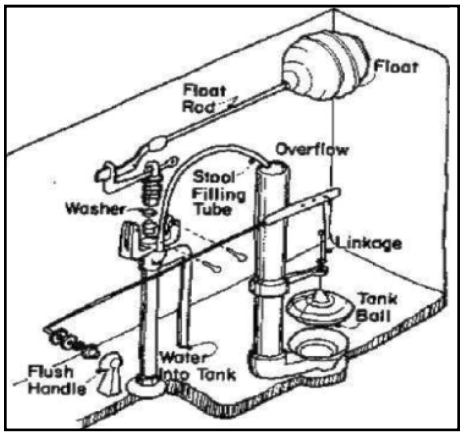
The Flapper (tank ball)

The flapper is what keeps water in the tank from flowing into the bowl. Make sure the flapper fits properly on the valve seat. It should fall straight onto the valve seat. A "worn" flapper won't seal properly either. To replace the flapper, turn off the valve and flush the toilet to drain the tank. Clean the seal and follow the instruction that came with the new flapper. Now run the dye test again. Approximately 90% of the leaks found are due to the toilet flapper. Tablet-type cleaning products placed in the tank can shorten the life of the flapper considerably.

The Faucet and Showerhead

REPLACE OLD AND WORN OUT WASHERS

Dripping faucets are not only a nuisance, they are a waste of precious water. Likely, the problem is a worn washer. Standard stem faucets with separate handles for hot and cold water use flat washers with a hole in the middle for a washer screw. Replacing the washer is easy and requires the use of a wrench, screwdriver and a new washer.



Faucet Drips

60 drips per minute =
192 gallons per month = **2,304 gallons per year**
90 drips per minute =
310 gallons per month = **3,720 gallons per year**
120 drips per minute =
429 gallons per month = **5,148 gallons per year**

Water leaks in the home

Does your shower head drip?

Even a low-flow showerhead can waste water if it drips. A leaky showerhead might be caused by an old washer in the faucet handle. Replace worn washer. Plumbing and hardware stores sell replacement parts. Call and contract with a licensed plumber when you need help on difficult plumbing projects.

Leaky Pipes

Some leaks are caused by carelessness. Make sure you give all sink and shower faucets a good tight turn to make sure they are completely off. Often, pipe leaks occur at the fittings. Look for leaks at pipe connection points for all of your household water-use appliances. Don't forget to check the connections on your hot water tank.

Find Leaky Pipes indoors and out

Size of Opening	Gallons wasted per month:	Gallons wasted per year:
1/32"	6,300	75,600
1/16"	25,000	300,000
1/8"	100,000	1.2 million
3/16"	225,000	2.7 million
1/4"	400,000	4.8 million

(at 60 lbs. of water pressure)

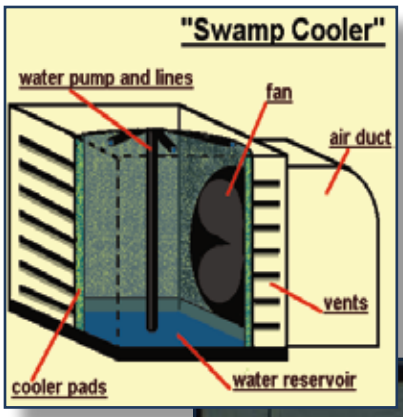
(Source: California Urban Water Conservation Council)

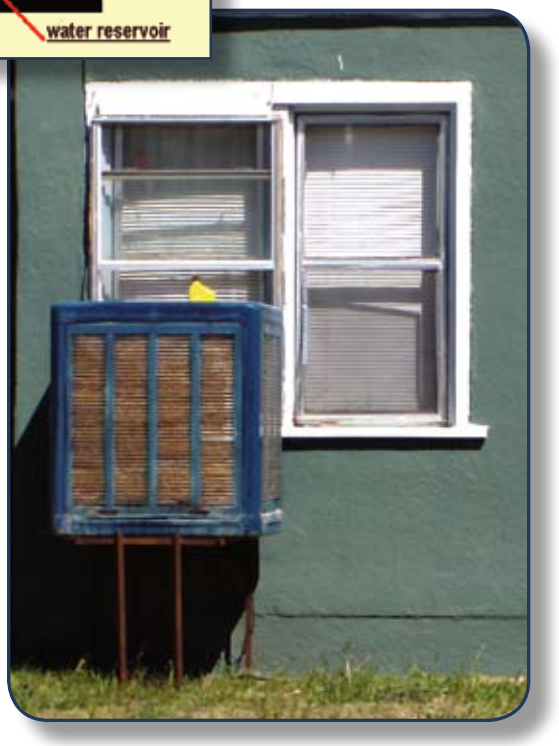
Finding and Fixing Outdoor Leaks

If a hose bib or outdoor faucet leaks, and a good hand-tightening won't fix it, replace the old washer. Look for wet spots in the landscape to help locate broken pipes and leaky or broken sprinkler heads. Buy replacement parts and fix them. Inspect water lines, sprinklers, emitters, and other components for possible leaks every month. Install a shut-off nozzle on your hose. Plant Native in your garden and limit turf areas. Installing a drip system is efficient and directs the water exactly where it is needed. Spraying or using a sprinkler system, throws the water out into the air where it is quickly evaporated. Be sure to check irrigation timers on a monthly basis to reset for the season and ensure efficient operation. Ask for Water Smart outdoor plant and landscaping information.

Don't Forget Your Evaporative Cooler

A leaking evaporative cooler isn't cool. Evaporative coolers ("swamp coolers") can efficiently cool an Arizona home, but a leaky cooler wastes a tremendous amount of water. Make sure the water level in the water pan is below the top of the overflow pipe. If the level is too high, bend the float valve arm downward (similar to adjusting the float ball in toilet tank). Also check the water lines leading to the cooler for leaks. Tighten loose connections.





Leak Resources

Fix a leak- www.epa.gov/watersense/fixaleak/
Drink Tap- www.drinktap.org/
Toilet ology 101- www.toiletology.org
USGS Drip Accumulator- www.ga.water.usgs.gov/edusc4.html
Laundry Wise- www.laundrywise.com

The Water and Energy Fact Sheet

Center for Sustainable Environments Northern Arizona University

September 2005

THE SUPPLY SIDE

Water Used for Electrical Generation
Coal and gas steam-generating electric plants in the Interior West (MT, ID, WY, NV, UT, CO, NM, and AZ) withdraw over 650 million gallons of water daily. This is enough water to meet the municipal needs of nearly four million people. A likely scenario in the near future involves the construction of an additional 16,800 MW of capacity requiring the withdrawal of about 116 million gallons of water daily.

Reliance on Coal-Fired Generating Plants

Coal-fired generating plants continue to be the dominant power source in the interior west. In 2000, coal plants consumed 94 percent of the freshwater used by fossil-fuel plants in this region. New natural gas power plants use 40-60 percent less water per megawatt of power generated than do existing coal-fired plants.

Uses of Water in Electrical Generation

The primary use of water at power plants is for condensing steam (cooling steam back to water). On average, about one-half gallon of water is used for each kilowatt produced. Five percent of water for the power plants comes from surface waters (mostly rivers) and 20 percent comes from groundwater. Groundwater is the dominant water source for plants in Arizona.

Thermonuclear Plants

U.S. thermonuclear power plants withdrew 225 billion gallons of water per day in 2002, or about three quarters of Lake Erie. Thermonuclear power withdraws more water than any water user in the U.S.

Low-Water Cooling Systems

Re-circulating systems can reduce water withdrawals by at least 95 percent compared to once through systems. Dry cooling technologies reduce water demand and minimize many water related impacts associated with power production. In the U.S. dry cooling systems are used in over 50 operating plants and the number is growing.

Revised Practices

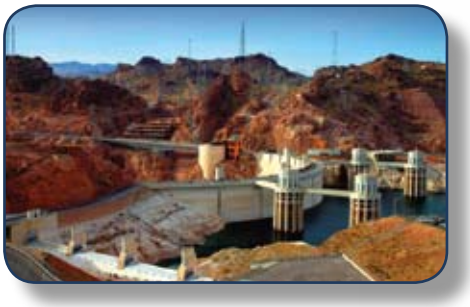
Until recently, water use and consumption have not been significant factors in decisions related to the permitting and citing of power plants. Serious drought conditions in the region have heightened public concern about how limited water resources should best be allocated. With greater awareness and importance placed on the value of water, permitting authorities have begun to deny permits on conditions based on potential impacts to water resources.

Water, Electricity and Climate Change

Power plants emit 40 percent of U.S. carbon dioxide pollution, the primary cause of climate change.

Climate change has the potential to greatly affect water supply and water management, likely leading to greater risk of drought, water shortages in summer and flooding in winter.

Decreased runoff equals decreased power production. In the Colorado River, a 10 percent decrease in runoff reduces hydropower production by 36 percent. As hydropower generation decreases, producers are likely to turn to fossil fuel plants, thereby increasing emissions that contribute to climate change. From 1987 to 1992, drought in California caused hydropower losses costing consumers $3 billion and leading to a 25 percent increase in greenhouse gas emissions.



THE DEMAND SIDE

Infrastructure in the West

Water systems in the west are energy dependent due to the energy intensive tasks of moving large quantities of water over long distances and significant elevations. Energy costs are accrued by pumping water during access, conveyance, distribution, treatment, local distribution, end uses, and wastewater collection and treatment. For a city of 50,000 people, approximately two million kwh/yr are required for all water-related operations, with more than 1.6 million kwh/yr needed for pumping alone.

Saving Water Saves Energy

Most consumers do not realize that saving water is an excellent way to save energy. Conservation at the end use stage eliminates all of the "upstream" energy required to bring the water to the point of end use (by avoiding conveyance, distribution, treatment, end use, and wastewater treatment of additional water.) The greatest energy and water savings come from reducing water consumed by residential laundries and showers.

The Efficiency of Conservation

The amount of electricity used to deliver water to residential consumers in Southern California is equal to one-third of the total average household electric use in Southern California. If San Diego relied on conservation instead of additional water from northern California to provide the next 100,000 acre-feet of water, it would save enough energy to provide electricity for 25 percent of all of the households.

Agriculture

Agriculture uses approximately 70 percent of the developed water supply in the United States. Pumping groundwater for irrigation uses 90 percent of all electricity used on farms. In 1995, California agriculture used 4.4 billion kwh of electricity for groundwater pumping and irrigation purposes, and more than 11 billion kwh for all purposes. As much as 50 percent of water used for irrigation is wasted due to inefficient technologies, system leaks, evaporation and over-watering. It is estimated that 150,000 hecta acres of agricultural land in the United States has already been abandoned because of high pumping costs brought on, in part, by reduced water accessibility due to drought.

Water Recycling

Reusing water is less energy intensive than obtaining it from any other source, except fot local surface water. Orange County is constructing a water recycling system that will use one-half the amount of energy required to import the same amount of water from northern California. From an energy perspective, a combination of conservation and water recycling is likely the best path for meeting growing urban water needs.

The Problem with Subsidies

Water subsidies increase water demand, discourage conservation and thereby increase energy use. Data show that per-capita water use is about one-third less in areas where water users are billed based on volumetric rates rather than fixed rates.

Energy subsidies encourage water pumping over long distances and accessing groundwater at depths that would not be economically feasible if full costs were paid. Resource management would improve if water planning and policy, including subsidies, reflected the critical link between water and energy.

Integrating Water and Energy Planning

Currently, water agencies select water sources without assessing the energy costs of transporting the water over the great distances to users. Likewise, they fail to consider the energy savings of using less water, causing high costs for consumers and wasteful water-supply decisions.

Looking at water use and energy use simultaneously generates valuable insights that do not arise from separate policy analyses of water and energy. Integrating energy use into water planning can save money, reduce waste, protect the environment, and strengthen our economy.

The Water and Energy Fact Sheet Center for Sustainable Environments Northern Arizona University
Compiled by Mike Madigan and Gary Deason from the following sources:
"The Last Straw-- Water Used by Power Plants in the Arid West," Hewlett Foundation Energy Series, April, 2003.
"Energy Down the Drain: the Hidden Costs of California's Water Supply," National Resources Defense Council and Pacific Institute, April, 2004.
"Energy-Water Nexus," Larry Flowers, National Renewable Energy Lab, presentation at the Arizona Water Summit, Northern Arizona University, August 4, 2005.
"Interrelations of Water and Electricity: The Demand Side," Jay Golden, SMART, Arizona State University, presented by Harvey Bryan at the Arizona Water Summit, Northern Arizona University, August 4, 2005.
"Water Resources: Agricultural and Environmental Issues," David Pimental, et al, BioScience, Vol. 54, No. 10, October 2004.

Center for Sustainable Environments (CSE)
PO Box 5765 Flagstaff, AZ 86011-5765 Phone: 928-523-0637 Fax: 928-523-8223
E-Mail: environment@nau.edu • www.home.nau.edu/environment/energy_farms.asp

Value Drinking Water

Think water smart and support the efficient use of drinking water which is conveniently delivered to your home or business.

Water and Wastewater

Service, Value and Benefit

We all benefit from our network of treatment plants, pump stations and pipes. In many of the systems both wastewater and water have been installed, maintained and passed down from prior generations. Because our water infrastructure has supported years of continued use and service, much of the region's water grid is going to need repairs, replacement or upgrade investment.

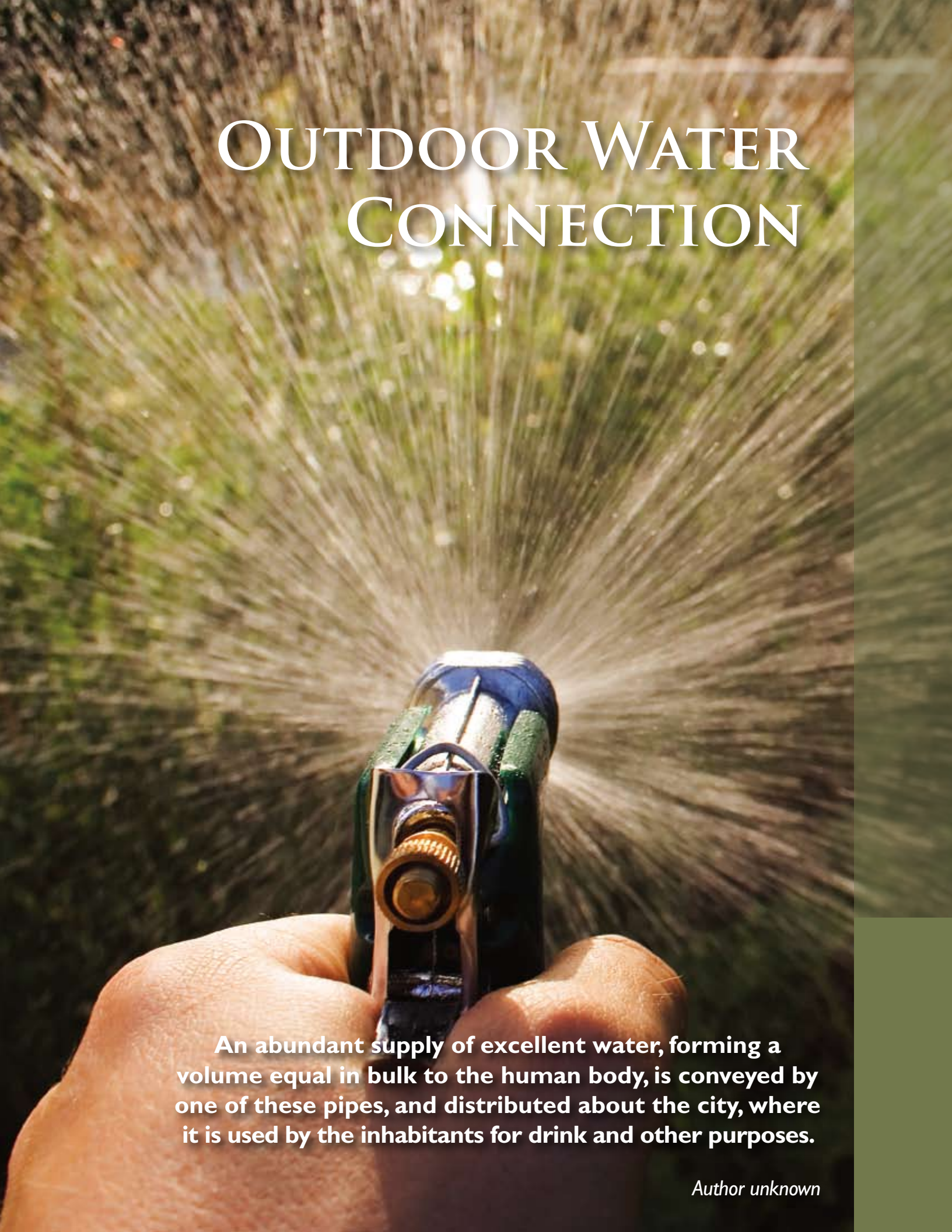
Regionally we can almost be certain that drinking water and wastewater service will cost more in the future. We must choose either to adopt strategies to sustain our water infrastructure, or accept the inevitable.

Erosion of our infrastructure may occur over time. We have a reliable water and wastewater distribution service. We can begin investing today by supporting and adopting rate structures and financing plans that reflect the full cost of water and wastewater service. When we consider the critical needs addressed by water and wastewater service, sound management is an enormous service with value. In fact, it is a steal.

Can we even begin to place a price on the community service that supports health, fire protection, economics and life?

One of the keys to regional water supply management is to find and support smart and innovative ways to collect, distribute and recycle water. New strategies for water and reuse include integrated water, wastewater and storm water systems.

Outdoor Water Connection



An abundant supply of excellent water, forming a volume equal in bulk to the human body, is conveyed by one of these pipes, and distributed about the city, where it is used by the inhabitants for drink and other purposes.

Author unknown

ENVIRONMENTALLY SOUND LANDSCAPE DESIGN, CONSTRUCTION, AND MAINTENANCE

Photograph: Steve Morgan, Landscape Architecture

PLAN BEFORE YOU PLANT

Beautiful outdoor environments begin with a well thought out landscape plan. When designing a landscape, take into account outdoor living preferences and purpose. Considerations may include the look you want to achieve, the ways in which a yard will be used, desired maintenance time, financial investment and water use budget.

BECAUSE LANDSCAPE PLANNING PREVENTS COSTLY PROJECT MISSTEPS:

☐ **Make a drawing of the site; base plan** – Measure the lot and draw a scaled diagram of the site. Use 1/10 or ¼" scale relationships to represent one foot and draw on a sheet of 11" x 17" size paper. This size is readily available and easy to make additional copies for contractors. On the base plan, be sure to include significant and existing site features. Note the project site address, scale of drawing and orientation of home to the direction north. Noting once on the original plan is efficient and will assist in communicating site characteristics throughout the design process.

☐ **Develop drawings** – Before sketching, take a complete base drawing to the local print shop; make 4+ copies. They will be used at various stages in the design process. Keep one clean original in a file for future projects. By drawing a scaled base plan, a homeowner is able to make certain that design features are appropriate in size. Use a scale ruler to determine mature size of plants and draw a light circle, sketch a symbol over it and create a legend on the drawing to represent that particular plant's growth. Remember planning on paper provides a tool to determine the design or concepts and estimate costs, as well as a project installation guide.

☐ **Make a wish list** – If unsure about how to start or what to include in the yard, ask some simple questions. These questions can include interest in aesthetics, views, functions, color, shade, food production, maintenance and watering requirements, wildlife habitat, play or entertainment and any other outdoor living requirements.

☐ **Start a scrapbook** – Photograph and tour local neighborhoods and nurseries, regional botanical gardens and participate in annual garden tours. Visit the public library, extension agency and conservation office to pick up regional plant lists and watering tips. Take pictures of plants to research. Limit tree and shrub selections to the top three to five choices of each plant type.

