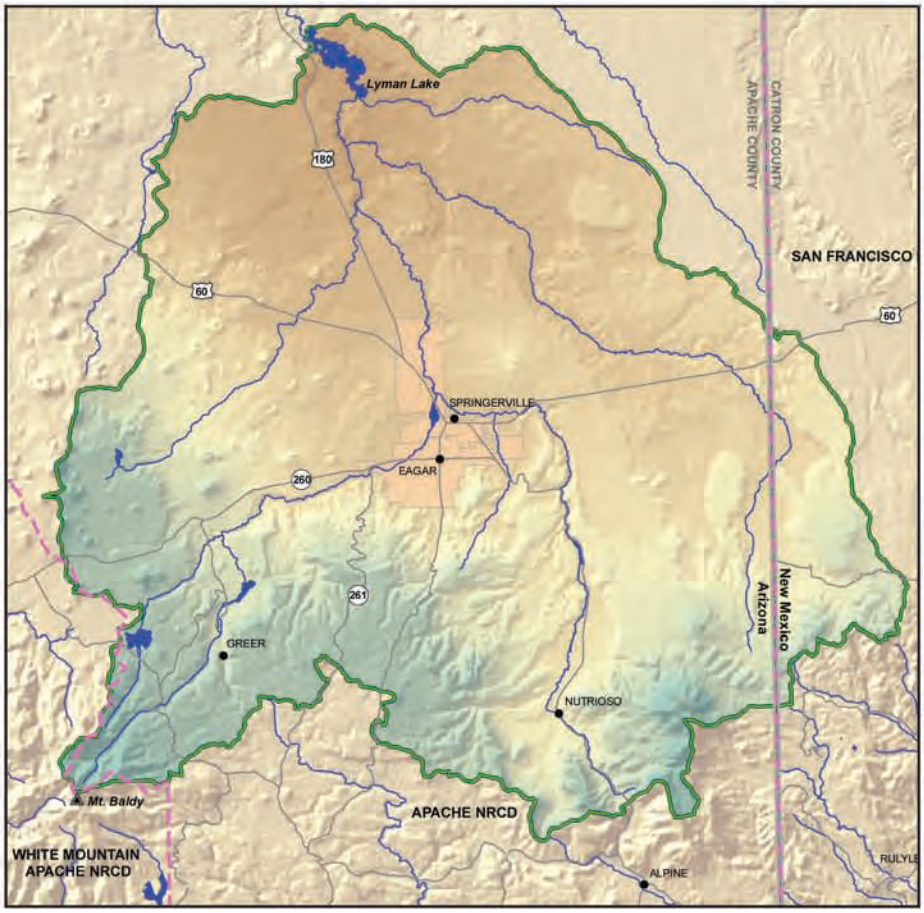
Little Colorado River Headwaters Watershed
Arizona
Rapid Watershed Assessment
June 2008



Prepared by:
USDA Natural Resource Conservation Service – Arizona
University of Arizona, Water Resources Research Center

In cooperation with:
Arizona Association of Conservation Districts
Arizona Department of Agriculture
Arizona Department of Environmental Quality
Arizona Department of Water Resources
Arizona Game & Fish Department
Arizona State Land Department
USDA Forest Service
USDI Bureau of Land Management

Released by:

Sharon Medgal
Director
University of Arizona
Water Resources Research Center

David McKay
State Conservationist
U.S. Department of Agriculture
Natural Resources Conservation Service

Principle Investigators:

Dino DeSimone - Natural Resources Conservation Service, Phoenix, Arizona
Keith Larson - Natural Resources Conservation Service, Phoenix, Arizona
Kristine Uhlman - Water Resources Research Center, University of Arizona
D. Phil Guertin - School of Natural Resources, University of Arizona

Cite as:
USDA Natural Resource Conservation Service, Arizona and University of Arizona Water Resources Research Center. 2008. *Little Colorado River Headwaters Watershed, Arizona, Rapid Watershed Assessment.*

The United States Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th and Independence Avenue, SW, Washington, D.C., 20250-9410 or call (202) 720-5964 (voice or TDD).
USDA is an equal employment opportunity provider and employer.

Little Colorado River Headwaters
Watershed 15020001
8-Digit Hydrologic Unit
Rapid Watershed Assessment

Section 1: Introduction

Overview of Rapid Watershed Assessments

A Rapid Watershed Assessment (RWA) is a concise report containing information on natural resource conditions and concerns within a designated watershed. The "rapid" part refers to a relatively short time period to develop the report as compared to a more comprehensive watershed planning effort. The “assessment” part refers to a report containing maps, tables and other information sufficient to give an overview of the watershed, including physical characteristics and socioeconomic trends.

The assessments involve the collection of readily available quantitative and qualitative information to develop a watershed profile, and sufficient analysis of that information to generate an appraisal of the conservation needs of the watershed. These assessments are conducted by conservation planners, using Geographic Information System (GIS) technology. Conservation Districts and other local leaders, along with public land management agencies, are involved in the assessment process.

An RWA serves as a communication tool between the Natural Resources Conservation Service (NRCS) and partners for prioritizing conservation work in selected watersheds. RWAs serve as a platform for conservation program delivery, provide useful information for development of NRCS and Conservation District business plans, and lay a foundation for future cooperative watershed planning.

General Description of the Little Colorado River Headwaters Watershed

The Little Colorado River Headwaters Watershed is located in the east-central portion of the state of Arizona, and in west-central New Mexico (Figure 1-1). The Little Colorado River Headwaters begin in the White Mountains. The entire 59-mile length of the Little Colorado River is perennial. A 9-mile reach of the West Fork Little Colorado River is also perennial.

The watershed comprises 516,480 acres (807 square miles), and is located approximately 94% in Apache County, Arizona and about 6% in Catron County, New Mexico. Forty-four percent of the land is owned by Fish and Wildlife, 37% is White Mountain Apache Indian Reservation land, 16% is State Trust land, 3% is managed by the BLM, 1% is Private Land, and <1.0% is Forest Service land .

There are about 1,500 acres of irrigated cropland in the watershed. Important crops include alfalfa and oats. The watershed is comprised primarily of rangeland and forest land. Livestock use is dominated by cow calf operations.

Major towns and cities include Springerville, Eagar, and Greer. Conservation assistance is provided through the Apache Natural Resource Conservation District and the Quemado Soil and Water Conservation District.

There are two U.S. Department of Agriculture (USDA) Service Center in the area, located in Springerville, Arizona and Datil, New Mexico.