☐ **Establish a water budget** - Determine how you much water will be required on an annual basis. Consider local rainfall, soil conditions, slopes and temperature that effect landscape watering. Planning a water budget when plant ideas are on paper allows homeowners to estimate annual water requirements by gallons per year. Review guides on irrigation and rainwater harvesting systems for specific information for selecting and growing plants and water requirements of landscape areas.

☐ **Study the site** – Spend some time walking around the lot, looking at every feature, such as how the lot is graded, firewise defensible space requirements, and potential for naturally selecting areas for rainwater gardens. Note the site orientation. Identify sunny or shady areas during different times of the day and year. Determine soil conditions. Note on a draft plant views to keep or obstruct. Evaluate both the negative and positive aspects of the site.

☐ **Research local plants and landscape materials** – Be sure to consider the mature size of a plant in the design. Consider the color and texture of plants and indigenous rocks and boulders. Keep in mind the seasonality of different plant species. Incorporate hardscape or rock structures (patios, boulders, barbeque, seating areas, etc.) in the landscape plan. Think about materials, colors, and shape and how they compliment the home exterior and environment.

☐ **Start the design by drawing hardscape and high function elements** – Draw existing and proposed patios, decks, recreation or storage areas and other semi-permanent outdoor amenities. Note areas where grading or contour changes are to be made. Next, incorporate shade trees and plants into the design. Finally incorporate another drawing to determine passive and active grading to support rain-water harvesting and another drawing for drip irrigation systems.

☐ **Draw a preliminary landscape design and irrigation plan** – It is easier to visualize a plan when it is on paper and to also make sure all components are the right size and in the proper location. Start by drawing in any hardscape elements, and then mark areas where grading or contour changes. Next, draw circles indicating mature plants into the design, and finally incorporate preliminary irrigation plan on a second sheet.

☐ **Shop locally** – Get accurate cost estimates on materials before making a final decision on the landscape project. Accurate costs will help avoid unexpected surprises. Now is a great time to decide whether to install a landscape project all at once or in stages. First, make a shopping list of all the materials needed. Estimate square feet of rock and hard surface areas and convert area into yards or tons as required. (Generally, one ton of ¾" size rock covers 100 square feet)

☐ **Prepare cost estimates** – The pre-shopping activities should provide the information needed to estimate the total land-scape cost. You can prepare a cost estimate worksheet with the item, size, amount needed, unit cost, and total cost for that item. Total the cost of all sprinkler permits, materials, labor and special services to arrive at an accurate project estimate. Determine the cost of irrigation or rainwater system components; identify any additional items or equipment rental required to complete the entire phased landscape installation.

☐ **Draft final working designs** – Landscape design, irrigation plan and installation project. Incorporate minor changes to the preliminary drawings, and move to the contract stage of installation. If major changes have been made, revise the original plan to mirror the proposed project.

☐ **Review the estimate** - Determine if costs are within budget. This is a great time to prioritize the project and make decisions to complete the project or consider developing it in stages.

☐ **Investigate professional services or design agents** - With a list of needs, shop and negotiate a price to install all or portions of the plan. Consider product quality, durability, guarantees, warranties, and customer service. It is advisable to get a cost estimate for materials from more than one supplier, and always hire licensed and insured contractors.

☐ **Installing the project in stages -** Determine priorities of the working design. Make several photocopies of the final plan, as this will make it easy to request an estimate, or give to subcontractors.

☐ **Request written quotes** - Including any shipping or delivery charges and always sign a written contract, which includes pay schedules, project timelines, annual water budgets, service details, and product warranties. Keep all drawings, contracts, product receipts, and photographs in a project folder for future reference or rebates.

Planning before planting will allow homeowners to become informed consumers. Prepare to install a landscape and take an active part in living in a beautiful, functional outdoor environment.

GROW WITH NATIVE LANDSCAPES

By Nichole Trushell, Author of Landscapes for the Highlands

A photographic and information guide to native plants suitable for landscape design in the mid to high elevation range of Arizona and New Mexico

Sotol, Dasylirion wheeleri.
Succulents like the Sotol provide a striking form in the landscape. These can be used as accents, or as sweeps for a dramatic effect. Some slow-growing succulents that produce little dry material can be placed near the home – they are the truly fire-wise plants.

Golden Dogbane Thymophylla pentachaeta
A hardy perennial that flowers throughout the summer and reseeds readily.

Chocolate flower Berlandiera lyrata
Blooms in summer mornings and late afternoons --their chocolate-like fragrance and striking flowers make this plant truly unique.

Grow with Natives
Photo Credits: Nichole Trushell

Landscaping to save water does not mean that you must give up beauty, or the feeling of a lush, secluded surrounding near your home. By using natives creatively in landscape design, spaces can be created that bring color, melody, and fragrances to enrich our daily lives without the high price of water consumption. In an increasingly urban environment, these spaces can also re-create a place to enjoy watchable wildlife like birds, butterflies, lizards and small mammals.

There are now exceptional varieties of garden-worthy, drought-tolerant plants available that can be incorporated into a new or existing design. Once established, native trees, shrubs, succulents and grasses require little supplemental irrigation.

Keep in mind that even a modest-size lawn can consume thousands of gallons of water. Diminishing water use is wise both ecologically and economically. Water harvesting can significantly enhance available water to plants on your property. This technique can be as simple as creating "eyebrows" below plants for catchment of natural downhill flow to installing attractive above ground or buried storage tanks. Tanks have the advantage of storing water for times when plants need it most. A soft winter rain or summer monsoon downpour can provide enough water for use during times when no rain clouds appear for many months.

While there is no such thing as a maintenance-free landscape, using natives for your design will eventually come close. And "bringing life back home" with plant species that naturally occur in our region (and all the other animal species that live with them) just naturally makes the home landscape richer and more inviting for everyone – including humans.

RECOMMENDED DROUGHT-TOLERANT NATIVE SPECIES FOR OUR LOCAL LANDSCAPES

In times of severe drought, a buffalo grass lawn only needs to be mowed once per season and requires only 1/4 inch of water per week compared to most turf grasses, which need 1 to 1 1/2 inches per week. Succulents and grasses provide striking forms in the landscape. These can be used as accents, or as sweeps for a dramatic effect. Some slow-growing succulents that produce little dry material can be placed near the home – they are the truly fire-wise plants.

There are a wide variety of both evergreen and deciduous shrubs that are well adapted to our dry, often windy environment. Three-leaf sumac is deciduous, grows quickly, provides brilliant fall color and produces attractive edible fruit.

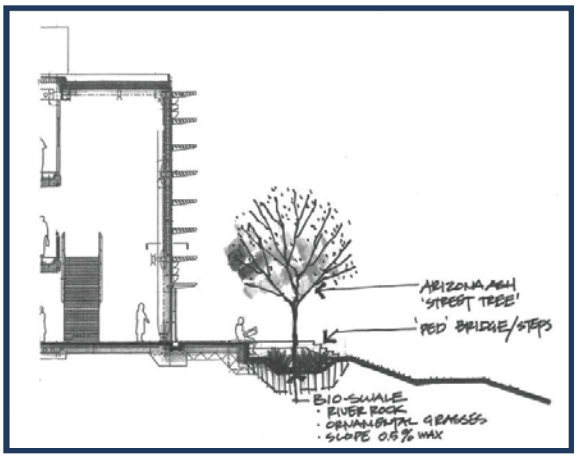
In areas where shade or greater height is needed a deciduous tree like Desert Willow is an excellent choice. These native trees produce showy flowers. Providing supplemental water during establishment and during our driest times of the year will still result in fairly rapid growth. Native perennials like Penstemons, Plains Coreopsis, Golden Dogbane, and Blue flax provide color throughout the summer and thrive in our local environment.

Autumn Sage (Salvia greggi)
A plant that thrives nestled among boulders. It's long bloom lasts throughout summer and is most striking in the fall.

Ecological Drainage Strategies

By T. Barnabas Kane, Landscape Architect

Landscape architecture plans precipitation run off from roofs and topography to match the moisture requirements of landscape plantings. This can be manipulated by a number of active and passive water-harvesting methods. With proper water harvesting techniques, a site that receives 15 in. of precipitation annually and has a 50 percent lot coverage can sustain plants that rely on 15 to 30 inches of rain annually.



Swales or bio-swales, berms and boulder placement may be used to augment active methods such as guttering, downspout locating, underground piping and leach trenches. Cisterns or ponds may collect rainwater to be distributed through irrigation systems. Slowing run off and allowing it to saturate soil as much as possible reduces offsite storm erosion and promotes healthy habitat. Drip irrigation alone cannot bring a tree to maturity; trees will never fully mature until they have a consistent natural or augmented groundwater source. Run off should be well-planned and managed to prevent damage or adverse interruption of natural flow lines. The design must take care not to flood or super-saturate soil under building footings. Roofs, driveways and hard surfaces should be designed to collect water and draw run-off into adjacent landscape areas.

When using plants not native to the region, timing of moisture over the course of the year should be considered. Native plants are always a preferred option, as they are already adapted to the moisture regimen.

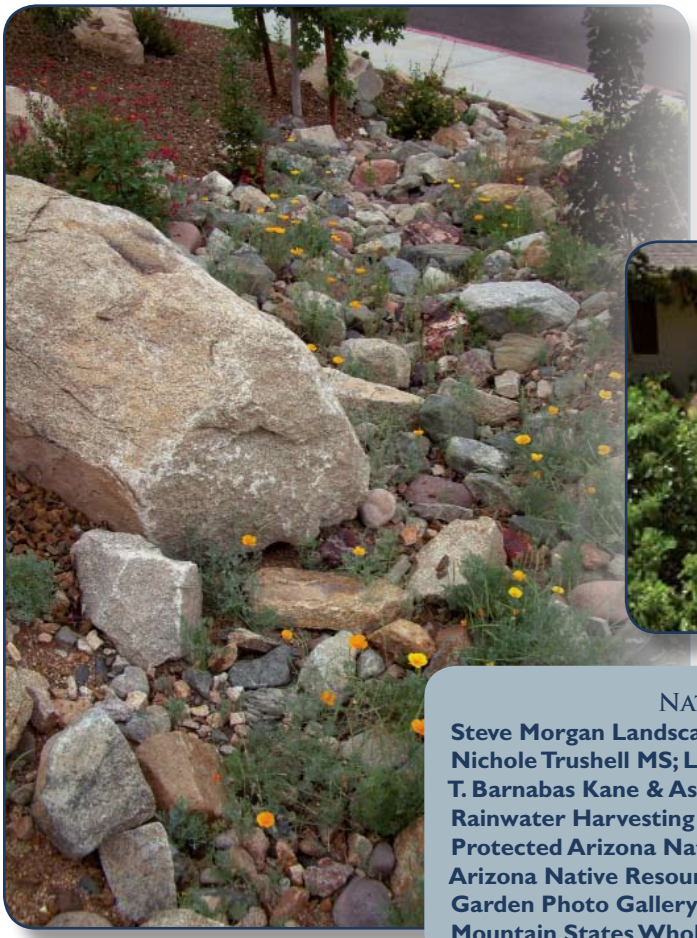


Photo Credits: T.B. Kane, AIA

Native Plants and Landscape Resources

Steve Morgan Landscape Architecture- www.morganlandscapes.com
Nichole Trushell MS; Landscapes for the Highlands- www.morganlandscapes.com
T. Barnabas Kane & Associates, P.C. Rehabitation by Design- www.tbkadesign.com
Rainwater Harvesting Eyebrow detail- www.morganlandscapes.com/eyebrow.html
Protected Arizona Native Plants- www.azda.gov/esd/nativeplants.htm
Arizona Native Resource- www.wildflower.org/collections/
Garden Photo Gallery- www.phgmag.com/garden/gallery/
Mountain States Wholesale Nursery Database- www.mswn.com/index2.htm

Fire-Resistant Landscaping

COOPERATIVE EXTENSION, THE UNIVERSITY OF ARIZONA ISSUED AUGUST 2002 BY: Fred Deneke, Interim Fire Education Specialist PUBLICATION AZ1291 8/2002

Firewise At a Glance

More people are moving into Arizona's rural areas, increasing the chances of wildfire. "Defensible space" is the primary determinant of a structure's ability to survive wildfire. Native species are generally the best plant materials for landscaping in defensible space. To be a FIREWISE homeowner, plan well, use the right plants in the right places, and maintain.

Arizona's population is growing, its urban areas and its communities in rural areas are rapidly expanding, and people are building more homes in what was once natural forest, grass and brush lands. It is important people know how to correctly landscape property to reduce wildfire hazards. Improper landscaping can greatly increase the risk of structure and property damage from wildfire. It is a question of when, not if, a wildfire will strike any particular area north of Prescott.

Defensible Space

Creating defensible space around a home is a primary determinant in surviving a wildfire. Defensible space is an area around a structure where fuels and the vegetation are treated, cleared or reduced to slow the spread of wildfire towards the structure. It also reduces the chance of a structure fire moving from the building to the surrounding forest. Defensible space provides room for firefighters to do their jobs. A house is more likely to withstand a wildfire if grasses, brush, trees and other common forest fuels are managed to reduce a fire's intensity. If a defensible space has not been created, firefighters may bypass a house, choosing to make their stand at a home where their safety is more assured and the chance to successfully protect the structure is greater.

Landscaping Defensible Space

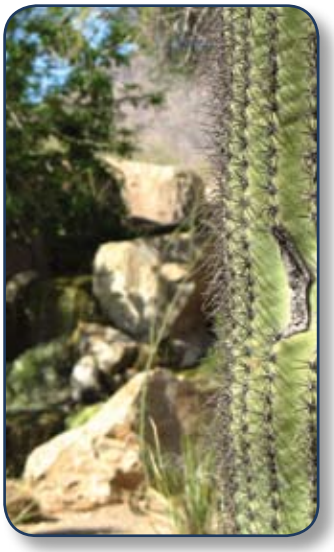
People often resist creating defensible space because they believe that it will be unattractive, unnatural and sterile-looking. It does not have to be! Wise landowners carefully plan landscaping within the defensible space. This effort yields the many-fold return of beauty, enjoyment and added property value and may lower home owner insurance premiums.

Arizona has great diversity in climate, geology and vegetation. Home and cabin sites can be found from the foothills through 8,000-foot elevations. Such extremes present a challenge in recommending plants. While native plant materials generally are best, a wide range of species can be grown successfully in Arizona. Many plant species are suitable for landscaping in defensible space. Use restraint and common sense, and pay attention to plant arrangement and maintenance.

It has often been said that how and where plants are placed is more important than what is planted. While this is indeed true, given a choice among plants, choose those that are more resistant to wildfire. Consider the following factors when planning, designing and planting the firewise landscape within a home's defensible space: Landscape according to the recommended defensible-space zones. That is, the plants near a home should be more widely spaced and lower growing than those farther away. Do not plant in large masses. Instead, plant in small, irregular clusters or islands.

Use decorative rock, gravel and stepping stone pathways to break up the continuity of the vegetation and fuels. This can modify fire behavior and slow the spread of fire across the property. Incorporate a diversity of plant types and species into the landscape. Not only will this be visually satisfying, but it should help keep pests and diseases from causing problems within the landscape.

In the event of drought and water rationing, prioritize plants to be saved. Provide available supplemental water to plants closest to the house. Use mulches to conserve moisture and reduce weed growth. Mulch can be organic or inorganic. Do not use pine bark, thick layers of pine needles



or other mulches that readily carry fire. Be creative! Vary your landscape by including bulbs, garden art and containers for added color.

Grasses

During much of the year, grasses ignite easily and burn rapidly. Tall grass will quickly carry fire to a house. Mow grasses low in the inner zones of the defensible space. Keep them short closest to the house and gradually increase height outward from the house, to a maximum of 8 inches. This is particularly important during fall, winter and before green-up in early spring, when grasses are dry, dormant and in a "cured" fuel condition. In Arizona, wildfires can occur any time of the year. Maintenance of the grassy areas around a home is critical. Mow grasses low around the garage, outbuildings, decks, firewood piles, propane tanks, shrubs, and specimen trees with low-growing branches.

Ground Cover Plants

Replace bare, weedy or unsightly patches near the home with ground covers, rock gardens, vegetable gardens and mulches. Ground cover plants are a good alternative to grass for parts of the defensible space. They break up the monotony of grass, enhance the beauty of a landscape, they provide a variety of textures and color, and help reduce soil erosion. Consider ground cover plants for areas where access for mowing or other maintenance is difficult, on steep slopes and on hot, dry exposures. Ground cover plants are usually low growing. They are succulent or have other firewise characteristics that make them useful, functional and attractive. When planted in beds surrounded by walkways and paths, in raised beds or as part of a rock garden, they become an effective barrier to fire spread. The ideal ground cover plant is one that will spread, forming a dense mat of roots and foliage that reduces soil erosion and excludes weeds.

Mulch

Mulch helps control erosion, conserve moisture and reduce weed growth. It can be organic (compost, leaf mold, hardwood bark chips, shredded leaves) or it can be inorganic (gravel, rock, decomposing granite.) When using organic mulches, use just enough to reduce weed and grass growth. Avoid thick layers. When exposed to fire, they tend to smolder and are difficult to extinguish. Likewise, while the property might yield an abundance of needles from native pines or other conifers, do not use them as mulch because they can readily catch and spread wildfire. Rake, gather and dispose of them often within the defensible space.

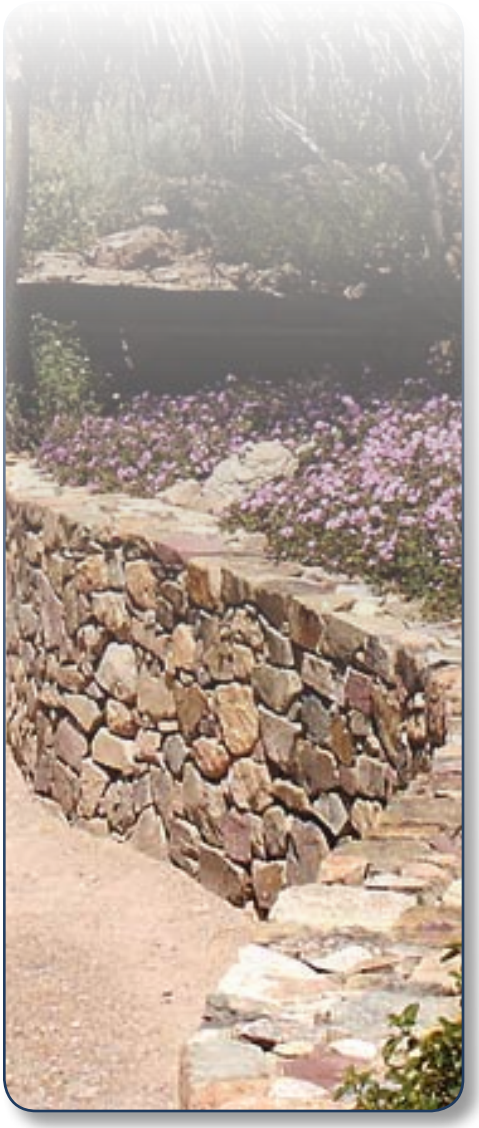
Wildflowers

Wildflowers bring variety to a landscape and provide color from May until frost. Wildflower beds give a softer, more natural appearance to the otherwise manicured look often resulting from defensible space development. A concern with wildflowers is the tall, dense areas of available fuel they can form, especially in dormancy. To reduce fire hazard, plant wildflowers in widely separated beds within the defensible space. Do not plant them next to structures unless the beds are frequently watered and weeded and vegetation is promptly removed after the first hard frost. Use gravel walkways, rock retaining walls or irrigated grass areas mowed to a low height to isolate wildflower beds from each other and from other fuels.