Resource concerns in the watershed include soil erosion, rangeland site stability, rangeland hydrologic cycle, excessive runoff (causing flooding or ponding), excessive suspended sediment and turbidity in surface water, threatened or endangered plant and animal species, noxious and invasive plants, wildfire hazard, inadequate water for fish and wildlife, habitat fragmentation, and inadequate stock water for domestic animals (NRCS Factsheet).

Section 2: Physical Description

Watershed Size

The Little Colorado River Headwaters Watershed covers approximately 516,480 acres (807 square miles), representing about 1.0% of the state of Arizona. The watershed has a maximum width of about 34 miles east to west, and a maximum length of about 35 miles north to south.

The Little Colorado River Headwaters Watershed was delineated by the U.S. Geological Survey and has been subdivided by the NRCS into smaller watersheds or drainage areas. Each drainage area has a unique hydrologic unit code number (HUC) and a name based on the primary surface water feature within the HUC. These drainage areas can be further subdivided into even smaller watersheds as needed. The Little Colorado River Headwaters Watershed is an 8-digit HUC of 15020001, and it contains the following 10-digit HUCs:

- 1502000101 Nutrioso Creek
- 1502000102 South Fork Little Colorado River-Little Colorado River Headwater
- 1502000103 Coyote Creek
- 1502000104 Canero Creek-Little Colorado River Headwaters (Figure 2-1)

Geology

The Little Colorado River Headwaters Watershed is in the northeastern corner of the state within the Colorado Plateau Uplands physiographic province. The Plateau Uplands province covers the northern two-fifths of the state of Arizona and is characterized by mostly level, horizontally stratified sedimentary rocks that have been eroded into canyons and plateaus, and by some high volcanic mountains.

Ancient marine and coastal deposits include a wide range of rock types – limestone, claystone, mudstone, sandstone, and conglomerate – throughout the sequence. Figure 2-2 shows the geology of the Little Colorado River Headwaters Watershed.

The local area is composed chiefly of basaltic rocks on land surface, and many volcanic cinder cones and craters are found across the landscape. Quaternary and Tertiary aged lava flows along the margins of the White Mountains are present in the watershed, and many flows have filled paleovalleys, protecting them from erosion that wore away surrounding unprotected paleoridges, so that now what was a valley has become a ridge, and what were ridges have become eroded valleys.

The White Mountain volcanic field rises towards a central volcano, Mt. Baldy (11,420 feet), where the volcanic rocks are reported to be nearly 4,000 feet thick (Chronic, 1983). The White Mountains are composed of rhyolitic to andesitic lava flows and related volcanic rocks, in which Pleistocene glaciers carved peaks and left smoothed valleys (Kamilli and Richard 1998).

The underlying Triassic age Chinle formation is exposed in places across the watershed. Here, the soft, limy mudstone of the Formation has been weathered to form extensive badlands. The Chinle Formation contains

bentonite, a clay formed from volcanic ash that swells when wet and dries into a crust that erodes easily. The Formation is famous for fossil trees and the great logs of the Petrified Forest. Fossils from large reptiles called *Placerias* have also been found in the Formation (Chronic, 1983).

The lowest point in the Little Colorado River Headwaters Watershed is where the Little Colorado River flows out of Lyman Lake at 5,955 ft elevation. The highest point is near Mt. Baldy in the White Mountains at 11,420 feet elevation.

Soils

Soils within the Little Colorado River Headwaters Watershed are diverse and formed as the result of differences in climate, vegetation, geology, and physiography. Detail soils information for the watershed is available from the Natural Resources Conservation Service (NRCS) and the U.S. Forest Service (USFS). The USFS maintains Terrestrial Ecosystem Surveys on National Forest Lands within the watershed. Lands outside of National Forests are included within the NRCS "Soil Survey of Apache County, AZ, Central Part." Detailed soils information and maps from this Soil Survey can be accessed through the NRCS Web Soil Survey website: http://websoilsurvey.nrcs.usda.gov.

Common Resource Areas

The USDA, Natural Resources Conservation Service (NRCS) defines a Common Resource Area (CRA) as a geographical area where resource concerns, problems, or treatment needs are similar (NRCS 2006). It is considered a subdivision of an existing Major Land Resource Area (MLRA). Landscape conditions, soil, climate, human considerations, and other natural resource information are used to determine the geographic boundaries of a Common Resource Area.

The Little Colorado River Headwaters Watershed is comprised of three Common Resource Areas (Figure 2-3 and Table 2-1).

The lower portion of the watershed is comprised of CRA 35.1 "Colorado Plateau Mixed Grass Plains" with elevations ranging from 5,100 to 6,000 feet and precipitation averaging 10 to 14 inches per year. Vegetation includes Stipa species, Indian ricegrass, galleta, blue grama, fourwing saltbush, winterfat, and cliffrose. The soils in the area have a mesic soil temperature regime and an ustic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep, coarse to moderately fine-textured soils occur on plains. Shallow, gravelly, cobbly and stony, medium and fine-textured soils occur on plains, mesa tops and cinder cones.

The middle portion of the watershed is comprised of CRA 35.7 "Colorado Plateau Woodland – Grassland" with elevations ranging from 5,000 to 7,000 feet and precipitation averaging 14 to 18 inches per year. Vegetation includes one-seed juniper, Colorado pinyon, Stansbury cliffrose, Apache plume, four-wing saltbush, Mormon tea, sideoats grama, blue grama, black grama, galleta, bottlebrush squirreltail, and muttongrass. The soils in the area have a mesic soil temperature regime and an aridic ustic soil moisture regime. The

dominant soil orders are Vertisols and Mollisols. Shallow to deep, gravelly, cobbly and stony, fine-textured, soils occur on basaltic plains, mesas and hills.

The upper portion of the watershed is comprised of CRA 39.1 "Mogollon Plateau Coniferous Forests" with elevations ranging from 7000 to 12,500 feet and precipitation averaging 20 to 35 inches per year. Vegetation includes ponderosa pine, Gambel oak, Arizona walnut, sycamore, Douglas fir, blue spruce, Arizona fescue, mountain muhly, muttongrass, pine dropseed, and dryland sedges. The soils in the area have a mesic to frigid soil temperature regime and a typic ustic to udic ustic soil moisture regime. The dominant soil orders are Alfisols, Mollisols, Vertisols and Entisols. Moderately deep and deep, medium and moderately fine-textured, soils occur on mountains. Deep and moderately deep, gravelly, medium to fine-textured soils occur in mountain meadows. Shallow to deep, gravelly, cobbly and stony, fine-textured soils occur on basaltic plains, mesas and hills. Deep, coarse to moderately fine-textured soils occur on plains. Shallow, gravelly, cobbly and stony, medium and fine-textured soils occur on plains, mesa tops and cinder cones.