Shrubs

Shrubs lend color and variety to the landscape and provide cover and food for wildlife. However, shrubs can add significantly to total fuel loading around a home. The primary concern with shrubs is they can serve as "ladder fuel" and carry a relatively easy-to-control ground or grass fire into tree crowns. Once a fire reaches into the tops of trees (the crowns) it is difficult, and sometimes impossible, to control.

This article is based on and draws heavily from a publication titled "Fire-Resistant Landscaping" written by F.C. Dennis and produced by the Colorado State Forest Service. FIREWISE is a multi-agency program that encourages the development of defensible space and the prevention of catastrophic wildfire.



Shrubs (con't)

To reduce the fire-spreading potential of shrubs, plant only widely separated, low-growing, non-resinous varieties close to structures. Do not plant them directly beneath windows or vents or where they might spread under wooden decks. Do not plant shrubs under tree crowns or use them to screen propane tanks, firewood piles or other flammable materials. Plant shrubs individually or in small clumps apart from each other and away from any trees within the defensible space. Mow grasses low around shrubs. Prune dead stems from shrubs annually. Remove the lower branches and suckers sprouts from trees to raise the canopy away from possible surface fires.

Trees

Trees provide a large amount of available fuel for a fire and can be a significant source of fire brands — stems and branches, carried in the smoke column ahead of the main fire rapidly spreading the fire in a phenomenon known as "spotting." Radiant heat from burning trees can also ignite nearby shrubs, trees and structures. Arizona's elevation and temperature extremes limit tree selection. The best species to plant generally are those already growing on or near the site. Others may be planted with careful selection and common sense. If a site receives enough moisture, plant deciduous trees such as aspen or narrow-leaf cottonwood. These species, even when planted in dense clumps, generally do not burn well, if at all. The greatest problem with these trees is the accumulation of dead leaves in the fall. Remove accumulations close to structures as soon as possible after leaf drop. When site or available moisture limits recommended species to evergreens, carefully plan their placement. Do not plant trees near structures. Leave plenty of room between trees to allow for their growth. Spacing within the defensible space should be at least 10 feet between the edges of tree crowns. On steep ground, allow even more space between crowns. Plant smaller trees initially on a 20 to 25 foot spacing to allow for tree growth. At some point, thin trees to retain proper spacing.

As the trees grow, prune branches to a height of 10 feet above the ground. Do not over-prune the crowns. A good rule of thumb is to remove no more than one-third of the live crown of the tree when pruning. Prune existing trees as well as ones that have been planted. Some trees tend to keep a full crown. Other trees grown in the open may also exhibit a full growth habit. Limit the number of trees of this type within the defensible space. Prune others as described above and mow grasses around such specimen trees.

Structural Elements of a FIREWISE Landscape

When building a deck or patio, use concrete, flagstone or rock instead of wood. These materials do not burn and do not collect flammable debris like the space between planks in wooden decking. Where appropriate on steeper ground, use retaining walls to reduce the steepness of the slope. This, in turn, reduces the rate of fire spread. Retaining walls also act as physical barriers to fire spread and help deflect heat from the fire upwards and away from structures. Rock or masonry walls are best, but even wooden tie walls constructed of heavy timbers will work. Put out any fires burning on tie walls after the main fire front passes. On steep slopes, consider building steps and walkways around structures. This makes access easier for home maintenance and enjoyment. It also serves as a physical barrier to fire spread and increases firefighters' speed and safety as they work to defend your home.

Maintenance

A landscape is a dynamic system that constantly grows and changes. Plants considered fire resistant and which have low fuel volumes can lose these characteristics over time. A landscape, and the plants in it, must be maintained to retain their firewise properties.

Always keep a watchful eye towards reducing the fuel volumes available to fire. Be aware of the growth habits of the plants within the landscape and of the changes that occur throughout the seasons. Remove annuals and perennials after they have gone to seed or when the stems become overly dry. Rake up leaves and other litter as it builds up through the season. Mow or trim grasses to a low height within the defensible space. This is particularly important as grasses cure. Remove plant parts damaged by snow, wind, frost or other agents. Timely pruning is critical. Pruning not only reduces fuel volumes, but also maintains healthier plants by producing more vigorous, succulent growth.

Landscape maintenance is a critical part of a home's defense system. Even the best defensible space can be compromised through lack of maintenance. The old adage, "An ounce of prevention is worth a pound of cure" applies here.

Firewise Resources:

Firewise Communities- www.firewise.org/
Preparing your home for fire season- www.firewise.org/fw_youcanuse/preparing/index.htm
www.firewise.org/fw_youcanuse/preparing/index
Plant Materials for 3,000 foot and Higher Elevation- www.ag.arizona.edu/pubs/natresources/az1289.pdf
www.ag.arizona.edu/pubs/natresources/az1289.pdf
Firewise /Defensible Space Education- www.cals.arizona.edu/yavapaianr/defspace/index.html" http://cals.arizona.edu/yavapai/www.anr/defspace/index.html
Fire-Resistant Landscaping- www.ag.arizona.edu/pubs/natresources/az1291.pdf" http://ag.arizona.edu/pubs/natresources/az1291.pdf
Homeowners' "Inside and Out" Wildfire Checklist- www.ag.arizona.edu/pubs/natresources/az1288.pdf" http://ag.arizona.edu/pubs/natresources/az1288.pdf
Additional Firewise sites- www.firewise.org/resources/links_related.htm" http://www.firewise.org/resources/links_related.htm

Mortimer Nursery

A CALMING GARDEN

While gazing at the subtle tones of the foliage and blooms, relax knowing that these appealing plants are tough and Water Smart. Plant this garden in lean soil (no need for lots of fertilizer and amendments) and give it low to moderate water once established.

Tufted Evening Primrose
Oenothera caespitosa
The 4" large, pure white blooms will light up a garden late afternoon through morning. As the sun rises, the blooms fade to pink and drop off –then the show starts all over again in the evening.

Size: 3 wide x 3 tall **Sun:** full
Water: low to moderate **Temp:** -20° F
Et0: 0.20 **WB:** 100 gal/y

Apache Plume
Fallugia paradoxa
This native shrub offers attractive texture year round. In early spring small, white flowers soon accompany shimmering pink seed heads which resemble small plumes of smoke and are semi-evergreen in the winter.

Size: 8 wide x 8 tall **Sun:** full
Water: none to low **Temp:** -30° F
Et0: 0.20 **WB:** 100 gal/y

Fringed Sage
Artemisia frigida
Reach out to touch the silky soft, silver foliage of this plant. In summer, enjoy foot-long spikes topped with small yellow flower heads that bend and nod in the breeze. The basal rosette of foliage remains attractive all year.

Size: 2' x 2' **Sun:** full
Water: low to moderate **Temp:** -30° F
Et0: 0.20 **WB :** 100 gal/y

Catmint
Nepeta x faasenii
A stunning plant in spring and early summer. Covered in soft lavender blue spikes this plant is a beacon to butterflies. Heart-shaped, silvery-gray foliage compliments blooms. Attractive after blooms fade. Cut back the flowers after blooms begin to fade to encourage a second bloom.

Size: 2 wide x 3 tall **Sun:** full
Water: moderate **Temp:** -20° F
Et0: 0.20 **WB:** 100 gal/y

Caryopteris
Caryopteris x clandonensis
Compact, well-behaved shrub adds color to late season gardens. Cool blue flowers adorn plant from late summer to frost. Butterflies enjoy this source of late season nectar. Seed heads add interest in winter landscape. Treat as a perennial and cut back stems nearly to the ground in late winter/early spring.

Size: 4 wide x 4 tall **Sun:** full
Water: moderate **Temp:** -20° F
Et0: 0.20 **WB:** 100 gal/y

Blue Fescue
Festuca glauca
Appealing blue foliage forms a small mounding plant topped with greenish-blue flower heads that fade to tan. A cool-season grass, Blue Fescue holds much of its color throughout winter and new growth shows in early spring. This accent grass makes an effective edging plant.

Size: 3' x 3' **Sun:** Full sun, among rocks is best.
Water: 4-8" annual supplement after established.
Temp: 0° F or colder if protected
Et: 0.20 **WB:** 200 gal/y

Concept and Design Ideas by: **Mortimer Nursery**
3166 Willow Creek Road Prescott, AZ 86301 928-776-8000
E-mail: info@mortimer-nursery.com Web address: www.mortimer-nursery.com

Steve Morgan Landscape Architecture

XERIC DELIGHTS

The unique forms of succulents and grasses planted with showy flowering plants as accents create a palette that is showy but drought resistant. Use plants in clusters or masses for a striking landscape display. Relax – water is not an issue, and if maintained, these are fire-wise.

Sotol
Dasylirion wheeleri
Dense rosette; leaves silver-blue with small hooks on margins. Huge flower stalks!

Size: 5' x 5', flower stalk 9-12'. **Sun:** Full sun, reflected heat
Water: None after established, good drainage.
Temp: to 0° F **Et:** 0.20 **WB:** 100 gal/y

Prickly Pear
Opuntia – various species
Round evergreen pads and showy flowers and fruits. Sizes, colors and shapes vary by species. A tough, classic, southwest landscape plant.

Size: Low to medium **Sun:** Full sun to part shade
Water: Minimal. Needs good drainage.
Temp: Varies with species, most are very hardy.
Et: 0.20 **WB:** 50 gal/y

Side Oats Grama
Bouteloua curtipendula
A warm season grass with narrow leaves and purple to orange coloration on spikelets produced.

Size: 2' x 2' **Sun:** Sun to part shade.
Water: None once established, need good drainage.
Temp: Hardy to 7000' elevation.
Et: 0.20 **WB:** 5 gal/ sq. ft. /y

Red Yucca
Hesperaloe parviflora
Narrow leaves, clumping habit. Stunning red or yellow flowers on long stalks. Excellent for attracting hummingbirds.

Size: 5' x 5' **Sun:** Full sun
Water: None after established, good drainage.
Temp: to -20° F
Et: 0.20 **WB:** 100 gal/y

Dyssodia, Golden Dogbane
Thymophylla pentachaeta
Numerous tiny yellow daisy flowers throughout summer. Reseeds readily.

Size: Mounding to 8" x 10" or more **Sun:** Full sun, good drainage
Water: Minimal after established
Temp: to -30° F **Et:** 0.20 **WB:** 100 gal/y

Autumn Sage
Salvia greggii
Brilliant red to fuchsia flowers are produced throughout the summer, with the best show in the fall. Hummingbirds love these.

Size: 3' x 3' **Sun:** Full sun, among rocks is best.
Water: 4-8" annual supplement after established.
Temp: 0° F or colder if protected
Et: 0.20 **WB:** 200 gal/y

Concept and Design Ideas by: **Steve Morgan Landscape Architecture**
Nichole Trushell & Steve Morgan Phone: 928.445.1060
E-mail: steve@morganlandscapes.com Web address: morganlandscapes.com

T. Barnabas Kane & Associates

REHABITATION GARDEN

An attractive, low-water landscape that creates habitat for pollinators, birds and other wildlife.

Spanish Broom
Spartium junceum
A large, fast-growing deciduous shrub that has an interesting, dense, evergreen branching habit. Bright yellow flowers June to September. Plant will reseed.

Size: 4 ft. wide x 6 ft. tall
Water: Low
Et0: 0.20
Sun: Full
Temp: -15° F
WB: 100 gal/y

Desert Willow
Chilopsis linearis
Once established, watering demand should decrease to zero. A low-maintenance shrub or small tree native to the Southwest. A hardy plant that performs well in low-water environments, it displays willowy foliage and large, pink flowers that bloom from early summer to first frost.

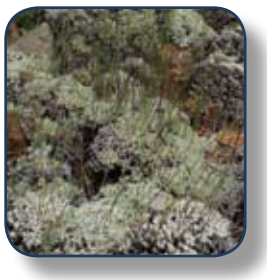
Size: 10 ft. wide x 15 ft. tall
Water: Low to none
Et0: 0.20
Sun: Full
Temp: -15° F
WB: 100 gal/y

Red Yucca
Hesperaloe parviflora
A member of the agave family, red yucca are native to Texas, New Mexico and northern Mexico. Hardy, drought-tolerant plants that grow in mounds of succulent leaves. Their distinctive red, bell-shaped flowers grow on tall stalks and bloom early summer through autumn, attracting hummingbirds.

Size: 3 ft. wide x 3 ft. tall
Water: Low
Et0: 0.20
Sun: Full
Temp: -10° F
WB: 100 gal/y

Chokecherry
Prunus virginiana L
A native shrub or small tree with dark green, glossy leaves and good fall color. Gets multiple clusters of berries, making it a great habitat plant. Birds love it. Flowers April to June.
Photo: Lost In Fog

Size: 6 ft. wide x 10 ft. tall
Water: Low to moderate
Et0: 0.20
Sun: Partial
Temp: -20° F
WB: 100 gal/y



Wrights Buckwheat
Eriogonum wrightii
A small, native shrub with slender, silvery green leaves that grows in low, dense mounds. A great foreground native. White or pinkish flowers July through October. Once established, requires no water. *Photo: Stan Shebs*

Size: 1 ft. wide x 1 ft. tall
Water: Very low
Et0: 0.20
Sun: Full
Temp: -15° F
WB: 100 gal/y

Winter Jasmine
Jasminum nudiflorum
Also known as "hardy jasmine," this slender, deciduous shrub does best spilling over a wall. First to bloom in February with bright yellow flowers.

Size: 6 ft. wide x 2 to 6 ft. tall
Water: Low
Et0: 0.20
Sun: Full or partial
Temp: -5° F
WB: 100 gal/y

Concept and Design Idea by: **T. Barnabas Kane & Associates**
822 W. Gurley St. Prescott, AZ 86305 928-445-3515
E-mail: bkane@tbkadesign.com Web address: www.tbkadesign.com

Yavapai County Cooperative

A FIREWISE GARDEN

All of these plants possess one or more fire-resistive characteristics that make them good choices for homes in the wildland-urban interface. They are also water-smart, slow growing, and require little maintenance to keep them firewise.

Harvard Agave
Agave harvardiana
A medium-sized agave, this native of New Mexico, Texas and Mexico makes an impressive accent, with its compact, regular shape and gray-green leaves. At higher elevations, it grows best in full sun.

Size: 3' x 2' tall **Sun:** full **Water:** low
Temp: 0° F Water once or twice a month during warm temperatures
Et0: 0.10 **Water Budget:** 30 gal/y

Claret Cup Hedgehog Cactus
Echinocereus triglochidiatus
This Southwest native can form mounding clumps up to 5 feet wide with hundreds of stems. The orange-red to dark red flowers attract hummingbirds. Needs good drainage.

Size: 3' x 1' tall **Sun:** full **Water:** low
Temp: -30° F **Et0:** 0.10 **Water Budget:** 30 gal/y
Water once or twice a month during warm temperatures

Gambel Oak
Quercus gambellii
A long-lived deciduous tree, this native is very slow-growing and drought-tolerant. With its irregular form and scaly trunk, it makes an excellent accent tree, providing fall color.

Size: 20' x 30' tall **Sun:** full/part shade **Water:** low
Temp: -40° F **Et0: 0.20 Water Budget: 100 gal/y**
Water once or twice a month during warm temperatures

New Mexico Locust
Robinia neomexicana
A member of the legume family, this deciduous tree features fragrant pink or purplish flowers and long seed pods. It is very drought tolerant and re-sprouts readily after a wildfire.

Size: 20' x 25' tall **Sun:** full/part shade
Water: low **Temp:** -20° F
Et0: 0.20 **Water Budget:** 100 gal/y

Blue Grama
Bouteloua gracilis
Native to the western U.S., this warm season bunchgrass produces attractive curly seed heads and bluish green blades. Its low-growing habit makes it a good firewise choice. Grows best in sandy native soils, no need to amend the soil.

Size: 1' x 1.5' tall **Sun:** full **Water:** low
Temp: -40° F **Et0:** 0.20 **Water Budget:** rainfall
During lawn area development use about10 gal/sq ft /y

Concept and Design Ideas by: **Yavapai County Cooperative Extension** Gene Twaronite - Defensible Space Educator
840 Rodeo Dr #C Prescott, AZ 86305 928-445-6590 ext 231
Web address: http://ag.arizona.edu/yavapai/

Terroir Seeds LLC

UNDERWOOD GARDENS AND GRANDMA'S GARDEN CATALOG

Heirloom, open-pollinated and rare seeds for Herbs, Flowers and Vegetables. Terroir in its most basic translation is "soil" or a "taste of place." Using heirloom seeds and soil will produce the best taste of place.

Amaranth, Hopi Red Dye

Amaranthus cruentus

Bright-burgundy stems and foliage; stately, erect, scarlet, flower plumes which stand out boldly, fresh or dried. Tolerates drought and most soils. An all purpose plant for flowers, grains, greens, dyes - or as a daily treat for the eyes.

Size: 4 wide x 5 tall **Sun:** full **Water:** low to moderate
Temperature: Direct sow in warm soil, mid to late spring, or germinate @ 80°F for 2 weeks in light indoors
Et0: 0.50 **WB:** 200 gal/y

Lettuce, Reine des Glaces

Latuca sativa

Visually exaggerated pointy leaves make a stunning as well as flavorful and disease resistant variety. Emerald-green, deeply cut leaves surround a lighter green, crisp heart. Slow-bolting, stays crisp and sweet even on hot days. Higher in choline (needed for all cellular membranes) than any other lettuces. For the longest shelf life, harvest greens late in the day.

Size: 1 wide x 1 tall (Crisphead) 62 days Iceberg type.
Sun: full **Water:** moderate
Temperature: **Et0:** 0.50 **WB:** 200 gal/y

Basil, Genovese

Ocimum basilicum

Genovese Basil is also known as Perfumed Basil- gourmet choice for pestos, sauces. Leaves are a bit smaller and finer than Sweet Basil, but have more aroma and potency. Huge quantities of choice, incredibly aromatic, flavorful leaves and easy-care.

Size: 2 wide x 2 tall **Sun:** full to part shade
Water: low **Temp:** Germinates at 70° F
Et0: 0.50 **WB:** 200 gal/y

Carrot, Purple Dragon

Daucus carota

Unique, deep-purple carrots whose skin contrasts strikingly with their dark-orange flesh. Sweet, spicy flavor holds true raw or cooked. Extra-high anti-oxidant and vitamin content. Spectacular in salads or steamed; delicious, nutritious, beautiful in juices. Best of the purple types.

Size: Carrots in 65 days **Sun:** full
Water: moderate **Temp:**
Et0: 0.20 **WB:** 200 gal/y

Tomato, Amish Paste

Lycopersicon esculentum

Indeterminate Amish heirloom from the late 1800s. Good-sized, thick-fleshed, sweet, red, paste tomato. Ultimate sauce type, yet also good for slicing and drying.

Size: 2 x 3, tomatoes in 80 days **Sun:** full
Water: moderate **Temp:**
Et0: 0.50 **WB:** 300 gal/y

Concept and Design Ideas by: Terroir Seeds LLC Underwood Gardens
P.O. Box 4995 Chino Valley, AZ 86323 888-878-5247 E-mail: info@underwoodgardens.com
Web address: www.underwoodgardens.com *Photo credits: heirloom seed, Maren Oslac*

Watters Garden Center

EASY CARE BEAUTY

Mountain landscapes should be easy to care for and environmentally friendly. Consider these plants as the perfect companion selection. They work and play well with each other in any garden. Guaranteed to provide the perfect balance between all four seasons.

Sensation Lilac

Syringa vulgaris

Desired for its large trusses of purplish-red florets edged in white in spring. Captivating fragrance is a bonus. Branches are erect and open with rich green foliage. The best flowers are produced in full sun. Bloom time is April - May

Size: 8 wide x 12 tall
Water: moderate
Et0: 0.30
Sun: full
Temp: -23° F
WB: 200 gal/y

Purple Robe Locust

Robinia ambigua

This rugged and drought resistant tree thrives in poor soils and produces loads of exquisite dangling clusters of magenta pink flowers. An excellent, fast-growing street or shade tree for suburban yards with aspen golden fall foliage.

Size: 40 wide x 30 tall
Water: low to moderate
Et0: 0.30
Sun: part to full
Temp: -30° F
WB: 200 gal/y

Hot Lips Sage

Salvia microphylla

Unusual two-tone flowers where the upper portion is pure white and lower lip is high contrast red. Blooms prolifically through the hottest summer until frost. Irresistible hummingbird flower that belongs in wildlife gardens, beds and borders.

Size: 3 wide x 3 tall
Water: low to moderate
Et0: 0.20
Sun : full
Temp: 10 - 20° F
WB : 100 gal/y

Majestic Beauty Hawthorn

Raphiolepis montic

What an evergreen ought to be. Easy-to-grow producing huge clusters of fragrant, pearl-pink flowers in spring. A great evergreen background shrub or foundation plant.

Size: 4 wide x 6 tall
Water: moderate
Et0: 0.30
Sun: full
Temp: 0-10° F
WB: 200 gal/y

Pink Gaura - Passionate Rainbow var.

Gaura lindheimeri

Compact & colorful selection of perennial bearing both unique variegated foliage and flowers. Green leaves are neatly edged in white with tinges of pink revealed in full sun. Soft pink flowers with magenta centers bloom late spring to fall.
Deer Resistant

Size: 4 wide x 4 tall
Water: moderate
Et0: 0.20
Sun : full
Temp.: -20° F
WB: 100 gal/y

Tiger Eye Sumac

Rhus typina

Grown like a drought hardy fern in full sun this sumac is a natural. Soft foliage dances in a summer breeze with intense fall foliage of reds and golden orange. Looks great with drought hardy sedums and daylilies.

Size: 6 wide x 6 tall
Water: low to moderate
Et0: 0.20
Sun : full
Temp: -30° F
WB : 100 gal/y

Concept and Design Ideas by: **Watters Garden Center** Ken Lain, the garden guy
1815 W. Iron Springs Road Prescott, AZ 86301 928-445-4159
E-mail: Watters@cableone.net Web address: www.Wattersonline.com

Vicente Landscaping

Secret Garden of Color

Color is one of the most important factors in a unified garden design. The secret is that a landscape designed to be "low-water use" does not have to be low-color. There are many water-wise plants that can be used to create an attractive, colorful, inviting setting in your yard. Select one or more of the following plants color.

Mimosa Tree
Albizia julibrissin
A medium sized ornamental with exotic powder-puff shaped flowers. Fragrant flower clusters attract hummingbirds and butterflies.

Size: 30 ft. wide x 30 ft. tall
Water: Low
Et0: 0.20
Sun: Full
Temp: -10° F
Water Budget: 100 gal/y

Potentilla
Potentilla fruticosa
A densely branched shrub with yellow flowers and silver-green foliage. This hearty plant tolerates poor soil, heat and drought conditions.

Size: 3 ft. wide x 3 ft. tall
Water: Low
Et0: 0.20
Sun: Full
Temp: -40° F
Water Budget: 100 gal/y

Spanish Broom
Spartium junceum
This fast growing evergreen shrub has long, almost leafless, green stems. Clusters of fragrant yellow flowers bloom all summer. A good choice for dry locations and hillsides in full sun.

Size: 6 ft. wide x 6 ft. tall
Water: Low
Et0: 0.20
Sun: Full
Temp: -20° F
Water Budget: 100 gal/y

Russian Sage
Perovskia atriplicifolia
Tall lavender-blue flower clusters appear above gray-green foliage. This hardy shrub blooms all summer long.

Size: 3 ft. wide x 3 ft. tall
Water: Low
Et0: 0.20
Sun: Full
Temp: -20° F
Water Budget: 100gal/y

Blue-Eyed Grass
Sisyrinchium montanum
Bright blue star-shaped flowers with gold centers rise above grass-like foliage. Blooms from late spring to mid summer.

Size: 1 ft. wide x 1 ft. tall
Water: Low
Et0: 0.20
Sun: Full to partial
Temp: -40° F
Water Budget: 100 gal/y

Paprika Yarrow
Achillea 'Paprika'
A hearty perennial with fern-like grey-green foliage. This summer bloomer performs in hot, dry situations with poor soil.

Size: 2 ft. wide x 2 ft. tall
Water: Low
Et0: 0.20
Sun: Full
Temp: -40° F
Water Budget: 100 gal/y

Concept and Design Ideas by: Vicente Landscaping
928-636-1601
E-mail: service@vicentelandscaping.com Web address: www.vicentelandscaping.com

PAT'S Custom Landscaping

Complete landscape Service

WaterSmart landscapes are practical, FireWise and low maintenance. Selecting plants that are easy to care for surrounded by outdoor living spaces allow you to enjoy our region year round.

Coreopsis 'Baby Sun'
Coreopsis varieties
Desired for its long lasting, golden and daisy like flowers. Stems are sturdy and offer deep rich green foliage. Flowers are produced throughout the summer. Cutback old flowers to produce more flowers throughout the blooming period.

Size: 15" wide x 2" tall
Water: moderate – dry soil
Et0: 0.30
Sun: full - well drained soil
Temp: -20° F
Water Budget: 100 gal/y

Arizona Cypress
Cupressus arizonica
This rugged and drought resistant evergreen tree grows quickly. A handsome specimen this is a plant that thrives in natural, well drained soils. Produces a wonderful screen or stand alone specimen. Allow room to mature. Blue-green in color. Avoid heavy clay or poorly drained soils.

Size: 20 wide x 40 tall
Water: low to moderate
Et0: 0.30
Sun: part to full
Temp: -30° F
Water Budget: 200 gal/y

Autumn Sage
Salvia greggii
White, peach and red or two-tone flowers offer high contrast in the garden. The plant blooms throughout the gardening season, cut back after the first hard frost. Hummingbirds love the flowers and this plant belongs in any garden.

Size: 3 wide x 3 tall
Water: Low to moderate
Et0: 0.20
Sun: Full
Temp: 10 - 20* F
Water Budget: 100 gal/y

Germander
Teucrium cahamaedrys
Low growing spreading evergreen with many upright stems. Dark green foliage, flowers through out the summer in red, purple or white. Easy-to-grow background shrub or foundation plant. Do not overwater.

Size: 3 ft. wide x 3 ft. tall
Water: Low
Et0: 0.20
Sun: Full
Temp: -20° F
Water Budget: 100gal/y

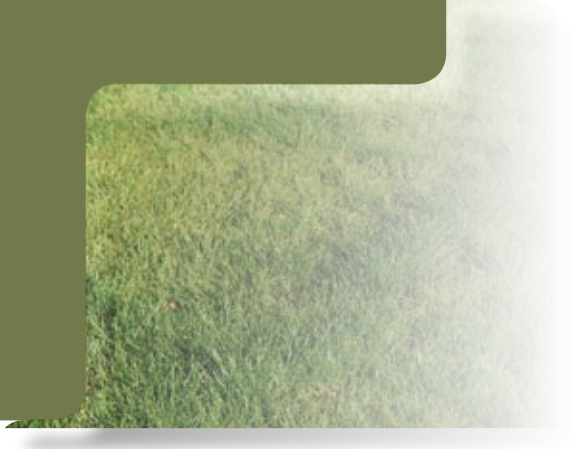
Custom Retaining Walls And Permeable Patio Pavers

Practical and low maintenance, constructed walls, fire pits, boulders and patios are the perfect companion to WaterSmart landscapes. Increase the outdoor living area and reduce your water use.

Paprika Yarrow
Achillea 'Paprika'
A hearty perennial with fern-like grey-green foliage. This summer bloomer performs in hot, dry situations with poor soil.

Size: 3 wide x 2 tall
Water: Low to moderate
Et0: 0.20
Sun: Full
Temp: -20° F
Water Budget: 100 gal/y

Concept and Design Ideas by: Pat's Custom Landscaping Complete landscape Services
P.O. Box 3600 • Prescott, AZ 86302
928-778-1359



Buffalo Grass

Turf grass can have many benefits in your landscape: keeping soil in place, lowering the temperature, providing green space, play areas, etc. Only two negative points come to mind: mowing and water consumption. Ignoring mowing for the moment, water consumption of turf can vary greatly depending on the species.

Buffalo grass (*Buchloe dactyloides*) is an excellent drought tolerant turf grass. It is a native of Arizona found in small, isolated populations in Coconino and Gila Counties. It is much more common in the Great Plains from Montana to Minnesota and south to New Mexico, Texas and Louisiana. This is one of the grasses that great herds of buffalo once grazed on and that formed the sod, which settlers often used to build their houses on the prairie.

Buffalo grass is a low growing, warm season perennial. It can tolerate prolonged drought and extreme temperatures. The blue-green leaves of unmowed plants are commonly 8-10 inches and have very fine hairs on both upper and lower surfaces. The hairs are not obvious but this adaptation offers additional drought protection. Leaf hairs slow air movement on the leaf surface, which prevents transpired moisture from being transmitted to the atmosphere too rapidly.

Seeding buffalo grass is about one-tenth the cost of sod. When purchasing, ask if the seed has been stratified (cold treated for 6-8 weeks) or chemically treated to break dormancy. If it has not, it may not germinate until the following year. To prepare the seedbed, till the ground, rake smooth, remove rocks or debris on the surface, then roll with a water filled roller (these can be rented).

Sow the seed in May or early June. After sowing, rake the seedbed to bury the seed and roll it another time to ensure good seed-to-soil contact. Sowing rates vary. Four to six pounds of treated seed per 1,000 square feet should germinate in seven-10 days and grow into a dense stand in several months if given adequate irrigation. Do not over irrigate buffalo grass after establishment. Buffalo grass is a low maintenance turf that should be used in low traffic areas. It can be mowed to one inch but will use less water and require less frequent maintenance when mowed between two to three inches. Fertilization is optional and applications should not exceed two pounds/1,000 square feet. One inch of water per week is adequate to maintain an established buffalo grass lawn and excessive water encourages bermuda grass encroachment. Like bermuda grass, buffalo grass will turn brown and go dormant when the weather cools off in fall and winter. During this dormant period, it should not be over seeded with any annual grasses (rye or others).

Buffalo grass has the following general traits:

- Likes the warm weather (dormant in the winter below 3,000 feet and dormant in the fall at higher elevations).
- Has a low water use rate. If it runs out of water in the summer, it will enter drought induced dormancy. That is, it will turn brown, just as it does in the winter. If observed side by side with bermuda grass, the buffalo grass takes longer to wilt and holds its color longer. However, when irrigation is applied after stress, the buffalo grass takes longer to recover. The more repeated cycles of stress, the slower the buffalo grass will be in recovering. This is more critical for turfs used at low elevation (3,000 feet and below).
- Mow with a rotary mower. Raise height to 2.5 or 3.0 inches in poor soils and/or minimal irrigation.
- Buffalo grass has a lower nitrogen requirement. It needs maybe 1.0 lbs -N-/1000 ft2 year, preferably in split applications of 1/2 lb. in June and July or August. If in a non-irrigated situation, apply the fertilizer in the middle of the rainy season.
- Since it has a lower growth rate than bermuda grass, its recuperative capacity is less. Current buffalo grass varieties are not recommended for use in high traffic situations, as they would not grow back fast

Article Source:
Arizona Cooperative Extension, Yavapai County
The University of Arizona Cooperative Extension has publications and information on turf establishment and maintenance.
March 10, 1999.

enough with constant use. Buffalo grass may be more adaptable at 3,500 feet and above. Mow it at 2.5 inches.

- Weed control is essential when establishing a buffalo grass lawn. Pre-emergent herbicides can adequately control annual weeds, while post-emergent herbicides can handle any remaining broadleaf weeds. Winter annuals can be controlled by non-selective herbicides prior to spring green up.
- Over fertilization and irrigation dramatically weaken the quality of buffalo grass by increasing weed competition and disease incidence.
- Buffalo grass can provide a great low maintenance lawn.
- **Shade:** The commercially available germplasm is not shade tolerant. There are some types from Mexico that are more shade tolerant.
- Buffalo grass is not salt tolerant.
- Plant seed in June, before the monsoons. It must be planted during that time. Seed at 1.0 - 1.5 lbs of pure live seed per 1,000 ft2.
- Check the label to see how much seed is dormant the first year. Some seed may be pretreated to eliminate dormancy.
- If using sod (Prairie, NE 609, etc.) plant the sod in June as the first choice. Plugs can also be used. The plugs and sod will lose color after transplanting, even with proper watering. They will start to green up after two weeks.

Buffalo grass is a native grass, which occurs as different land races from southern Mexico to North Dakota. It is a warm season grass and more closely related to bermuda grass than cool season grasses. In Arizona, its asset is that it can go two weeks without water at higher elevations, if good soil moisture conditions allow.

Warm season grass lawns actively grow from mid-April to mid-October. They are termed "warm season" grasses because they grow during warm weather.

Cultivars can be used as forage or low maintenance turfs. Female plants on average have better turf quality attributes than males (darker color, shorter internodes, higher stolon densities, etc.). As a result, universities and sod companies have released single female clone varieties for turf. Those available in Arizona and sold as sod are: Prairie buffalo grass, NE 609 buffalo grass, NE 609 and NE 315 lower growing and darker green.

Consider the savings... Plant buffalo grass in water scarce environment.

Buffalo Grass Resources

Yavapai County BackYard Gardener- www.ag.arizona.edu/yavapai/anr/hort/byg/index.html
Choosing the Right Grass- www.denverwater.org/.../rightgrass.html
Put native plants to work on your site- www.grownative.org
Establishing a lawn:- www.grownative.org/index.cfm?fuseaction=landscaping.articleDetail&articleID=13

7 Steps to Low-water Use Landscaping

Create beautiful, lush and colorful outdoor living spaces with low-water use flowers, plants, trees and shrubs. Research plants in relation to sun exposure, water and maintenance demands. Investigate harvesting rainwater to sustain all outdoor water requirements. Understand how plants and outdoor spaces will function with the existing topography, wildlife, views and household privacy needs.

1 **Design a Plan:** Sketch the area. Include existing and proposed walkways, outdoor spaces, structures and planted areas. Install flowers, plants, trees and shrubs with similar light and water needs on the same irrigation zone. Consider the use of outdoor spaces in relation to indoor spaces.

2 **Amend the Soil:** Most plants and turf areas require some organic compost. Be aware of the soil composition necessary for the plants, trees and shrubs selected, and make amendments during the site preparation stage. Native plants will thrive with little or no soil amendments.

3 **Select Low-Water Use Plants:** A wide variety of plants, trees and shrubs flourish in low-water use landscapes, and are available for purchase at local nurseries. Categories include very low, and moderate water use. Tags in each plant explain water and light needs. Do not forget to consider space requirements upon mature growth.

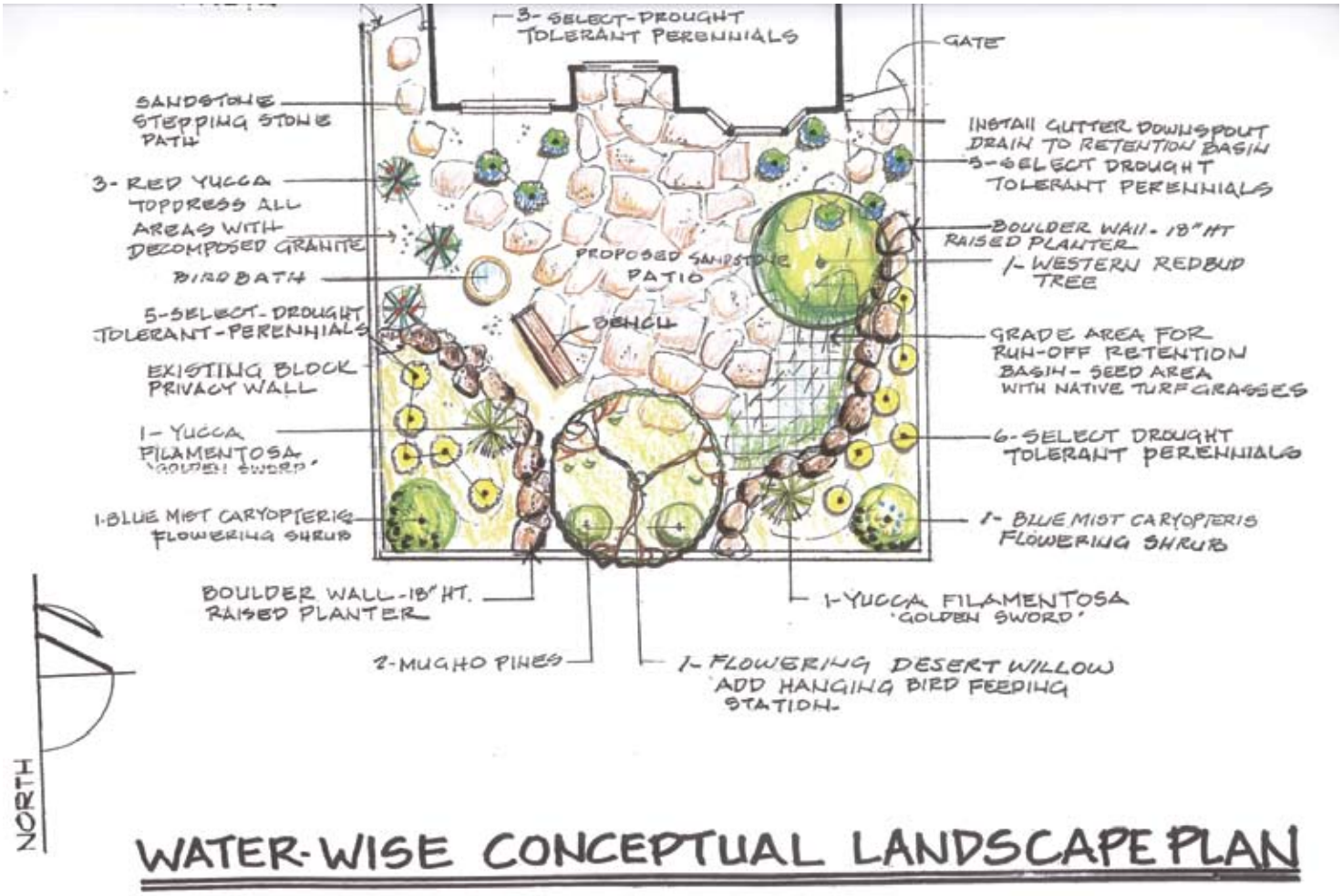
4 **Create a Practical Lawn Area:** Lawns have a place in low-water use landscapes. Options include seasonal native grasses, turf, ground covers and native wildflowers. Take into account the long-term water demand, maintenance needs and cost.

5 **Install an Irrigation System:** Design an efficient watering system during the planning phase. Permit and install the required backflow prevention device. Zone the plant, shrub and turf areas. Adjust watering systems to account for plant maturity, topography and seasonal precipitation.

6 **Mulch Top Dress:** Install 2-3" of mulch or rock over a woven fabric weed barrier. Shredded wood chips and garden compost conserve soil moisture. Decomposed granite and select rock types work best in unplanted areas. Consider pre-and post-emergent herbicides to reduce weed growth.