These three Common Resource Areas (35.1, 35.7, 39.1) occur within the Colorado Plateau Physiographic Province which is characterized by a sequence of flat to gently dipping sedimentary rocks eroded into plateaus, valleys and deep canyons. Sedimentary rock classes dominate the plateau with volcanic fields occurring for the most part near its margin

.

Table 2-1: Little Colorado River Headwaters Watershed - Common Resource Areas

Common Resource Area Type	Area (sq. mi.)	Percent of Watershed
35.1 Colorado Plateau Mixed Grass Plains	**301**	**37.39%**
35.7 Colorado Plateau Woodland - Grassland	**3**	**0.37%**
39.1 Mogollon Plateau Coniferous Forests	**501**	**62.23%**

Data Sources: GIS map layer "cra". Arizona Land Information System (ALRIS 2004). Natural Resource Conservation Service (NRCS 2006)

Slope Classifications

Slope, as well as soil characteristics and topography, are important when assessing the vulnerability of a watershed to erosion. Less than 0.1% of the Little Colorado River Headwaters Watershed has a slope greater than 15%, while 94% of the watershed has a slope less than 5%.

The Canero Creek Little Colorado River Headwaters Watershed has the least amount of slope, with 0% of its area over 15% slope, and 99% less than 5% slope. The Nutrioso Creek Watershed has the greatest amount of slope, with 12% of the area greater than 15% slope (Table 2-2 and Figure 2-4).

Table 2-2: Little Colorado River Headwaters Watershed Slope Classifications.

Watershed Name	Area (sq. mi.)	Percent Slope		
		<5%	5-15%	>15%
Nutrioso Creek 1502000101	172	88%	12%	<0.1%
South Fork Little Colorado River-Little Colorado River Headwaters 150200010202	162	92%	8.0%	<0.1%
Coyote Creek 150200010302	231	96%	4.0%	0.0%
Canero Creek-Little Colorado River Headwaters 150200010402	242	99%	1.0%	0.0%
Little Colorado River Headwaters Watershed	807	94%	6.0%	<0.1%

Data Sources: Derived from DEM, obtained from U.S. Geological Survey, April 8, 2003 http://edc.usgs.gov/geodata/

Streams, Lakes and Gaging Stations

The locations of active and inactive gaging stations, and their respective annual mean stream flow, are found in Table 2-3.1. Little Colorado River above Layman Lake near St. Johns has the largest annual stream flow with 21.2 cfs. Of the streams with inactive gages, Little Colorado River at Greer has the highest stream flow with 15.7 cfs. Table 2.3.2 lists major lakes and reservoirs in the Little Colorado River Headwaters Watershed, as well as their watershed position, surface area, elevation and dam name. Lyman Lake is the largest surface water body in the watershed with an area of about 1,308 acres. Figure 2-3.3 lists the major streams and their lengths. Stream lengths range from 59 miles for Little Colorado River to .02 miles for irrigation canals.

Outstanding Arizona Waters

The Arizona Department of Environmental Quality (ADEQ) recognizes state resource waters of unique value as Outstanding Arizona Waters (OAW), a designation which affords such waters a Tier 3 level of antidegradation protection, meaning no degradation of current water quality can be tolerated. As stated in Antidegredation Implementation Procedures (ADEQ 2007), a body of water is eligible to be considered for OAW classification if the following criteria are met:

- The surface water is a perennial water and is in a free-flowing condition;

- The surface water has good water quality. For the purpose of this regulation, “good water quality” means that the surface water has water quality that meets or is better than applicable water quality standards; and
- The surface water meets one or both of the following conditions: (a) is of exceptional recreational or ecological significance because of its unique attributes; (b) threatened or endangered species are known to be associated with the surface water and maintenance of existing water quality is essential to maintenance or propagation of said species or the surface water provides critical habitat for a threatened or endangered species.

ADEQ currently recognizes 20 reaches of various water bodies throughout the state as Outstanding Arizona Waters, and is reviewing two additional streams for possible OAW classification. Within the Little Colorado River Headwaters Watershed, portions of two areas are currently protected as Outstanding Arizona Waters: the west fork of the Little Colorado River and Lee Valley Creek (Figure 2-5). 1.9 miles of Lee Valley Creek is currently recognized as an OAW, from its headwaters to Lee Valley Reservoir. 9.1 miles of the West Fork Little Colorado River, from its headwaters to Government Springs, is currently recognized as an OAW (ADEQ 2007)

.

Table 2-3.1: Little Colorado River Headwaters Watershed USGS Stream Gages and Annual Mean Stream Flow.

USGS Gage ID	Site Name	Begin Date	End Date	Annual Mean Stream Flow (cfs)
	Active Gages			
09384000	Little Colorado River above Layman Lake near St. Johns	1940	2007	21.2
	Inactive Gages			
09383220	Lee Valley Creek Tributary near Greer	10/01/1966	9/30/1972	0.1
09383200	Lee Valley Creek above Lee Valley Reservoir near Greer	10/01/1966	9/30/1972	0.5
09383250	Lee Valley Creek below Lee Valley Reservoir near Greer	10/01/1966	9/30/1972	0.3
09383300	Filler Ditch at Greer	08/01/1960	06/30/1977	2.3
09383400	Little Colorado River at Greer	08/01/1960	09/30/1982	15.7
09383500	Nutrioso Creek above Nelson Reservoir near Springerville	06/22/1967	09/30/1982	5.9
09383550	Nutrioso Creek below Nelson Reservoir near Springerville	07/28/1967	09/30/1982	5.6

Data Sources: GIS dataset “usgs_gages_utm” USGS 2007; USGS website, National Water Information System http://waterdata.usgs.gov/nwis/

Table 2-3.2: Little Colorado River Headwaters Watershed Major Lakes and Reservoirs

Lake Name (if known)	Watershed	Surface Area (acres)	Elevation (feet above mean sea level)	Dam Name (if known)
Carnero Lake	Canero Creek-Little Colorado River Headwaters	67.04	9,033	
Greer Lakes	South Fork Little Colorado River-Little Colorado River Headwaters	140.49	8,221	Tunnel Dam
Lyman Lake	Canero Creek-Little Colorado River Headwaters	1307.62	5,977	
Nelson Reservoir	Nutrioso Creek	67.06	7,775	Nelson Dam
White Mountain Reservoir	South Fork Little Colorado River-Little Colorado River Headwaters	349.10	9,219	White Mountain Dam

Data Sources: GIS data layer "Lakes", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), February 7, 2003 http://www.land.state.az.us/alris/index.html

Table 2-3.3: Little Colorado River Headwaters Watershed Major Streams and Lengths.

Stream Name	Watershed	Stream Length (miles)
Little Colorado River	South Fork Little Colorado River-Little Colorado River Headwaters and Canero Creek-Little Colorado River Headwaters	59
Coyote Creek	Coyote Creek	41
Nutrioso Creek	Nutrioso Creek	30
Carnero Creek	Canero Creek-Little Colorado River Headwaters	22
Hall Creek	South Fork Little Colorado River-Little Colorado River Headwaters	14
West Fork Little Colorado River	South Fork Little Colorado River-Little Colorado River Headwaters	9
Picnic Creek	Nutrioso Creek	8
Irrigation Canals	Canero Creek-Little Colorado River Headwaters	<1.0

Data Sources: GIS data layer "Streams", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), October, 10, 2002.
http://www.land.state.az.us/alris/index.html

Riparian Vegetation

The Arizona Game & Fish Department has identified and mapped riparian vegetation associated with perennial waters in response to the requirements of the state Riparian Protection Program (July 1994). This map was used to

identify riparian areas in the Little Colorado River Headwaters Watershed (Figure 2-6).

Ten types of riparian vegetation communities occur within the Little Colorado River Headwaters Watershed. Riparian areas encompass approximately 2,124 acres (3.3 sq. mi.) or less than 1.0% of the entire watershed. Wet Meadow comprises about 1,065 acres, or 50% of the riparian areas. Mixed Broadleaf , Confer Oak, and Mountain Shrub comprise 427 acres (20%), 352 acres (17%) and 123 acres (11%) of the watershed, respectively (Table 2-4).

South Fork Little Colorado River-Little Colorado River Headwaters Watershed has the greatest amount of riparian vegetation with about 1,374 acres (2.1 square miles). The Canero Creek-Little Colorado River Headwaters Watershed has about 378 acres (0.6 sq. mi.) and the Nutrioso Creek Watershed has only about 372 acres (less that 0.6 sq. mi.). Coyote Creek has no listed riparian vegetation.

Table 2-4: Little Colorado River Headwaters Watershed Riparian Vegetation (acres) by 10 Digit Watershed.

Riparian Vegetation Community	Nutrioso Creek 1502000101	South Fork Little Colorado River-Little Colorado River Headwaters 1502000102	Coyote Creek 150200103	Canero Creek-Little Colorado River Headwaters 1502000104	Little Colorado River Headwaters Watershed
Conifer Oak	21	210	-	121	352
Marsh	8.0	-	-	-	8
Mesquite	-	-	-	46	46
Mixed Broadleaf	-	425	-	1.0	427
Mountain Shrub	48	16	-	60	123
Strand	-	-	-	12	12
Tamarisk	-	-	-	91	91
Wet Meadow	295	723	-	47	1,065
Total Area (acres)	372	1,374	-	378	2,124

Data Sources: GIS data layer "az_riparian_att", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), June 12, 2003 http://www.land.state.az.us/alris/index.html

Land Cover

The Riparian Vegetation map (Figure 2-6) and Land Cover map (Figure 2-7) were created from the Southwest Regional Gap Analysis Project land cover map (Lowry et. al, 2005). Within the Little Colorado River Headwaters Watershed, Table 2-5 identifies the Evergreen Forest as the most common land cover type over the entire watershed, encompassing about 50% of the watershed. The next most common type is the Grassland / Herbaceous Cover, comprising 46% of the watershed.

Note: There are a total of 26 GAP vegetation categories present within the Little Colorado River Headwaters

Watershed boundary. Some of these categories occur only in small concentrations, and are not visible at the small scale in which the maps are displayed. Some of the vegetation categories were re-grouped in order to increase the legibility of the map. In collaboration with NRCS, staff were able to create a total of 10 grouped GAP vegetation categories, as shown on Table 2-5.

Table 2-5: Little Colorado River Headwaters Watershed Southwest Regional GAP Analysis Project Land Cover, Percent of 10-digit Watershed.

Watershed / Land Cover	Nutrioso Creek 1502000101	South Fork Little Colorado River-Little Colorado River Headwaters 1502000102	Coyote Creek 1502000103	Canero Creek-Little Colorado River Headwaters 1502000104	Percent of Total
Agriculture*	<1.0%	1.0%	-	<1.0%	<1.0%
Altered or Disturbed	<1.0%	1.0%	<1.0%	<1.0%	<1.0%
Deciduous Forest	3%	6%	1.0%	1.0%	2%
Developed – High Intensity	1.0%	1.0%	-	<1.0%	<1.0%
Developed – Low Intensity	<1.0%	2%	-	-	<1.0%
Evergreen Forest	73%	60%	55%	22%	50%
Grassland / Herbaceous Cover	22%	29%	44%	75%	46%
Open Water	<1.0%	1.0%	<1.0%	1.0%	<1.0%
Scrub / Shrub	<1.0%	<1.0%	<1.0%	1.0%	<1.0%
Sparsely Vegetated / Barren	1.0%	<1.0%	1.0%	1.0%	1.0%
Area (sq.mi.)	172	162	231	242	807

Not necessarily irrigated land.
Data Sources: GIS data layer "Southwest Regional GAP Program", originated by Southwest Regional GAP program, 2005. http://ftp.nr.usu.edu/swgap/

Meteorological Stations, Precipitation and Temperature

For the years 1961-1990, the average annual precipitation for the Little Colorado River Headwaters Watershed was about 18 inches (Table 2-6). The South Fork Little Colorado River-Little Colorado River Headwaters

watershed received the most rainfall with about 24 inches of rain in an average year, while the Nutrioso Creek, Coyote Creek, and Canero Creek-Little Colorado River Headwaters Watersheds typically received 20, 16, and 15 inches per year, respectively. Average Temperature for the Little Colorado River Headwaters Watershed ranged from 44° F to 48 ° F. Active meteorological stations in the watershed are located at Greer and Springerville (Figure 2-8).

The Western Regional Climate Center calculates the average minimum and maximum temperatures for each month for the period of record and then takes an annual average.

Table 2-6 shows two different meteorological stations for HUC 1502000102 (South Fork Little Colorado River-Little Colorado River Headwaters), Greer and Springerville. The differences in temperature reflect the fact that the Greer meteorological station is at a higher altitude than Springerville.