7 **Maintain the Landscape:** Low-water use landscapes require seasonal maintenance. A well-maintained landscape and efficient irrigation system will insure outdoor living spaces remain healthy and attractive.

More information on low water use landscaping is available through the city or town public works, water offices, county extension agencies, and Arizona State Department of Water Resources. Call the local offices or check their websites; many have sections dedicated to indoor and outdoor water conservation.



WATER-WISE CONCEPTUAL LANDSCAPE PLAN

Illustration: Lee Morris – Mortimer Nursery

Photo Credit – T. B. Kane, A.I.L.A.

"We inspire people to plant, nurture, and celebrate trees".
--Arbor Day Foundation

Improved Planting Standards

Using the proper planting method is critical to long-term viability of trees and shrubs. The Improved Planting Standard is based on digging a wide, shallow planting hole with no amendments added in the backfilled soil. The International Society of Arboriculture, the National Arbor Day Foundation, and the nationwide cooperative extension system recommend this standard. Peer-reviewed research has proven that this method is superior to the outdated and inferior deep hole, amended soil planting method.

Improved Planting Standard Steps Include:

(1) Dig the planting hole only as deep as the root ball.

(2) Loosen the soil in an area three to five times as wide as the root ball.

(3) Areas where loosened soil meets the undisturbed soil should be rough and sloped (not glazed or vertical).

(4) Place the tree or shrub in the planting hole and backfill with non-amended, native soil.

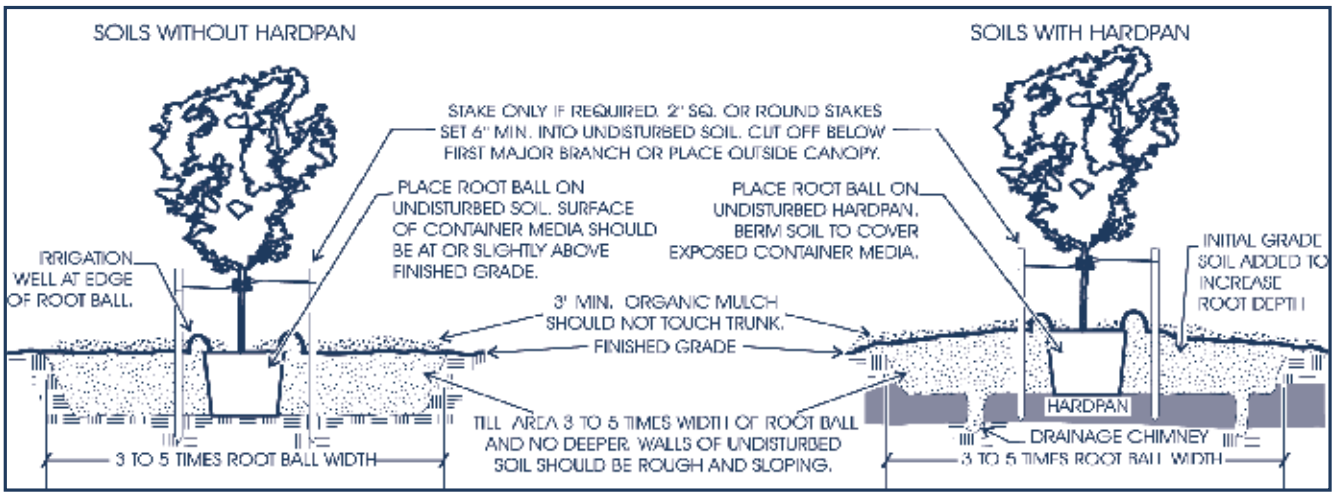
(5) Mound soil to create an irrigation well just outside the original root ball.

(6) Place three inches of organic bark mulch on the soil surface, but do not allow it to come into contact with the trunk.

(7) Remove the original nursery stake.

(8) Install new planting stakes only if the tree falls over when the nursery stake is removed.

(9) Irrigate the tree or shrub as necessary wetting the root ball and surrounding soil.

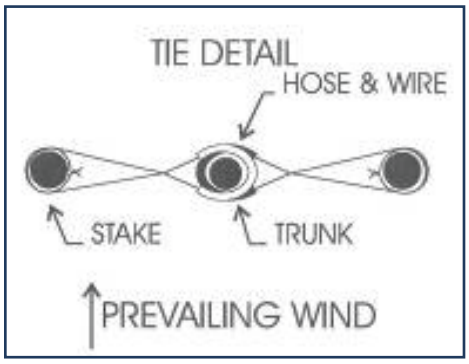


Planting Guidelines: Container Trees, Cooperative Extension AZ1022 Planting 05198

The Improved Planting Standard allows roots to acclimate to native soil and grow beyond the planting hole. It also prevents the root ball from sinking below the surrounding grade. Soil should never cover the root crown; the bark that is formed above this point requires oxygen and prolonged exposure to moisture can lead to disease or decreased vigor.

Tree Stake Standards

Nursery stakes should always be removed because they are not designed for long-term in-ground application. Tree staking more often than not, prevents the tree from developing strength and taper. Wood strengthens in response to wind and its own weight.



Install new planting stakes only if the tree falls over when the nursery stake is removed.

Invest in the quality pole or metal rail type, and stake on opposite sides of the tree. Stakes should be driven deep enough to hit undisturbed soil below the root ball. Use flexible tree ties and allow some movement while preventing damage to the trunk. Cut off the tops of the stakes to prevent damage to nearby branches. Staking should also prevent movement of the root ball allowing new roots to extend into the native soil. Shrubs and most small trees do not require staking.

Pruning is not necessary after planting. Damaged limbs can be removed, but do not prune undamaged material. There is no evidence that newly planted landscape trees and shrubs should be fertilized. Fertilize ornamental landscape plants only when they show signs of nutrient deficiency.

Call Before You Dig

The Dig Safely campaign was developed to address one of the leading causes of disruption to the nation's underground facilities—external force damage that occurs during excavation activities including tree planting. Before digging, be sure that all utilities in the area have marked their facilities, or given notice facilities do not exist where planting trees.

Arizona Blue Stake
Phone: 800-782-5348
Alternate: 602-659-7500 or
602-263-1100

Tree and Shrub Planting Guidelines

Arizona Blue Stake Inc.- www.azbsinc.com

The University of Arizona Planting Guidelines, Container Trees and Shrubs: www.ag.arizona.edu/,pubs/garden/az1022.pdf

Yavapai County Cooperative Extension Backyard Gardener, archived columns: www.cals.arizona.edu/yavapai/anr/hort/byg

Arbor Day Foundation: www.arborday.org

Soil in Landscape Construction:

Don't Call it "Dirt"

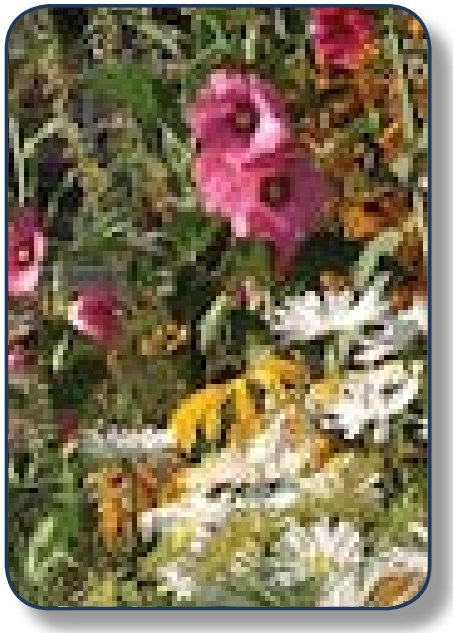
A key factor in constructing a low water use landscape is to have proper soil conditions for the landscape. Landscapes on poor and shallow soils can be extremely water intensive because root systems remain shallow and require increased water to survive during summer months.

Poor soils are unable to absorb and hold water, resulting in high water run-off that does not benefit the landscape. Adequate organic material in the soil not only helps to hold water, but also provides a source of nutrients for the plants. Some have it tagged as "Black Gold" and consider this soil the secret to successful annuals and vegetable gardening. Research and develop your own home composting soil system.

Soil is a complex mixture of minerals, organic matter, microorganisms, water, and air. As the foundation of the landscape, the type and quality of the soil directly influences water use. It is important to know the composition of the soil in order to improve it. There are three broad categories of soil:

1. A ***clay soil*** consists of small particles, is slow to absorb water, has good water retention, and has poor drainage capacity.
2. A ***sand soil*** consists of large particles, absorbs water quickly, retains water poorly, and drains well.
3. A ***silt soil*** consists of medium particles, absorbs water quickly, has moderate retention and drainage capacity, and is ideal for most gardens.

For more information on the composition of the soils, consider the one stop website of United States Department of Agriculture. Resources to investigate soils are broad and information on soil surveys plentiful. The University of Arizona's Extension Service offers a wide variety of scientific and easy to understand fact sheets on soils, plants and garden preparation.



Soil Management in the Landscape

- Add compost or an organic material as necessary, preferably adding it to soil to a depth of 6"-8" inches for grass lawn areas and 12" to 18" inches for annual and vegetable areas to improve soil conditions and water retention. Organic soils can hold water significantly longer than sandy soils.
- Use mulch in flowerbeds and around shrubs and trees to minimize evaporation, reduce weed growth, and decrease erosion. Consider layering 2"-3" mulch over several layers of newspaper to minimize maintenance and weed growth.

Soil Resources

Arizona Cooperative Extension, Yavapai County- 928-445-6590
www.ag.arizona.edu/yavapai/anr/hort/byg/index.html.
Natural Resources Conservation Service
www.az.nrcs.usda.gov/technical/soils
www.soils.usda.gov/survey.

Composting "black Gold" Soil

Composting is a way to produce organic matter. Compost contains humus, the loose, crumbly matter that results from the decay of organic matter. It is dark brown or black and has a soil-like, earthy smell. It is created by combining nitrogen containing "green" organic wastes (e.g., grass and plant trimmings, kitchen scraps, manure) in proper ratios with carbon containing "brown" materials (e.g., dry leaves, straw, sawdust, dried manure) into piles, rows, or vessels. Both are essential to create compost. Mature compost has experienced high temperatures, above 140°F, which eliminate most pathogens and weed seeds that natural decomposition does not destroy. Avoid using animal-based materials and oils when composting. These will attract pests (skunks, cats, dogs and other scavengers) and cause bad smells.

Advantages to Composting

• Composting reduces the dependency on commercial fertilizers and improves soil structure, while adding nutrients needed for healthy plants. It is also inexpensive because you can easily make it with material that would otherwise be thrown away.

• Soil pH may be altered by compost addition. Ideal pH for most edible plants and flowers is between 6.0 - 7.0. If the soil is alkaline (over pH 7.5), as much of the arid Southwest is, compost may help lower it over time.

• Recycling organic waste materials also reduces landfill use.

How to Get Started

• **Cost –** Composting does not take a lot of time or require much equipment.

• **Location –** The compost pile should be placed in a warm area with adequate sunshine, but out of the wind so it will not dry out too quickly.

• **Size –** An ideal size is one cubic yard (3 feet x 3 feet x 3 feet). If the pile is too small it will decompose slowly. Also, it will not generate and hold enough heat to kill weed seeds and other pests. If the pile is too tall, aeration may not be adequate.

• **Water –** Consistent moisture is important. The pile should contain enough water to feel like a well-wrung out sponge. If the pile is too wet, it may produce unpleasant odors. If it is too dry, decomposition will not occur. Drying out is a major problem for successful composting in the Southwest.

• **Microorganisms –** Periodically add a little native soil to the compost pile. This will inoculate the compost with beneficial microorganisms. These include bacteria, fungi, worms and insects. (Purchase of special composting microbes is not necessary.) Aerobic (air-loving) microbes do the actual decomposing. Creating an environment in which they thrive is the goal.

• **Oxygen –** Air is essential for the organic matter to decompose. Turn the pile frequently, poke deep holes in it, or position the pile a foot or so off the ground to allow for air circulation.

The Compost Process

The first point to remember is that smaller pieces of waste material decompose faster. "Green" and "brown" materials are alternatively layered no more than a foot or two deep. The best material ratio of carbon (brown) to nitrogen (green) is about 25 to 30 parts to 1, respectively. If there is too much brown material in the pile, decomposition will be slow. This can be corrected by adding more green material or some nitrogen fertilizer. If too much green material is present nitrogen may be lost and the pile may smell like ammonia. While layering the two types of material, remember to add some native soil to inoculate the pile with microbes.

After the pile is started, wet it thoroughly with water. Monitor moisture over time. Placing a water sprinkler on the pile may aid in keeping the pile moist, but not wet. Turning the pile will aerate it. This will accelerate the decomposition process.

INVASIVE PLANT SPECIES

Please avoid planting invasive plants in Yavapai County

As we work to save water by carefully selecting plants, it is important to remember that the vigorous growth characteristics of some may make them a serious problem. Such plants are typically "invaders," that is, they are not native to the region. Some were brought intentionally to use in erosion control for their quick rates of growth or as feed plants. Others were introduced unintentionally as seed in feed, with crop seed, or with animals. Invasive plants often reduce biological diversity and can have severe impacts on local natural systems - both plant and animal communities. The selection of invasive species in home landscape should be strictly avoided and invasive species should be eradicated if present on a property.

Be cautious, and identify the plants before removal -- there are beautiful native thistles that are important nectar sources for hummingbirds, bees and butterflies.

TREES AND SHRUBS

Common Name	Scientific Name
TREE OF HEAVEN	*Ailanthus altissima*
MEXICAN BIRD OF PARADISE***	*Caesalpinia gillesii*
RUSSIAN OLIVE**	*Elaeagnus angustifolia*
SWEET RESINBUSH**	*Euryops subcarnosus*
KAROO BUSH***	*Pentzia incana*
SALTCEDAR **	*Tamarix chinensis, T. pentandra, T. ramosissima*
CHINESE ELM***	*Ulmus parvifolia*
SIBERIAN ELM *	*Ulmus pumila*

VINES AND GROUNDCOVERS

Common Name	Scientific Name
FIELD BINDWEED *	*Convolvulus arvensis*
HIMALAYAN BLACKBERRY *	*Rubus armeniacus, R. discolor*
BIGLEAF PERIWINKLE I *	*Vinca major*

GRASSES

Common Name	Scientific Name
GIANT REED **	*Arundo donax*
WILD OAT *	*Avena fatua*
SMOOTH BROME *	*Bromus inermis*
RIPGUT BROME *	*Bromus diandrus*
RED BROME **	*Bromus rubens*
JAPANESE BROME	*Bromus japonicus*
CHEATGRASS **	*Bromus tectorum*
PAMPAS GRASS *	*Cortaderia selloana*
BERMUDAGRASS *	*Cynodon dactylon*
QUACKGRASS (HIGHER ELEVATIONS)	*Elymus repens*
WEEPING & LEHMANN ** LOVEGRASS	*Eragrostis curvula & E. Lehmanniana*
MOUSE BARLEY *	*Hordeum murinum*
PERENNIAL RYEGRASS *	*Lolium perenne*
FOUNTAIN GRASS (LOWER ELEVATIONS) **	*Pennisetum setaceum*
JOHNSONGRASS *	*Sorghum halepense*

Photo Credits: Nichole Trushell – Steve Morgan L.A.

ANNUALS & PERENNIALS

Common Name	Scientific Name
RUSSIAN KNAPWEED **	*Acroptilon repens*
CAMELTHORN (LOWER ELEVATIONS)	*Alhagi maurorum*
ONIONWEED	*Asphodelus fistulosus*
BLACK MUSTARD	*Brassica niger*
LENS-PODDED & GLOBED PODDED HOARY CRESS *	*Cardaria chalenpensis, C. draba*
HAIRY WHITETOP *	*Cardaria pubescens*
PLUMELESS THISTLE & MUSK THISTLE *	*Carduus acanthoides, C. nutans*
SOUTHERN & FIELD SANDBUR	*Cenchrus echinatus, C. spinifex*
KNAPWEED *	*Centaurea diffusa*
MALTA STARTHISTLE*	*Centaurea melitensis*
YELLOW STARTHISTLE **	*Centaurea solstitialis*
SPOTTED KNAPWEED	*Centaurea stoebe ssp. micranthus*
RUSH SKELETONWEED*	*Chondrilla juncea*
CANADA THISTLE (HIGHER ELEVATIONS)*	*Cirsium arvense*
BULL THISTLE (HIGHER ELEVATIONS)	*Cirsium vulgare*
POISON HEMLOCK *	*Conium maculatum*
COMMON TEASEL	*Dipsacus fullonum*
REDSTEM FILAREE *	*Erodium cicutarium*
LEAFY SPURGE **	*Euphorbia esula*
PERENNIAL PEPPERWEED **	*Lepidum latifolium*
DALMATIAN & YELLOW TOADFLAX *	*Linaria dalmatica, Linaria vulgaris*
PURPLE LOOSESTRIFE	*Lythrum salicaria*
WHITE SWEETCLOVER *	*Melilotus alba*
YELLOW SWEETCLOVER *	*Melilotus officinalis*
SCOTCH THISTLE (HIGHER ELEVATIONS)	*Onopordum acanthium*
GLOBE CHAMOMILE	*Oncosiphon piluliferum*
JAPANESE KNOTWEED	*Polygonum cuspidatum*
RUSSIAN THISTLE *	*Salsola kali, S. tragus*
WILD MUSTARD	*Sinapis arvensis*
SPINY SOWTHISTLE *	*Sonchus asper*
ANNUAL SOWTHISTLE *	*Sonchus oleraceus*

* Plants identified as medium concern ** Plants identified as high concern *** sometimes used in cultivation, not recommended

Plants included here were selected based on common occurrence in Yavapai County.
For a list of invasive species for Arizona visit your local Cooperative Extension office, and check these resources online:

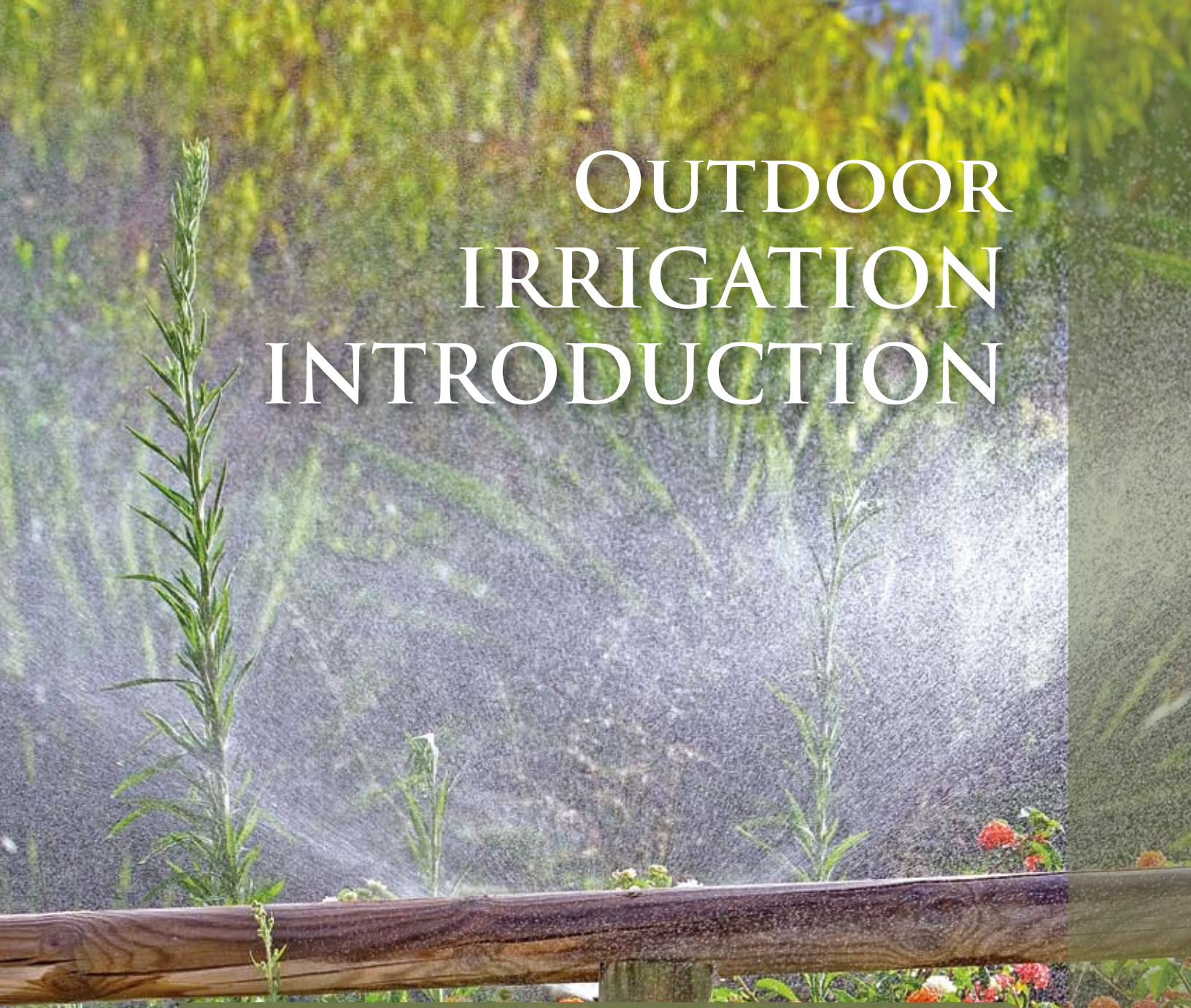
Arizona Invasive Species Advisory Council- www.governor.state.az.us/ais/Documents/Final%20Invasive%20Report%20low%20res.pdf

Arizona Wildlands Invasive Species Working Group- www.swvma.org/InvasiveNon-NativePlantsThatThreatenWildlandsInArizona.pdf

Effects of Invasive Plants on Public Land Management of Pinyon-Juniper Woodlands in Arizona- www. fs.fed.us/rm/pubs/rmrs_p051/rmrs_p051_113_120.pdf

Arizona Invasive Species/Noxious Weed Information- www.ecbarranch.com/adeq%206001/Weeds/handbook.htm

Descriptions and photos are available for nearly all plants on this list. It is best to type the scientific name into Google Images and research findings from these results.