Table 2-6: Little Colorado River Headwaters Watershed Meteorological Stations, Temperature and Precipitation.

10-digit Watershed Name	Meteorological Stations and Map ID	Temperature (°F)			Precipitation (in/yr)		
		Avg. Min.	Avg. Max.	Avg	Avg. Min.	Avg. Max.	Weighted Average
Nutrioso Creek 1502000101	None	-	-	-	13	31	20
South Fork Little Colorado River-Little Colorado River Headwaters 1502000102	Greer Springerville	30 31	58 66	44 48	13	35	24
Coyote Creek 1502000103	None	-	-	-	11	31	16
Canero Creek-Little Colorado River Headwaters 1502000104	None	-	-	-	11	31	15
Little Colorado River Headwaters Watershed	-	-	-	-	*11*	*35*	*18*

Data Sources: GIS data layer "precip_a_az" Water and Climate Center of the NRCS (1998); GIS data layer "NWS_Stations" Western Regional Climate Center (WRCC), Temperature data. July 15, 2004; http://www.wrcc.dri.edu/summary/climsmaz.htm

Land Ownership/Management

There are 6 different land ownership/management entities in the Little Colorado River Headwaters Watershed (Figure 2-9 and Table 2-7). Forest Service holds the most land, representing about 44% of the watershed, followed by the State Trust Land with 37%, and Private Land with 16%. The Fish and Wildlife Service, Bureau of Land Management, and White Mountain Apache Indian Reservation together have about 4% of the land in the watershed.

Table 2-7: Little Colorado River Headwaters Watershed Land Ownership/Management (Percent of each 10-digit Watershed).

Land Owner	Nutrioso Creek 150200101	South Fork Little Colorado River-Little Colorado River Headwaters 150200102	Coyote Creek 150200103	Canero Creek-Little Colorado River Headwaters 1502000104	Little Colorado River Headwaters Watershed
BLM	-	-	6%	2%	2%
Fish and Wildlife	1%	1%	-	2%	1%
Forest Service	79%	78%	28%	10%	44%
Private Land	16%	12%	17%	16%	16%
State Trust Land	3%	8%	48%	70%	37%
White Mountain Apache Indian Reservation	-	1%	-	-	<1%
Area (square miles)	*172*	*162*	*231*	*242*	*807*

Data Sources: GIS data layer "ownership", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), October 27, 2007 http://www.land.state.az.us/alris/index.html

Land Use

The Land Use map was created from the Southwest Regional GAP Analysis Project land cover map (Lowry et. al, 2005).

The land cover condition during the early 1990's was determined using the National Land Cover Dataset (NLCD). The NLCD classification contains 21 different land cover categories (USGS, NLCD Land Cover Class Definitions); however, these categories have been consolidated into five land use types (Figure 2-10 and Table 2-8). The five groupings for the land use categories are:

- Agriculture (Crop), which includes confined feeding operations; cropland and pasture; orchards, groves, vineyards, nurseries and ornamental horticulture; other agricultural land.

- Forest, includes areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25-100 percent of the cover

- Water, identifies all areas of surface water, generally with less than 25% cover of vegetation/land cover

- Range, which includes herbaceous rangeland; mixed range; shrub and brush rangeland.

- Urban (high density and low density), which includes residential areas; commercial and services; industrial and commercial complexes; mixed urban or built-up land; other urban or built-up land; strip mines quarries and gravel pits; transportation, communication and utilities.

The most common land use type is Range which makes up about 66% of the watershed. Forest is the next most common type with about 33% of the total area.

2-8: Little Colorado River Headwaters Watershed Land Use, Percent of 10-digit Watershed

Land Cover/Location	Agriculture	Forest	Urban High Intensity	Urban Low Intensity	Range	Water	Area (sq.mi.)
Nutrioso Creek 1502000101	0.3%	56%	0.7%	0.4%	42%	0.2%	172
South Fork Little Colorado River-Little Colorado River Headquarters 1502000102	1.1%	57%	1%	1.5%	38%	0.5%	162
Coyote Creek 150200103	-	20%	-	-	80%	0.03%	231
Canero Creek-Little Colorado River Headwaters 1502000104	0.03%	13%	0.1%		87%	0.5%	242
Percent of Little Colorado River Headwaters Watershed	0.3%	33%	0.4%	0.4%	66%	0.3%	807

Data Sources: GIS data layer "Southwest Regional GAP Program", originated by Southwest Regional GAP program, 2005. http://ftp.nr.usu.edu/swgap/

Mines - Primary Ores

Table 2-9 and Figure 2-11 show the types of ores being mined in the Little Colorado River Headwaters Watershed. The most common type of ore is pumice with 20 mines. Other ore types in the area are unknown, sand and gravel, coal and zeolites.
There are no heavy metal mines in the watershed.

Table 2-9: Little Colorado River Headwaters Watershed Mines – Primary Ores

Ore Type	Total Number of Mines
Pumice	20
Unknown	4
Sand & Gravel	3
Coal	1
Zeolites	1

Note: If a mine contains more than one ore, only the major ore is noted. Data Source: "mines" Arizona Land Information Service, 2006.

Section 3: Resource Concerns

Introduction

Conservation Districts and other local leaders, along with NRCS and other resource management agencies, have identified priority natural resource concerns for this watershed. These concerns can be grouped under the broad resource categories of Soil, Water, Air, Plants, or Animals (SWAPA). Refer to Table 3-1 for a listing of priority resource concerns by land use within the Little Colorado River Headwaters Watershed.

Table 3-1: Little Colorado River Headwaters Watershed Priority Resource Concerns by Land Use

Resource Category	Cropland Concerns	Rangeland Concerns	Forest Concerns	Urban Concerns
Soil Erosion		Sheet & Rill Erosion	Sheet & Rill Erosion	Roads & Construction Sites
Water Quality		Excessive Suspended Sediment in Surface Water	Excessive Suspended Sediment in Surface Water	
Water Quantity	Inefficient Use on Irrigated Land			
Air Quality				
Plant Condition		Plant Productivity, Health & Vigor	Plant Productivity, Health & Vigor	
Noxious & Invasive Plants		Noxious & Invasive Plants	Noxious & Invasive Plants	
Domestic Animals		Inadequate Quantities & Quality of Feed & Forage & Water		
Species of Concern		T&E Species & Declining Species & Species of Concern		

(NRCS, 2008)

Soil Erosion

Soil erosion is defined as the movement of soil from water (sheet and rill or gully) or wind forces requiring treatment when soil loss tolerance levels are exceeded. Sheet and rill erosion is a concern particularly on rangeland and forest land in areas of shallow soils and poor vegetative cover. Soil loss results in reduced water holding capacity and plant productivity. Gully erosion can be a significant problem in areas of steep slopes and deep soils. Loss of

vegetative cover and down-cutting of streams contribute to gully formation. Wind erosion is locally significant where adequate vegetative cover is not maintained.