Outdoor Irrigation Introduction

- ❑ 30% of water consumed on the East Coast goes to watering lawns; 60% on the West Coast.
- ❑ 18% of municipal solid waste is composed of yard waste.
- ❑ The average suburban lawn received 10 times as much chemical pesticide per acre as farmland.
- ❑ Over 70 million tons of fertilizers and pesticides are applied to residential lawns and gardens annually.
- ❑ Per hour of operation, a power lawn mower emits 10-12 times as much hydrocarbon as a typical auto. A weedeater emits 21 times more and a leaf blower 34 times more.
- ❑ Where pesticides are used, 60-90% of earthworms are killed.
- ❑ Earthworms are important for soil health.

Source: U.S. National Wildlife Federation.

Home and Commercial Irrigation Audits

A typical sprinkler system consists of underground pipes, valves, pressure regulators, spray or rotary type irrigation heads, and drip systems. Since most systems are set to water in the early morning or night, you will not see the system at work. Your irrigation systems should be visually inspected throughout the watering season. Lawnmowers, tires, animals and foot-traffic can and often are the cause to damaged or malfunctioning irrigation systems.

Buy your Water Smart kit and begin saving water today

Previously emphasized for commercial properties, the irrigation audit is gaining popularity among residential water users as more people become aware of the critical need to effectively manage this limited resource.

An irrigation audit is an evaluation of how well an irrigation system is operating after it has been installed. It is another effective tool to conserve water, and several hours of work can result in thousands of gallons of water saved, as well as lower monthly utility bills.

The first step is to gather water bills or request your history of water use from your water provider; this is a tool for you to analyze water use over the years. For most residential customers, water bills are much higher during the summer months, a direct result of increased landscape irrigation, and often the result of over watering lawn areas, plants, trees and shrubs.

Conduct a physical inspection of the irrigation system when it is running to insure all parts are working to specification. Check for leaking service lines or valves, failed backflow or pressure regulators and clogged or missing drip irrigation emitters.

Realign misdirected sprinkler heads that are spraying water onto roads, walkways, or driveways. Make certain all risers are operational. Heads should pop-up completely when on and retract fully when off. Replace any leaky risers or broken sprinkler heads. Remember to match manufacture types and volume/ precipitation rate on heads.

Steps to a Catch Can Test

If you have a lawn area and after determining all parts of the system are in correct working order, conduct a "catch can" test to insure uniform coverage throughout the landscape. The general rule of thumb is 8 to 24 catch cups.

1. Place the 8-24 equal-sized catch cup containers on the lawn area
2. Prepare a map or sketch of where the cans are placed
3. Run the irrigation system for fifteen minutes exactly. Repeat this step with all lawn stations.
4. Measure in inches and record the water in each catch cup.

   Note: Find the average volume in all of the catch cups by adding the total of water measured. Divide the total by the number of cup used in the test.
   (0.50 + 0.25 + 0.40 + 0.33 + 0.40 + 0.30+ 0.75 + 0.10 = 3.03" / 8 catch cups = 0.370)
5. Large variations in water levels between cans typically indicate a problem with spray system distribution and uniformity.

More extensive water audits involve evaluation of plant material in a landscape and evaluation of its placement on watering zones. The ultimate goal is a site specific, water management plan. Watering smart today will result in effective water management, conservation and reduced water costs.

A certified irrigation auditor will make recommendations and provide a more comprehensive evaluation than that which is available through the do-it-yourself approach. Check with the local water provider for a list of qualified irrigation audit professionals. National Resource, Irrigation association- www.irrigation.org

If you choose an automatic sprinkler system, make sure you set it correctly and adjust it as conditions change. Water early in the morning to reduce the evaporation rate. If water runs off your yard, split your watering times into two or more sessions. And be sure to turn off your system if you're getting enough water from rain showers.

Harvesting Rainwater for the Garden

Citizens and the landscape industry play a key role when working together to understand the challenges of a water delivery system. Learning more and implementing tools, such as rain gardens and rainwater harvesting, in landscapes will result in significant strides toward sustaining water resources.

These efforts combined with low impact commercial development that adopts green solutions will yield a powerful effect in reducing flood events, erosion and environmental pollutants in rivers and streams. It only takes 1/4 inch of rainfall to runoff from a 10 x 10-roof area to overflow a 55-gallon barrel. Consider investing in large capacity tanks that hold anywhere from 250 – 5000 gallons to maximum water catchment.

Varied tank designs will allow property owners to connect several smaller units together to maximize and catch every drop!

Remember the weight of water, one gallon in volume weighs over eight pounds. Add it up; a 250-gallon container when filled with rain water will weigh over 2,000 pounds. It is critical to consider the location, installation and plan a secure foundation for a holding tank. This may require some engineering calculations to be certain that the tank is secure and safe to avoid personal or property damage and liability.

Mortimer Nursery – low water use garden 2007

COLLECTING AND USING RAINWATER FOR USE IN THE OUTDOOR LANDSCAPES

A growing number of homeowners are investing in the installation or design of a rainwater harvesting garden or collection system. Residential irrigation accounts for up to 40 percent of a household's water consumption in any given municipality.

Rainwater harvesting in large capacity tanks or barrels captures and stores water for later use, reducing the demand to invest in new water supplies. Rainwater is "soft water." It contains no chlorine, lime or other minerals and few types of sediment. It is ideal for watering vegetable gardens, raised planter beds and containers or indoor tropical plants like ferns and orchids. It is perfect for automobile washing and cleaning household windows.

EIGHT ADVANTAGES OF DIVERTING WATER INTO A RAIN GARDENS OR RAIN CATCHMENT SYSTEM:

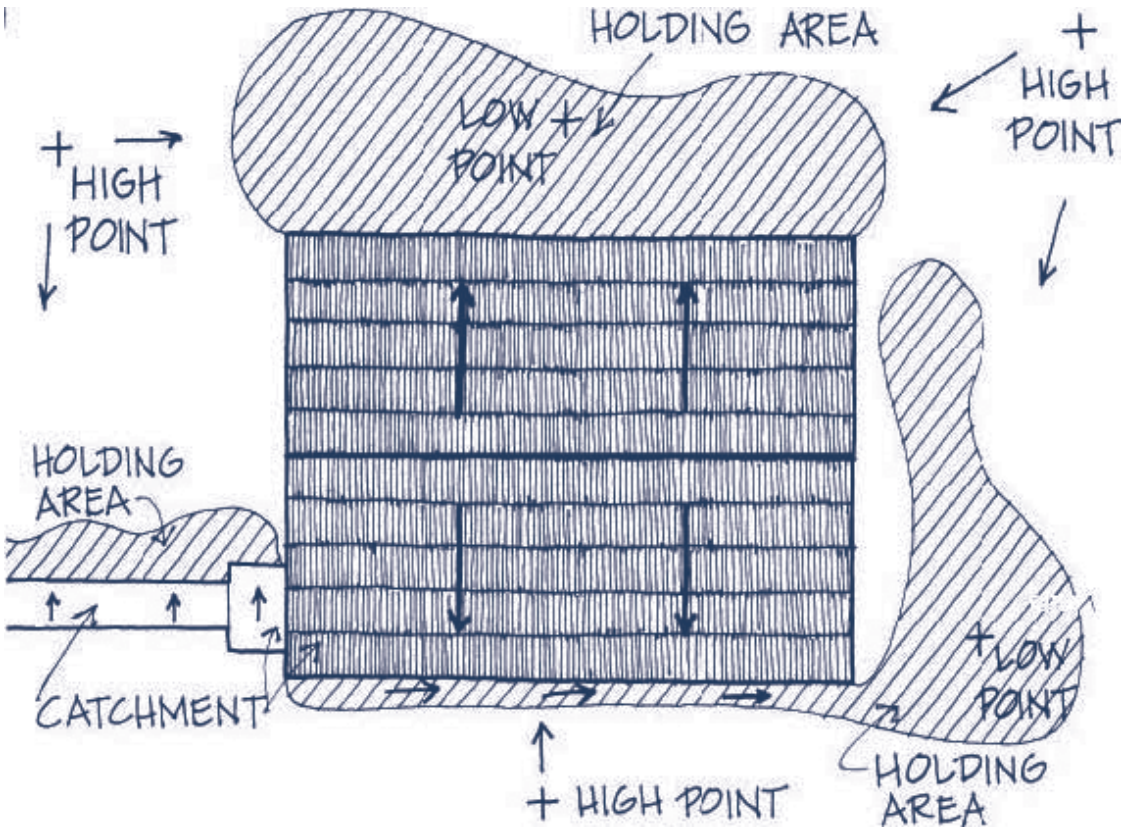
1. Lowers the percentage of rooftop rainfall as a component of urban runoff.
2. Backup source of water for summer water use and during times of drought.
3. Helps to keep our creeks clean.
4. Rainwater is naturally softened water and great for houseplants, auto cleaning and window washing, and all native landscape watering.
5. Saves money by lowering your water bills.
6. Reduces the need for additional tax dollars earmarked for water supply and system expansion.
7. Chlorine-free water helps maintain a healthy biotic community in the soil.
8. Educational tool for teaching sustainable living to students and homeowners.

Meet your landscape and outdoor water needs by collecting rainfall
Consultations with a certified rainwater professional can save time and money. The service may include design and sale of cisterns, rainwater harvesting system components and pump equipment.

All systems should use covered barrels or cisterns that keep the water from accumulating leaves, pine needles and other contaminants. Systems should also have some kind of filter or flush valve to keep out silt and leaves. Filters can range from a funnel with mesh at the bottom covered by gravel, to a rainwater washing apparatus.

Bigger and more complex systems may use gravity to feed water from gutters to a larger cistern, which pumps water to the landscape.

Site Evaluation:



Harvesting Rainwater For Landscape Use; University of Arizona, Patricia Waterfall, Second Edition, October 2004

Passive Harvesting

A simple and passive water harvesting method is to divert the water from gutters directly into landscaping—great for people on a budget or where other site restrictions exist. Observe drainage patterns, grade low planting areas and install flexible drainpipe or rock-lined trenches. Design naturally planted washes towards a rain garden. Plants will appreciate the soft rainwater. Rain gardens absorb 30 percent more water than a comparable-sized lawn. Digging large retention or swales and planting in the rain garden allow the water to slowly filter into the ground rather than run off the site and into the street or storm drain. Quick formula for planning: 30 percent of roof area = rain garden area.

RAINWATER...

A WATER SUPPLY FALLING FROM THE SKY.

Need a rain gauge?

Buy a Tru-Chek gauge here at Rainlog.org

Rainwater, a natural resource for outdoor landscapes

High Desert Rain Catchment

Cosmic Steel Sculptor - TBKA

Rainwater is much healthier for plants because it is free of salt, arsenic and metals commonly found in imported water.

- Use harvested water most efficiently by grouping together plants with similar water needs.
- For existing landscapes, reduce plant water demand either by lowering plant density or by selecting lower water-use plants.
- For new landscapes, select types and numbers of plants that can be supported by the water harvested from an existing catchment.
- All plants need regular watering when they are initially established. New plantings, even native plants, need increased amounts of irrigation during their establishment period, which can range from one to three years.
- Direct overflow away from foundations, downgrade or toward a rainwater garden or planting bed.
- A general guide when planning the square footage of a rain garden recessed area is to estimate the garden size that is equal to about 30 percent of the square footage of the roof.
- Avoid using old tanks once contaminated with septic or any other waste. Rainwater is so naturally clean it is important to keep your tanks clean.
- Land area may not lend itself to a gravity fed rainwater system. The tank may need a booster pump for consistent pressure. Systems connected to work with existing irrigation or drip systems often require a pump. Consider the electrical needs and these costs when planning a system.
- Tanks should be UV resistant and dark colored unless specified by the manufacturers as being UV resistant. This is to prevent bacteria and algae growth.
- Underground storage, slim line or low profile tanks offer a design solution for homeowners required to meet Homeowner Association (HOA) or CC&R development standards.
- Plumbing codes require a permit for a backflow prevention device to prevent cross connection with potable water supplies.
- If properly designed, systems should be low maintenance and require only seasonal care.

DID YOU KNOW..

For every inch of rain that falls on a 1,000 sq. ft. roof or is directed to a rain garden, you can harvest 600 gallons of rainwater!

To calculate the square feet of a catchment area, measure the length of the outside walls and then add the overhang (OH) of any eaves. For example, a house with outside dimensions of **36 feet by 46 feet**, plus the measured overhang of your eaves as **2 feet x 2 feet**, gives dimensions of **40 by 50 feet.**

Multiply **40 x 50** (length x width including overhangs) to determine the **total catchment area.**

(36 + 4 OH) x (46 + 4 OH) = 40 x 50 = **2,000 sq ft. roof catchment area.**

So how many gallons of water might be caught from this roof area?

The roof catchment area is 2,000 square feet. Generally, one inch of rainfall provides approximately 600 gallons of water for 1,000 square foot of catchment area.

Formula

2000/1000 = 2 x 600 gallon = 1,200 gallons of rainwater harvest potential for every 1" of rain.

HARVESTING SYSTEMS

There are many possible configurations and degrees of complexity to a rainwater catchment system. Costs vary anywhere from a few dollars to thousands of dollars. To get started determine the site-specific water holding capacity potential. Determine if it will be an active or passive harvesting system. Evaluate how and when rainwater will be used. Investigate options and availability and include in an estimate for shipping and installation.

Consider that rainwater-harvesting systems are not necessarily 100 percent efficient. Most sources estimate efficiency between 70 percent and 90 percent. All rainwater-harvesting systems lose some of the rainwater. It may spill out of gutters or wind may blow it away. Evaporation will also affect containment. To maximize collection of rainwater, use outbuildings, detached garages or storage sheds as the harvest area. Get creative, plan the water budget, grade away from any solid surface on your property to allow the water to drain towards a rain garden. Install gravity fed tanks securely on the site to move water towards landscaped areas.

If supplies of harvested water do not meet irrigation demands, balance a water-harvesting checkbook either by increasing supply or by reducing demand.

Acker Park System installed 2007

To increase supply:

Increase the catchment area or runoff coefficient.
Use another source of water, such as a municipal supply.

High Desert Rain Catchment

To reduce demand:

Reduce landscaped area.
Reduce plant density.
Replace high-water-use plants with lower-water-use plants.
Use mulch to reduce surface evaporation.

20,000 gallon tank

Tax Credits in Arizona 2006 – 2012
Graywater-Plumbing and Rainwater-Harvesting

Reference Statue definition- Arizona Revised Statutes §43-1090
Arizona Department of Revenue:
www.azdor.gov/Refunds%20and%20Credits/graywaterchoicesmenu.htm

Rain Garden Resources

Harvesting Rainwater Calculator , a helpful site to estimate your water harvesting potential
www.rainwaterharvesting.tamu.edu/onlinecalculator/arizona.html
www.rainwaterharvesting.tamu.edu/onlinecalculator/AZ/html/Prescott/Prescott.htm

Find the rainfall in your area- www.countrystudies.us/united-states/weather/

American Rainwater Catchment Systems Association- www.arcsa-usa.org/

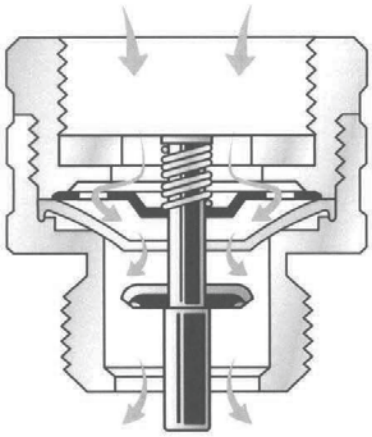
Harvesting Rainwater For Landscape Use; University of Arizona, Patricia Waterfall, Second Edition, October 2004
www.cityofprescott.net/_d/harvesting_rainwater.pdf

Planning a Native Rain Garden- www.grownative.org/index.cfm?fuseaction=landscaping.raingarden

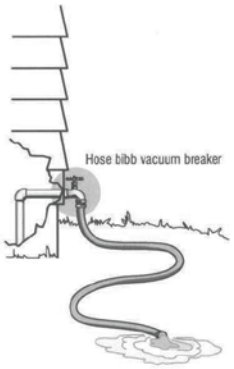
Backflow Prevention Assemblies

Protect your family and home from backflow.

Hose bibb vacuum breaker.



Typical installation of hose bibb vacuum breaker.



Backflow prevention assemblies installed on all in-ground irrigation systems are required to prevent contamination or pollution from entering the public or private water supply. Lawn irrigation and sprinkler systems require a permit and inspection. The purpose of the permit is to determine the proper installation of an approved backflow prevention assembly. Annual testing is necessary to ensure the assembly is functioning properly.

The International Residential Plumbing Code requires annual testing for backflow prevention assemblies. Water purveyors often maintain a list of Certified Backflow Testers.

1. Drip irrigation and sprinkler spray systems require backflow prevention assemblies and often a building/ sprinkler system permit.

2. Install the assembly in an area that allows easy access for testing and repairs.

3. Winter protection for the water backflow assembly is either an insulated pouch or a" hot-box." Bags or boxes come in several colors, designs of rocks or painted boxes, which cover the backflow assembly and insulate it from winter freeze. Consider applying heat tape, wrapped around all above grade water lines for extra winter protection.