Conservation practices applied to address this resource concern are generally those that help improve vegetative cover, stabilize sites, and control water flows. Practices may include critical area planting, deferred grazing, grade stabilization structures, herbaceous wind barriers, prescribed grazing, range planting, stream channel stabilization, tree and shrub establishment, water and sediment control basins, water spreading, windbreak establishment, and wildlife upland habitat management.

Water Quality

The Arizona Department of Environmental Quality (ADEQ) assesses surface water quality to identify which surface waters are impaired or attaining designed uses and to prioritize future monitoring. Strategies must be implemented on impaired waters to reduce pollutant loadings so that surface water quality standards will be met, unless impairment is *solely* due to natural conditions.

Once a surface water body has been identified as impaired, activities in the watershed that might contribute further loadings of the pollutant are not allowed. Agencies and individuals planning future projects in the watershed must be sure that activities will not further degrade these impaired waters and are encouraged through grants to implement strategies to reduce loading. One of the first steps is the development of a Total Maximum Daily Load (TMDL) analysis to empirically determine the load reduction needed to meet standards.

The draft *2006 Status of Ambient Surface Water Quality in Arizona* indicates that the following surface waters in the Upper Little Colorado River Watershed are impaired:

1. Most of the Little Colorado River from the West Fork of the Little Colorado River to Lyman Lake (39.1 miles) is listed as impaired by sediment. A TMDL was completed in 2002 and several water quality improvement projects have been implemented on this section of the Little Colorado River and its tributaries. This portion of the Little Colorado River flows through two watersheds: South Fork Little Colorado (1502000102) and Carnero Creek (1505000104) (Figure 3-1).
2. Nutrioso Creek (1505000101) is also listed as impaired by sediment. A TMDL was completed in 2002. Water quality improvement projects on the creek and its tributaries have resulted in significant improvement in water quality; therefore, ADEQ is recommending delisting the reach from the headwaters to Nelson Reservoir in the draft 2006 Assessment Report.
3. Lyman Lake, a 1,300 acre reservoir on the Little Colorado River located in the Carnero Creek Watershed (1505000104), is listed as impaired due to mercury in fish tissue. Mercury

TMDLs are currently being developed in five other lakes in the larger Little Colorado River Watershed; therefore, this one is scheduled to be initiated after those are approved. It is expected that work completed for the other lakes will also help identify sources and potential mitigation at Lyman Lake. A fish consumption advisory is in place to warn the public concern risks associated with eating these contaminated fish.

The draft assessment indicates that the following lakes and streams were either attaining all or some of their designated uses (other uses were assessed as "inconclusive"):

1. Carnero Lake, a 65 acre lake in the Carnero Watershed (1505000104), is attaining some uses. A few low dissolved oxygen and high pH may indicate nutrient enrichment issues that should be studied further.
2. Colter Creek, a 9 mile tributary to Nutrioso Creek in the Nutrioso Watershed (1505000101), is attaining all designated uses.
3. East Fork of the Little Colorado River, an 11 mile tributary to the Little Colorado River located in the South Fork Little Colorado River Watershed (1505000102), is attaining all designated uses.
4. Lee Valley Reservoir, a 35 acre reservoir located in the South Fork Little Colorado River Watershed (1505000102), is assessed as attaining some uses. Occasional elevated nitrogen and low dissolved oxygen may indicate nutrient enrichment issues that should be studied further.
5. West Fork of the Little Colorado River, and 11 mile tributary to the Little Colorado River in the South Fork Little Colorado River Sub-watershed (1505000102), is attaining its uses.(A portion of this tributary must be given a higher level of protection as it is classified as a Unique Water or Arizona Outstanding Water, as discussed in Section 2 and mapped in Figure 2-5).

Water pollution from suspended sediment and turbidity is a resource concern whenever accelerated soil erosion contributes excessive sediment to perennial waters that support aquatic fauna. Conservation practices used to address this resource concern are generally those that improve vegetative cover and reduce upland and stream bank erosion. Practices may include critical area planting, filter strips, heavy use area protection, prescribed grazing, range planting, sediment basins, stream bank protection, upland wildlife habitat management, and windbreak establishment.

Water Quantity

According to the Arizona Department of Water Resources (ADWR Water Atlas, 2007), surface water is an important supply in some areas, but is geographically limited. The Little Colorado River, the main drainage in the area, flows perennially 59 miles from its headwaters to Lyman Lake, north of Springerville. A 9-mile reach of the West Fork Little Colorado River is also perennial. Surface water at higher

elevations in the area is available for agricultural use (Tellman, 1997).

Water quantity is a resource concern whenever water supplies are inadequate to meet the needs for agricultural or domestic uses. Conservation practices applied to address this resource concern on irrigated cropland are generally those that improve the quantity and efficient distribution of water. Practices may include irrigation land leveling, irrigation system, irrigation water conveyance (ditch or pipeline), irrigation water management, and structure for water control.

Air Quality

There are no known air quality concerns in the watershed (Figure 3-2).

Environmental Sites

There are no environmental Superfund or WQARF sites located in the Little Colorado River Headwaters (Figure 3-3).

Plant Condition

Plant condition is a resource concern whenever plants do not manufacture sufficient food to continue the growth cycle or to reproduce. Plant condition is frequently a concern where proper grazing management is not being applied.

Conservation practices applied to address this resource concern are generally those that maintain or improve the health, photosynthetic capability, rooting and reproductive capability of vegetation. Practices may include brush management, critical area planting, deferred grazing, fencing, herbaceous wind barriers, nutrient management, pest management, prescribed grazing, prescribed burning, range planting, recreation area improvement, wildlife upland habitat management, and windbreak establishment.

Noxious and Invasive Plants

Noxious and invasive plants are a resource concern whenever these species cause unsuitable grazing conditions for livestock or wildlife and due to their potential to out-compete native species which are generally preferred for wildlife habitat value. Increases in noxious and invasive plants can result from poor grazing management, drought, and other causes.

Conservation practices applied to address this resource concern are generally those that control the establishment or reduce the population of noxious and invasive plant species. Practices may include brush management, deferred grazing, fencing, forest stand improvement, pest management, prescribed burning, prescribed grazing, and wildlife upland habitat management.

Bark Beetle, Drought and Wildfire

Over the past several years, Arizona has experienced increased piñon and ponderosa pine mortality due to outbreaks of several species of bark beetles. The lps beetle and western pine beetle are the two most common groups of bark beetles responsible for the outbreaks in Arizona (USFS, 2004 USFS, 2007). Low tree vigor caused by several years of drought and

excessively dense stands of trees have combined to allow beetle populations to reach outbreak levels. These insects are native to ponderosa pine forests and piñon-juniper woodlands of the Southwest, and normally only attack a small number of diseased or weakened trees. Healthy trees are usually not susceptible to these beetles.

Arizona has been in an extended drought since 1996. Drought, in this context, is defined as a sustained, natural reduction in precipitation that results in negative impacts to the environment and human activities. Most areas of the state continue to experience record low winter precipitation and snowpack, above-average temperatures, and low soil moisture. These conditions have led to high vegetation stress, high fire potential, below-normal streamflow, decreasing water supplies and deteriorating range and pasture conditions. (adapted from Arizona Drought Preparedness Annual Report, 2006)

The Climate Assessment for the Southwest (CLIMAS) website (www.ispe.arizona.edu/climas) and ADWR Statewide Drought Program website (www.azwater.gov/dwr/drought) provide information on Arizona's drought status. For the area of Arizona that encompasses the Little Colorado River Headwaters Watershed, the long-term drought status is severe, indicating a long-term reduction in precipitation, snowpack and reservoir levels, and increased vegetation stress affecting trees, shrubs and wildlife habitat.

Domestic Animal Concerns

Domestic animal concerns occur whenever the quantity and quality of food are not adequate to meet the nutritional requirements of animals, or adequate quantity and quality of water is not provided. This is frequently a concern on rangeland when changes in species composition resulting from poor grazing management and drought can reduce the availability of suitable forage.

Conservation practices applied to address this resource concern are generally those that maintain or improve the quantity, quality, and diversity of forage available for animals, reduce the concentration of animals at existing water sources, and insure adequate quantity and reliability of water for the management of domestic animals.

Practices may include brush management, deferred grazing, fencing, pest management, prescribed burning, prescribed grazing, pipelines, ponds, range planting, water spreading, wells, spring development, watering facility, and wildlife upland habitat management.

Species of Concern

There are 55 threatened and endangered species listed for Arizona (U. S. Fish and Wildlife Service website). In 1990 Arizona voters created the Heritage Fund, designating up to $10 million per year from lottery ticket sales for the conservation and protection of the state's wildlife and natural areas. The Heritage Fund allowed for the creation of the Heritage Data Management System (HDMS) which identifies elements of concern in Arizona and consolidates information

about their status and distribution throughout the state (Arizona Game & Fish website, 2006).

The Little Colorado River Headwaters Watershed contains eight species that are either listed, species of concern, or candidate species, under the U.S. Endangered Species Act (Table 3-2). Among other listed species, the watershed provides habitat for the Southwestern Willow Flycatcher (Empidonax traillii extimus) which is classified as being in imminent jeopardy of extinction.

Table 3-2: Little Colorado River Headwaters Watershed Species of Concern and Endangered Species Classifications and Observations(1)

Common Name	Species Name	USESA (2)	USFS (3)	STATE (4)
Apache Trout	Oncorhynchus apache	LT	S	WSC
Arizona Willow	Salix arizonica		S	HS
Bald Eagle	Haliaeetus leucocephalus	LT,PDL	S	WSC
Chiricahua Leopard Frog	Rana chiricahuensis	LT	S	WSC
Little Colorado Spinedace	Lepidomeda vittata	LT	S	WSC
Mexican Spotted Owl	Strix occidentalis lucida	LT	S	
Southwestern Willow Flycatcher	Empidonax traillii extimus	LE	S	WSC
Western Yellow-billed Cuckoo	Coccyzus americanus occidentalis	C	S	WSC

Data Sources: Arizona Land Information System (ALRIS), Natural Resource Conservation Service (NRCS).
Note: Status Definitions as Listed by Arizona Game and Fish Department, November 26, 2006
http://www.gf.state.az.us/w_c/edits/hdms_status_definitions.shtml

(1) Proposed for Listing: **(USEA) Federal U.S. Status**
ESA Endangered Species Act (1973 as amended)
US Department of Interior, Fish and Wildlife Service

(2) Listed:
LE Listed Endangered: imminent jeopardy of extinction.
LT Listed Threatened: imminent jeopardy of becoming Endangered.
PDL Proposed for Delisting

Candidate (Notice of Review: 1999):
C Candidate. Species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as Endangered or Threatened under ESA. However, proposed rules have not yet been issued because such actions are precluded at present by other listing activity.

(3) USFS US Forest Service (1999 Animals, 1999 Plants)
US Department of Agriculture, Forest Service, Region 3
S Sensitive: those taxa occurring on National Forests in Arizona which are considered sensitive by the Regional Forester.

(4) State Status

Arizona Department of Agriculture

HS Highly Safeguarded: no collection allowed.

WSC Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona (WSCA, in prep).

Resource Concern Summary

Local leaders have identified watershed health as a priority concern for the Little Colorado River Headwaters Watershed. This includes both the upland areas of the watershed and the riparian or stream course areas. The condition of the upland areas is integral to hydrologic function, such that when precipitation falls on the land its disposition is affected by the soil and vegetation, which in turn are affected by land uses, both historical and current. The amount of the precipitation which immediately runs off the land surface, and that which infiltrates into the soil to either be used for plant growth or to recharge ground water, is dependent on this critical interface.

The Little Colorado River Headwaters Watershed is a mosaic of federal, state, tribal and private lands where livestock grazing, agriculture and recreation are the primary land uses. The upper portion of the watershed is primarily managed by the U.S. Forest Service while the lower portion of the watershed a mixture of state and private lands. Livestock grazing and agriculture is the primary land use activity on the private land, while livestock grazing and recreation occur on the U.S. Forest Service lands in the high elevations. The watershed has several areas with significant development; the communities of Springerville and Eagar near the confluence of Nutrioso Creek and the Little Colorado River, and the mountain communities of Greer and Nutrioso.

Forest health and fire prevention are issues on the U.S. Forest Service lands especially near the communities of Greer and Nutrioso. Severe wildland fires can also have significant impacts on watershed health. The area is a highly popular summer destination for recreationists from the Phoenix and Tucson metropolitan areas. Camping, hiking, mountain biking, off road vehicles and fishing are common summer recreation activities. The area is also used for winter sports such as cross county skiing and ski mobiles.