4. It is highly recommend that in-ground irrigation systems be winterized and special attention given to the backflow prevention assembly, including a need to drain water from irrigation lines. Preventing a system from freezing will protect pipes from bursting, limit potential water loss and reduce or eliminate costly repairs.

5. When recharging the irrigation system in the spring, check the backflow prevention assembly for leaks. If repaired or replaced, the device must be re-tested and certified prior to returning the system to full irrigation operation. Call the local building department for information regarding permit and testing requirements.

6. When repairing plumbing at home, know the limits. If the job is beyond a homeowner's skill level, call in a professional and always hire a licensed contractor to install and a certified device tester to service the backflow assembly.

7. Request bids from at least three licensed contractors. Insist they obtain all required permits, inspections and testing records. Place a copy of all records in a home improvement file.

It is easy to take water for granted. Around the globe, scientists are discovering our water supply may seem abundant, but our drinkable water supply is in high demand and short supply. Installation of important safety devices is standard practice and the introduction of technologies has evolved over the last century. The plumbing and landscape/irrigation industry dedicate considerable effort to protect the drinkable water supply.

Wikipedia- www.en.wikipedia.org/wiki/Backflow_prevention_device
EPA Cross-Connection Control Manual- www.epa.gov/safewater/crossconnection.html
Arizona Department Of Environmental Quality (ADEQ) Reference Regulation- R-18-4-115
The American Backflow Prevention Association (ABPA)- www.abpa.org
American Water Works Association- www.awwa.org
Foundation for Cross-Connection Control And Hydraulic Research- www.usc.edu/dept/fccchr/Graphics/intro.gif
Backflow Protection Technical sites- www.BackflowPreventionTechZone.com
Details for installing irrigation systems- www.tempe.gov/engineering/standard_landscape_...
www.glendaleaz.com/CrossConnection/residentiallandscapeinformation.cfm
Do It Yourself Plumbing- www.keidel.com/resource/diy

Frequently Asked Questions

What is backflow?

Backflow is the unintended reversal flow of non-potable water through a cross-connection possibly contaminated water may enter public or private water systems. A serious health hazard may result when contaminated water is used for drinking, cooking or bathing. Backflow is caused by reduced supply pressure, increased private system pressure, or damage to water piping. There are two types of backflow, backpressure backflow and back-siphon backflow.

Why do I have to have a backflow device assembly and does my installation contractor have to be licensed?

Lawn sprinkler systems, are directly connected to your city water supply and must meet local code in regard to a backflow device. These device assemblies prevent water from being siphoned back into the water supply. The type of device required and the necessary building permits, licenses and certifications required vary from city to city. Contact your local water provider or city building permit office for backflow assembly requirements.

What is the most common cause of cross connections?

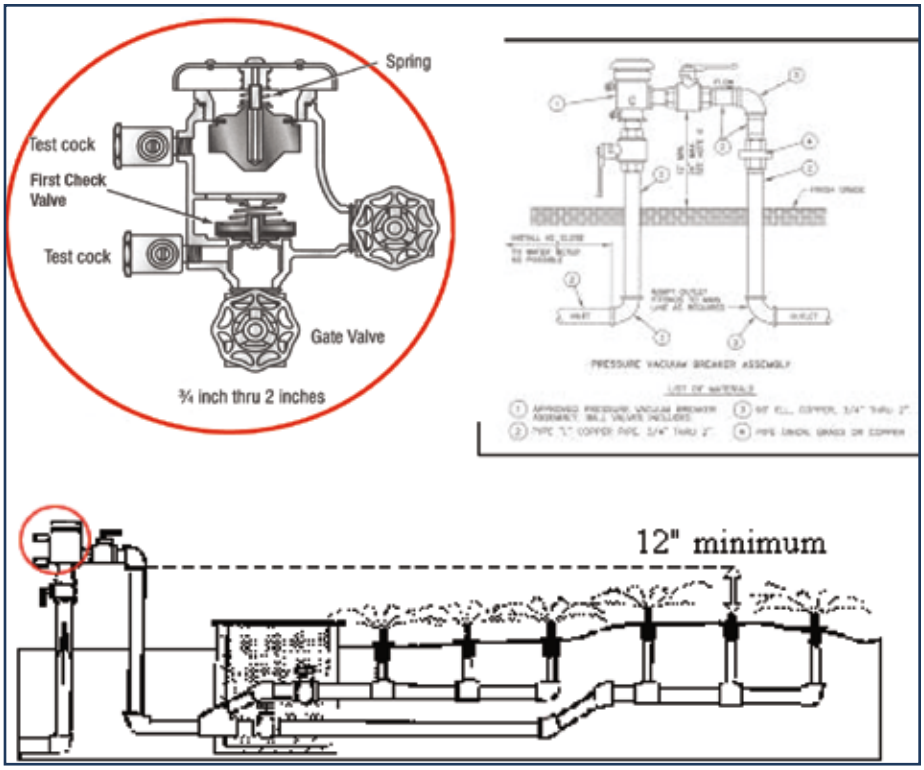
Cross connections commonly occur with ordinary garden hoses. A garden hose connected to the drinking water supply, often may be attached to yard applicators used for a variety of potentially dangerous activities, including the application of household or garden pesticides or products used for cleaning outdoor surfaces.

Does backflow really happen?

Yes, documented cases of cross connection incidents have occurred throughout the United States.

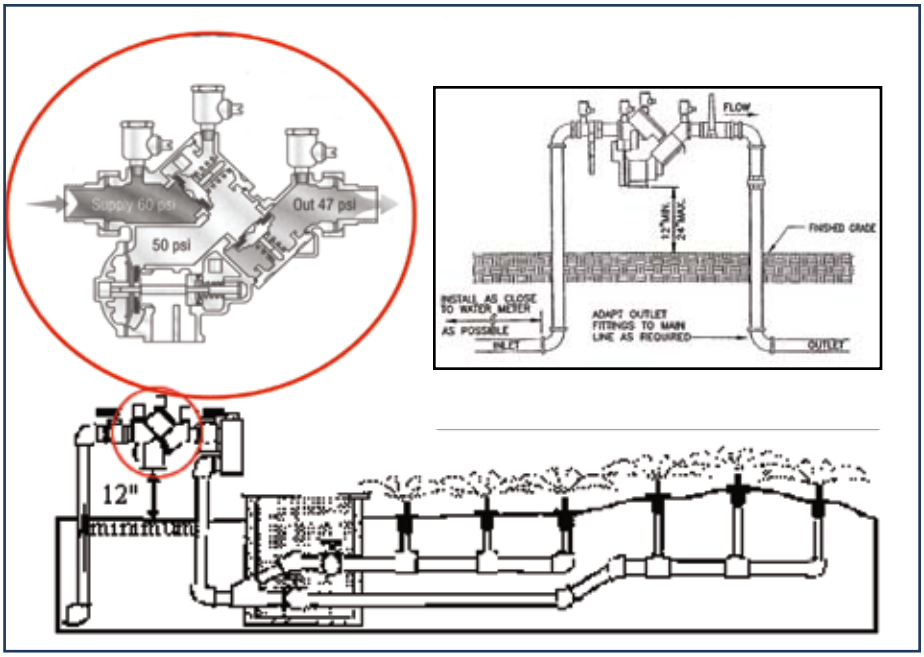
How do I contact a certified backflow device tester?

Find certified professional on the web, in your area phone book, through the Yavapai County Contractor Association, or request a list from your water provider or plumbing authority.



Pressure Vacuum Breaker (PVB) Assembly

- Only one PVB is required to serve the whole irrigation system.
- Drip irrigation systems and spray systems require backflow prevention.
- Control valves may be located downstream of (after) the PVB.
- PVB's must be installed a minimum of 12" or 18" in some jurisdictions. Installed above the highest point of water to be served.
- No chemical or fertilizer shall be introduced into an irrigation system equipped with a PVB.
- No pumps or back pressure sources are permitted on downstream side of (after) a PVB.



Reduced Pressure Principle (RPP) Assembly

- Only one RPP is required to serve the whole system; control valves can be located downstream of (after) the RPPA.
- RPP's must be installed a minimum of 12" above ground level.
- Fertilizer and other agricultural chemical must be introduced downstream of the approved backflow prevention assembly.
- During a backflow condition, the RPPA can and should discharge water; the volume discharged is dependent upon the size of the supply pipe, the backflow prevention assembly, and the irrigation system.

Nearly all of your landscape can be watered with drip irrigation. Drip systems are particularly well suited for desert landscapes, places where runoff can be a problem, and small, narrow areas such as entryways. Drip is also a great way to water vegetables, flowers and potted plants.

Drip Irrigation 101

Also known as low-flow, micro, and trickle irrigation is the slow, measured application of water through devices called emitters. A properly functioning drip irrigation system saves water because little is lost to runoff or evaporation. This watering method also promotes healthy plant growth, controls weed growth, and reduces pest problems. Drip irrigation systems can be big time water savers. But if left alone after installation or if incorrectly assembled, the system can be a big water waster instead of a water saver. Systems should be tested monthly to check for leaks.

Just like the song "Head, Shoulders, Knees and Toes," that teaches children about anatomy, understanding drip irrigation systems isn't hard once you learn the basics. The valve is connected to the — filter, and the filter is connected to the — pressure regulator, and the pressure regulator is connected to the — piping, and oh! That's how an irrigation system goes. There is a wide assortment of equipment to suit most budgets and watering needs. Use the descriptive list below to identify system components and maintenance actions.

Controller/Timer: This device automatically activates irrigation valves on pre-selected days. It controls when, how long and how often the system waters. Good timers allow maximum watering intervals of 30 days. **Established low water use plants do not need water more frequently than every 2-3 weeks.** If the controller only allows you to water once a week or less, you are wasting water. Water for no less than 1 hour to allow enough water to penetrate to a root depth of 1, 2 or 3 feet deep for small plants, shrubs or trees respectively. Change watering frequencies monthly or seasonally. Do not use the budgeting feature on most controllers because it changes the length of watering time, not the frequency.

Backflow Preventer: This device prevents the irrigation system from being siphoned back into drinking water. Your water provider may regulate the installation of backflow preventers. Contact them for more information.
Ref Backflow Prevention Assemblies

Valves: Manually or automatically operated control valves turn the water on and off. Automatic control valves are wired to a controller. Good drip systems have multiple valves to control watering small plants, shrubs and trees separately.

Filter: All drip systems need a filter to keep dirt and debris from clogging the emitters. Replace or clean the filter at least once a year. Clogged filters are often the cause of a poorly performing drip system.

Pressure Regulator: Most drip systems operate at low pressure, usually less than 30 psi. Pressure regulators reduce incoming water pressure to the ideal pressure for the drip system. Water companies are required to deliver water at a minimum of 30 psi, although pressures can exceed 80 psi. Excessive water pressures can pop off emitters and cause water to be emitted at a greater rate than desired.

Pipe: Polyethylene tubing and rigid PVC are the two most commonly used types of irrigation pipes. Pipes distribute water from valves to the irrigated area. Over time, pipes can become bent, cracked or punctured. Excessive plant growth or a prolonged hissing sound during full operation may indicate an underground leak.

Micro-tubing: Also known as ¼ inch or spaghetti tubing, micro-tubing delivers water from the piping to or from the emitters. Periodically check for micro-tubing leaks.

Emitters: These connect to the pipes or tubing and deliver water at a slow, consistent rate, usually 1, 2 or 4 gallons per hour. The choice of emitter output depends on how quickly or slowly water penetrates the soil. Compacted and clay soils cannot absorb water at a fast rate. That factor makes smaller quantity emitters the best choice to reduce run-off. Inspect pipes and tubing monthly for missing or clogged emitters. As the plant grows, do not keep the emitters near the base of the plant. Move them out to the plants drip line. Close off unused emitters using "goof plugs."

Flush Valve/Cap: Found at the end of each irrigation line, flush valves cap the line and allow flushing the line of dirt and debris. Remove this cap for winterizing your irrigation system.

Four Easy Steps

To Operate and Maintain a Drip Irrigation

1. Do not over water. One inch of water per week will suffice for plants with average water requirements. A 1 gallon per hour (gph) emitter will deliver this amount of water in about one hour. Hot climates often require the equivalent of 2" per week of rainwater. It's best to water deeply, but infrequently. There should be no puddles around the emitters.
2. Check your watering depth. After a full watering cycle, stick a moisture sensor or screwdriver into the soil near emitters to see if moisture is present. If the soil is moist, the sensor will slip easily into the ground. Dry soils may require you to add emitters, or change their spacing.
3. Drip irrigation systems left above ground tend to clog less than buried systems, and they are easy to lift when cultivating or planting. Cover the soil with mulch to conceal the tubing and further reduce evaporation. If you are going to bury the system, leave the trenches unfilled until you have tested the complete system. Make a diagram and take picture of the system before you bury the main lines for future care and maintenance
4. Winterize your irrigation system, including the backflow prevention device and outdoor hoses. If you live in a colder climate, drain your system at season's end. Simply unplug the end stoppers, or fold open the crimped end of the lines. Tie a plastic or cloth wrap over the open end of the line to keep it free of debris and bugs. Draining the line prevents any breakage due to freezing. Store the filter, pressure reducer and timer indoors for the winter.

Irrigation Resources

Author: Cado Daily, Water Wise Conservation Program Coordinator

www.cals.arizona.edu/backyards/

www.irrigation.org/

www.greetouchirrigation.com

THINK

about the
bigger
picture,
the Earth
is sick
but we can
fix her.

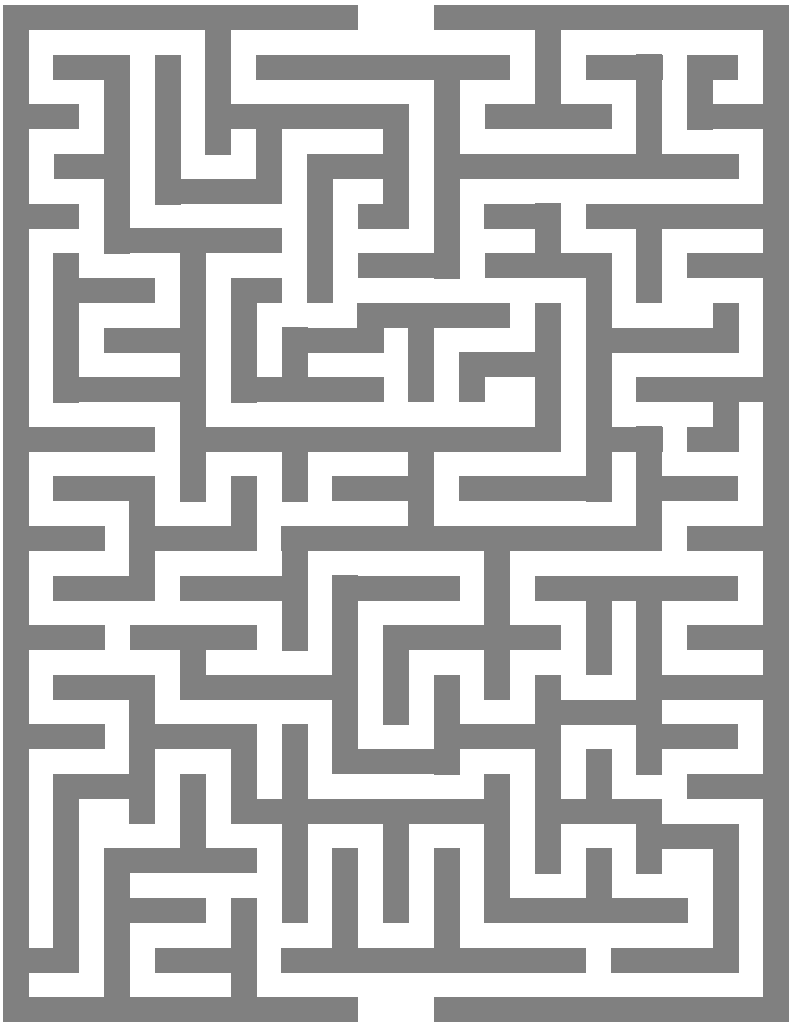
PAY ATTENTION

read the news, today
there's more that we
can do!
Write a letter, take
a stand, spread the
word and
lend a hand!

Artwork by Juanita Hull-Carlson

FIND YOUR WAY THROUGH AN
AMAZING COMMUNITY ACTION JOURNEY.

START



FINISH

WATER CONSERVATION WORD SEARCH

Find the following words that support water and water conservation in the word search puzzle. Discuss these terms with your family, friends and classmates. Ask why they are important to water conservation.

WATER WISE
GALLON
LOW FLOW
DRINKING
WATER SUPPLY
PIPELINE
PUMPS
DRIP

METER
WELL
LEAK
AQUIFER
SPRINKLER
RESERVOIR
TANK
LAKES

RAINFALL
SAVE
TREATMENT
WATER CYCLE
RAIN GAUGE
EVAPORATION
CONSERVE
SNOW

WORDS CAN BE LOCATED FORWARD, BACKWARD, DIAGONALLY, UP AND DOWN.

W	S	P	R	I	N	K	L	E	R	E	Z	G	S	R	L
W	E	I	T	S	K	K	N	N	A	G	B	A	E	E	E
A	V	P	R	A	N	E	V	O	I	D	A	L	K	S	G
T	R	E	E	K	N	O	B	I	N	R	B	L	A	E	U
E	E	L	A	S	R	K	G	T	F	I	K	O	L	R	A
R	S	I	T	Z	N	N	B	A	A	P	L	N	F	V	G
C	N	N	M	S	I	O	E	R	L	D	A	K	T	O	N
Y	O	E	E	K	U	O	W	O	L	F	W	O	L	I	I
C	C	D	N	S	P	M	U	P	G	J	Y	X	L	R	A
L	M	I	T	N	E	C	S	A	Q	U	I	F	E	R	R
E	R	W	I	T	R	S	A	V	E	Y	T	O	W	D	G
D	R	L	E	S	W	A	T	E	R	S	U	P	P	L	Y
J	M	R	R	V	B	K	E	S	I	W	R	E	T	A	W

Conservation Is Key

- ✔ 75 % of the earth is covered with water.
- ✔ 97 % of earth's water is in the oceans.
- ✔ Only 3 % of the earth's water is fresh for use as drinking water.
- ✔ 75 % of the world's fresh water is frozen in the polar ice caps.
- ✔ Although a person can live without food for more than a month, a person can only live without water for approximately one week.
- ✔ The average person in the United States uses 60 to 80 gallons of water each day.
- ✔ During medieval times, a person used only 5 gallons per day.
- ✔ It takes 2 gallons to brush your teeth, 2 to 7 gallons to flush a toilet, and 25 to 50 gallons to take a shower.
- ✔ It takes about 1 gallon of water to process a quarter pound of hamburger.
- ✔ It takes 2,072 gallons of water to make four new tires.
- ✔ Sources of water pollution include; oil spills, fertilizer and agricultural run-off, sewage, stormwater, and industrial wastes.

I play my part
I am fun and Smart

Our current plan is
breaking down
Some of our actions
are not sound
Spoiled rivers,
soils and air
Wasting, wanting
without a care

To clean things up
we have to know
that wastefulness
has got to go!

So even though
we have
the cash,
play your part,
don't waste and
trash

ARIZONA Wet
Water Education for Teachers

CONSERVE, RESERVE, PRESERVE

DEFINITIONS

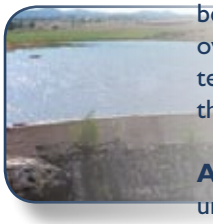
Preserve- to protect, to keep from harm, damage, danger: to save, to keep up, carry on, maintain

Conserve- to keep from being damaged, lost or wasted; to save

Reserve- to keep back, store up or set aside for later use

Glossary

JUST A FEW WATER SMART TERMS TO SUPPORT WATER EDUCATION

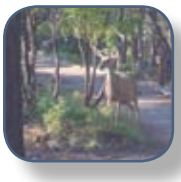


Active Management Area (AMA) – areas in the State of Arizona that have been declared in a state of groundwater overdraft and are concerned with the long-term management and conservation of their limited water supplies.

Artesian Water – groundwater that is under pressure, and when tapped by a well, the pressure may be enough to push the water out on its own.

Aquifer – a body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant amount of water and from which water can be extracted.

- **Confined** – an aquifer that is bounded by impermeable layers both above and below and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer creating artesian water.
- **Unconfined** – an aquifer which is not bounded by an impermeable layer at the top and is saturated with water to the top of the water table.



Backflow – water that flows backward through a water supply system because of a change in pressure and can potentially contain toxic substances.

Biodiversity – number and variety of plant and animal species that live in a particular area.

Biomes – regional ecosystems that are characterized by distinct flora and fauna that live under the specific climatic conditions of that region.

Boosters – pumps and pumping facilities located throughout the municipal distribution system to ensure proper water pressure within the system.

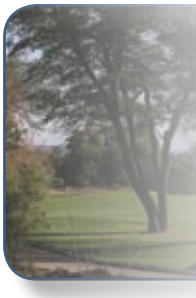
Climate – the long-term weather pattern of an area, including temperature, precipitation, and wind.

Condensation – the process of water vapor (gas) in the air turning into liquid water.

Conifers – trees and shrubs that are cone-bearing, such as ponderosa and piñon pine, also known as evergreens.

Deciduous – trees and shrubs that shed their leaves in the fall and winter seasons.

Drip Irrigation – a common irrigation method where pipes or tubes filled with water slowly drip onto plants, shrubs, or trees and less water is lost to evaporation when compared to high-pressure spray irrigation.



Drought – a period of water shortage.

Ecosystem – an ecological community together with its environment, functioning as a unit.

Effluent – wastewater that has been treated and is ready for reuse or to be discharged back to surface waters or recharged back into aquifers.

Evaporation – the process of liquid water changing into a gaseous form and becoming water vapor.

Evapotranspiration (ET) – the sum of evaporation and transpiration; the quantity of water transpired (given off), from plant tissues and evaporated from surrounding soil surfaces.

Firewise – the act of participating in the pre-fire activities that are necessary to protect people, property, and natural resources from the risk of wildland fire before a fire starts.

Groundwater – water that flows or seeps downward and saturates soil or rock, supplying aquifers, springs, and wells.

Groundwater Overdraft – the state or condition in which groundwater is being extracted faster than it can be recharged, either naturally or artificially.

Humus – organic matter in the soil; a source of nutrients for soil organisms and plants.

Hydrologic (Water) Cycle – the cyclic transfer of water through the phases of solid, liquid, and gas: 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.

Infiltration – the flow of water from the land surface into the subsurface of the ground.

Monsoon – the seasonal shift in wind patterns, rains are often associated with it.

Precipitation – moisture that falls from the atmosphere (rain, snow, etc.)

Rainwater Harvesting – process by which rain is captured from surface runoff.

- **Active** – process of capturing rain from surfaces, such as roofs or pavement, and storing for later use.
- **Passive** – process of using earthworks to control surface water and promote its storage in the soil.

Recharge – water added to an aquifer or the process of adding water to an aquifer.

- **Artificial** – the intentional addition of water to an aquifer by human activity, either through directly injecting it or by creating infiltration pits.
- **Natural** – replenishment of an aquifer via seepage from the surface from precipitation and snow melt.

Safe Yield – the maximum quantity of water that can be continuously withdrawn from a groundwater basin without having adverse effects.

Springs – a location where groundwater flows naturally to the land surface or a surface water body.

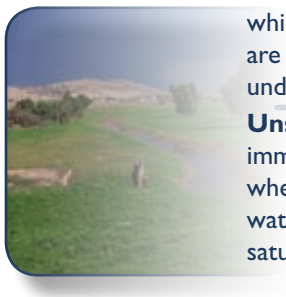
Storm water – the flow of water that results from precipitation and runoff from land, pavements, building rooftops and other surfaces.

Surface Water – water that rests or moves on the surface of the earth, such as streams, rivers, ponds, and lakes.

Survivable (Defensible) Space – the area between a structure and an oncoming wildfire that has been modified to reduce the intensity of a wildfire and its ability to spread.

Transpiration – process in which plant tissues give off water vapor to the atmosphere through the pores on their leaves.

Underground Water – all water beneath the land surface.



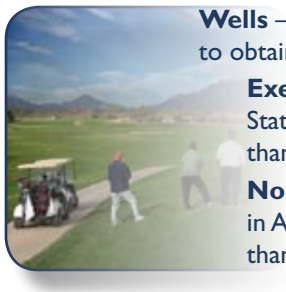
- **Saturated Zone** – the zone in which all pore spaces in the ground are filled with water, usually found under the unsaturated zone.
- **Unsaturated Zone** – the zone immediately below the land surface where pore spaces contain both water and air but are not totally saturated with water.

Water Table – found at the upper surface of the saturated zone in an unconfined aquifer; the layer between the saturated and unsaturated zones.

Watershed – the land area from which water drains to a given point, such as a reservoir, stream, river, or lake.

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

Weather – the state of the atmosphere at a given time and place, with respect to variables such as temperature, moisture, wind velocity.



Wells – drilled into the Earth's surface to obtain water.

- **Exempt** – category of wells in the State of Arizona that can pump less than 35 gallons per minute.
- **Non-Exempt** – category of wells in Arizona that can pump more than 35 gallons per minute.

Wildland-Urban Interface – where urban and suburban communities are encroaching on fire-prone natural areas.

Xeriscape – a type of water-conserving landscaping technique that refers to seven horticultural principles and utilizes plants that are well adapted to the local area and are drought-resistant.

Contacts & Resource

MUNICIPALITIES

Upper Verde River Watershed Protection Coalition www.UVRWPC.org
City of Prescott 928-777-1130 www.prescott-az.gov/services/water/conservation.php
Town of Chino Valley 928-636-7140 www.chinoaz.net
Town of Prescott Valley 928-759-3000 www.pvaz.net/Index.aspx?page=280
928-759-3070 Water and Wastewater Utilities
Yavapai County www.co.yavapai.az.us
928-771-3100 Prescott and Surrounding Area
928-639-8100 Verde Valley Area
Yavapai-Prescott Indian Tribe 928-445-8790 www.ypit.com

CHAMBERS OF COMMERCE

Arizona Department of Commerce 602-771-1100 www.azcommerce.com
Chino Valley 928-636-2493 www.chinovalley.org
Prescott 928-445-2000 or 800-266-7534 www.prescott.org
Prescott Valley 928-772-8857 www.pvchamber.org
Town of Dewey-Humboldt 928-632-7362 www.dewey-humboldt.net
Paulden Area Community Organization PACO pacopres@whitesoon.com

DEMOGRAPHICS

City Data www.city-data.com
US Census Bureau www.census.gov

LOCAL

Agua Fria Open Space Alliance www.aguafriaopenspace.org
Arizona Department of Water Resources
Prescott Active Management Area 928-778-7202 www.azwater.gov/prama
Citizens Water Advocacy Group www.cwagaz.org
Community Supported Agriculture www.prescott.edu/csa
Farmers Market www.prescottfarmersmarket.org
Garden Clubs www.az.gardenclub.org
Highlands Center for Natural History 928-776-9550 www.HighlandsCenter.org
NEMO www.srnr.arizona.edu/nemo/index
Prescott Public Library 928-777-1500 www.PrescottLibrary.info
Prescott Creeks 928-445-5669 www.PrescottCreeks.org
Yavapai County Cooperative Extension 928-445-6590 www.ag.arizona.edu/yavapai
Yavapai County Contractor's Association 928-778-0040 www.ycca.org
Yavapai County Nursery and Landscape Association
Participating nursery and landscape professionals

STATE

The Arboretum at Flagstaff www.thearb.org
American Rivers www.americanrivers.org
Arizona @ Your Service - Official Web of the State www.az.gov
Arizona Dept of Environmental Quality www.azdeq.gov
Arizona Department of Water Resources www.azwater.gov

STATE (cont)

Arizona Game and Fish www.gf.state.az.us
Arizona Meteorological Network www.ag.arizona.edu/azmet/
Prescott Meteorological Network www.ag.arizona.edu/azmet/31.htm
Arizona Municipal Water Users Association www.amwua.org
Arizona Native Plant Society www.aznps.com
Arizona Water www.arizonawater.org
Sonoran Institute www.sonoraninstitute.org

UNIVERSITY OF ARIZONA

Yavapai County Cooperative Extension www.ag.arizona.edu/yavapai
Water Resources Research Center www.ag.arizona.edu/AZWATER
Southwest Hydrology www.swhydro.arizona.edu
Project WET – Water Education for Teachers www.cals.arizona.edu/arizonawet

GREEN BUILDING RESOURCES

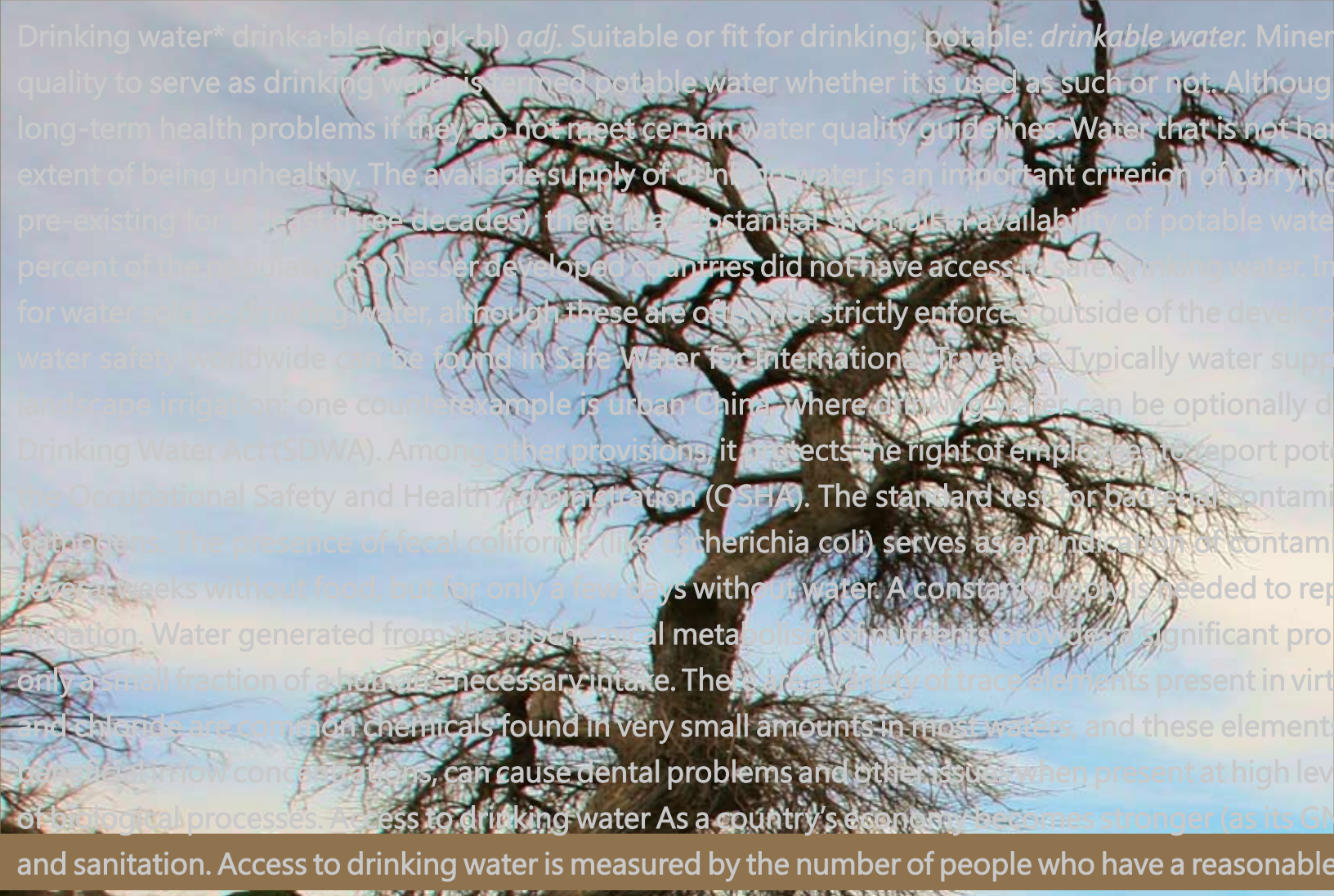
U.S. Green Building Council www.usgbc.org
Whole Building Design Guide www.wbdg.org
Ecological Building Network www.ecobuildnetwork.org
Ecosa Institute www.ecosainstitute.org
Center for Maximum Potential Building Systems (CMPBS) www.cmpbs.org
Center for Resourceful Building Technology (CRBT) www.crbt.org
Center for Renewable Energy and Sustainable Technology (CREST) www.crest.org
Center of Excellence for Sustainable Development www.smartcommunities.ncat.org
Urban Land Institute www.uli.org

NATIONAL

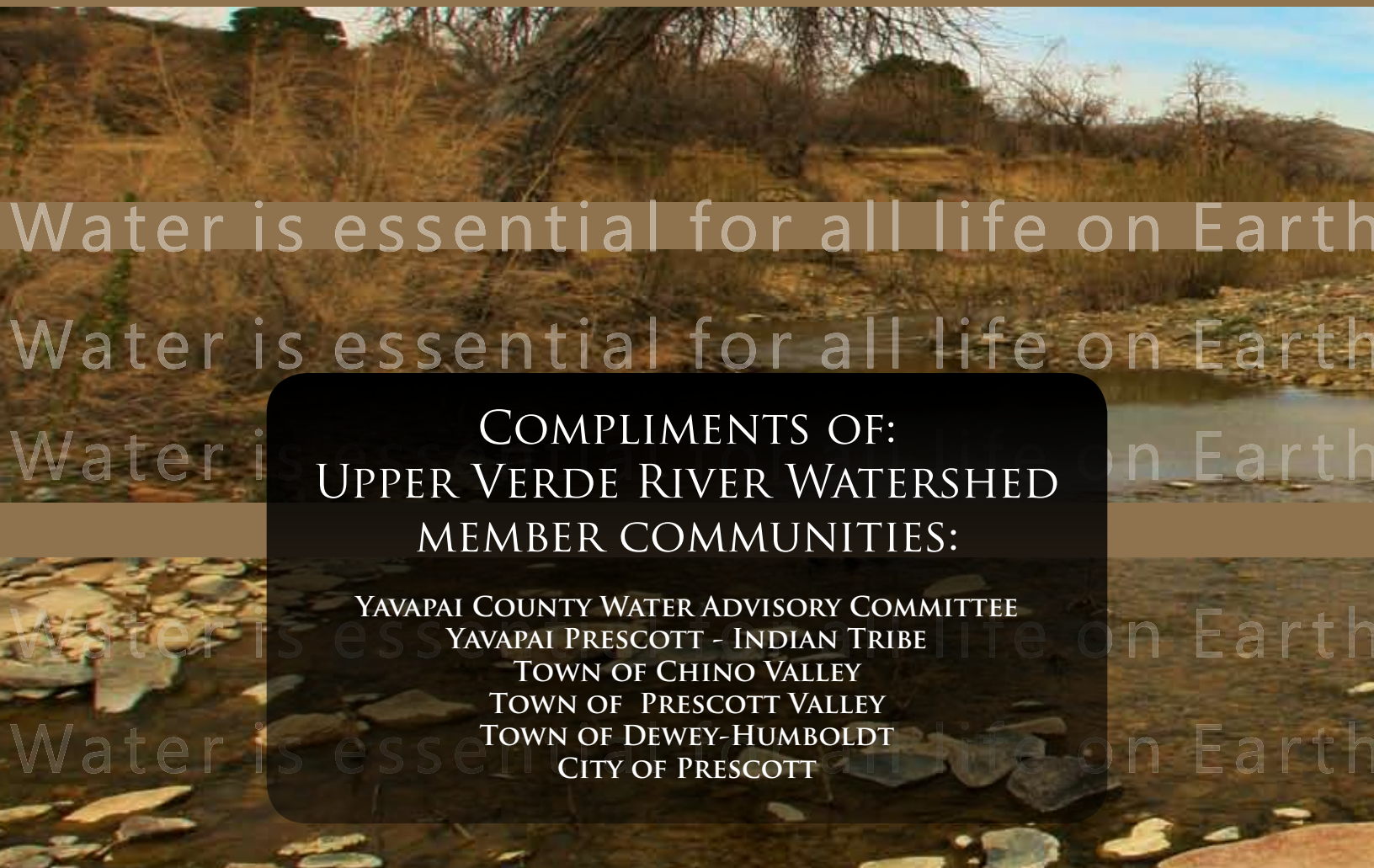
Alliance for Water Efficiency www.allianceforwaterefficiency.org
American Public Gardens Association www.publicgardens.org
Colorado Water Wise www.xeriscape.org
The Irrigation Association www.irrigation.org
National Weather Service www.nws.noaa.gov
Western Regional Climate Data www.wrcc.dri.edu
Natural Resources Conservation Service www.nrcs.usda.gov
Online Rainwater Harvesting Community www.harvesth2o.com
US Bureau of Reclamation www.usbr.gov/waterconservation
US Geological Survey www.usgs.gov
US EPA WaterSense www.epa.gov/watersense

PUBLICATIONS

Prescott AMA Low Water Use Drought Tolerant Plant List
Arizona Department of Water Resources
Harvesting Rainwater for Landscape Use
Patricia H. Waterfall Extension Agency, University of Arizona Cooperative Extension
Sunset Western Garden Book
Xeriscape: Landscaping with Style in the Arizona Desert
Arizona Department of Water Resources



Drinking water* drink·a·ble (drngk-bl) *adj.* Suitable or fit for drinking; potable: *drinkable water.* Miner
quality to serve as drinking water is termed potable water whether it is used as such or not. Althoug
long-term health problems if they do not meet certain water quality guidelines. Water that is not ha
extent of being unhealthy. The available supply of drinking water is an important criterion of carrying
pre-existing for at least three decades), there is a substantial shortfall in availability of potable wate
percent of the populations of lesser developed countries did not have access to safe drinking water. In
for water sold as drinking water, although these are often not strictly enforced outside of the develop
water safety worldwide can be found in Safe Water for International Travelers. Typically water supp
landscape irrigation; one counterexample is urban China, where drinking water can be optionally d
Drinking Water Act (SDWA). Among other provisions, it protects the right of employees to report pote
the Occupational Safety and Health Administration (OSHA). The standard test for bacterial contami
bacteriophage. The presence of fecal coliforms (like Escherichia coli) serves as an indication of contam
several weeks without food, but for only a few days without water. A constant supply is needed to rep
transpiration. Water generated from the biochemical metabolism of nutrients provides a significant pro
only a small fraction of a human's necessary intake. There are a variety of trace elements present in virt
and chloride are common chemicals found in very small amounts in most waters, and these element
can cause dental problems and other issues when present at high lev
of biological processes. Access to drinking water As a country's economy becomes stronger (as its GN
and sanitation. Access to drinking water is measured by the number of people who have a reasonable



Compliments of:
Upper Verde River Watershed member communities:

Yavapai County Water Advisory Committee
Yavapai Prescott - Indian Tribe
Town of Chino Valley
Town of Prescott Valley
Town of Dewey-Humboldt
City of Prescott