There are several reserves in the watershed, managed by the Arizona Department of Game and Fish, which protect and conserve wildlife areas. The Wenima Wildlife Area approximately three miles northwest of the towns of Springerville and Eagar along the Little Colorado River. The 355-acre wildlife area includes 2.5 miles of sensitive stream and riparian habitat along the Little Colorado River, which currently provides habitat for the federally-threatened Little Colorado spinedace (Lepidomeda vittata). Other Special Status Species occurring on or near the Wenima Wildlife Area include the federally-threatened bald eagle (Haliaeetus leucocephalus), federally-listed candidate Western yellow-billed cuckoo (Coccyzus americanus occidentalis), and federally-proposed threatened mountain plover (Charadrius montanus). The Becker Lake Wildlife Area is located on the west side of Springerville and within its city limits. Becker Lake is stocked with rainbow trout. Brown trout (Salmo trutta) recruit

naturally from the Little Colorado River. The lake also contains Little Colorado suckers (Catostomus sp.), fathead minnows (Pimephales promelas) and stocked populations of Apache Trout (Oncorhynchus apache). The federally-threatened bald eagle has been observed nesting adjacent to Becker Lake.

Given its mild climate, available water, and access to winter sports the area is likely to see increased development in the near future with potential water quality and quantity impacts. Sections of the Springerville and Eagar communities have already seen over 50% growth between the 1990 and 2000 census. This trend is likely to continue in the near future.

The lower reaches of both Nutrioso Creek and the Upper Little Colorado River are listed by the Arizona Department of Environmental Quality as impaired for sediment. Both streams have reaches actively eroding streambanks and degrading riparian areas. Agriculture in the middle and lower portion of watershed introduces nutrients and organics into streams and groundwater. Inefficient irrigation systems, including unlined channels, are also an important water quantity problem in the watershed. Lyman Lake is also listed as impaired due to mercury in fish tissue.

There are a number of wildlife species of concern found with the watershed that can be impacted by poor watershed and riparian health. The entire Little Colorado River Headwaters Watershed is part of the U.S. Fish and Wildlife Service Little Colorado spinedace recovery plan. Other species of concern that are affected by watershed and riparian health include bald eagle, apache trout, Chiricahua Leopold Frog (Rana chiricahuensis), southwestern willow flycatcher (Empidonax traillii extimus), western yellow-billed cuckoo (Coccyzus americanus occidentalis) and Arizona willow (Salix arizonica).

Conservation Progress/Status

Conservation progress for the previous five years in the Little Colorado River Headwaters Watershed has focused on addressing the following primary resource concerns:

- ✓ Soil Erosion – Sheet and Rill Erosion
- ✓ Water Quality – Excessive Nutrients and Organics in Surface Water
- ✓ Water Quantity – Inefficient Water Use on Irrigated Land
- ✓ Plant Condition – Productivity, Health and Vigor
- ✓ Domestic Animals – Inadequate Quantities and Quality of Feed and Forage

Table 3-3 presents conservation accomplishments in this watershed during fiscal years (FY) 2003 through 2007, according to the NRCS Progress Reporting System.

Table 3-3: Little Colorado River Headwaters Watershed Conservation Treatment Applied

Little Colorado River Headwaters Watershed (15020001) Conservation Treatment Applied	FY03-07 TOTAL
Irrigation System, Sprinkler (442) (acres)	56
Irrigation Water Management (449) (acres)	162
Nutrient Management (590) (acres)	114
Pipeline (516) (feet)	20,486
Prescribed Grazing (528) (acres)	25,766
Upland Wildlife Habitat Management (645) (acres)	365

Section 4: Census, Social and Agricultural Data

This section discusses the human component of the watershed and the pressure on natural resources caused by humans and by population change.

Population Density, 1990

Census block statistics for 1990 were compiled from information prepared by Geo-Lytics (Geo-Lytics, 1998). These data were linked with census block data and used to create a density map (Figure 4-1) through a normalization process using a grid of 7 km squares. This process involves calculating density per census block and intersecting it with the grid, which is then used to calculate the number of people and thus density per grid square.

Table 4-1 shows the tabulated minimum, maximum and mean number of people per square mile in 1990 for each 10-digit watershed. In 1990, the mean population density for the entire watershed was 7 people per square mile. The South Fork Little Colorado River-Little Colorado River Headwaters Watershed had the highest population mean with 28 people per square mile, and it had a maximum population density of 1,220 people per square mile. Coyote Creek Watershed had the lowest density with a mean of only 0.1 people per square mile.

Population Density, 2000

The Census Block 2000 statistics data were downloaded from the Environmental Systems Research Institute (ESRI) website (ESRI Data Products, 2003)

A population density map and table (Figure 4-2 and Table 4-2) were created from these data. The mean population density in 2000 was 8 people per square mile. The South Fork Little Colorado River-Little Colorado River Headwaters Watershed had the highest mean population density with 28 people per square mile. The South Fork Little Colorado River-Little Colorado River Headwaters Watershed also had the highest maximum density of 1,227 people per square mile.

Population Density Change, 1990-2000

The 1990 and 2000 population density maps were used to create a population density change map. The resulting map and table (Figure 4-3 ant Table 4-3) show population increase or decrease over the ten year time frame. Overall, mean population density increased by 0.6 people per square mile during this ten-year time period. The Canero Creek-Little Colorado River Headwaters Watershed had the largest increase in mean population at 1.4 people per sq.mi.

Housing Density, 2000 and 2030

The Watershed Housing Density Map for the years 2000 and 2030 were created with data developed by David M. Theobald (Theobald, 2005). Theobald developed a nationwide housing density model that incorporates a thorough way to account for land-use change beyond the “urban fringe.”

Exurban regions are the “urban fringe”, or areas outside suburban areas, having population densities greater than 0.68 –

16.18 ha (1.68 – 40 acres) per unit. Theobald stresses that exurban areas are increasing at a much faster rate than urban sprawl, are consuming much more land, and are having a greater impact on ecological health, habitat fragmentation and other resource concerns.

Theobald estimates that the exurban density class has increased at a much faster rate than the urban/suburban density classes. Theobald's model forecasts that this trend will continue and may even accelerate by 2030. This indicates that development patterns are shifting more towards exurban, lower density, housing units, and are thereby consuming more land. He suggests that exurban development has more overall effect on natural resources because of the larger footprint and disturbance zone, a higher percent of impervious surfaces, and higher pollution because of more vehicle miles traveled to work and shopping.

Housing density for the year 2000 indicates that about 8% of the watershed is classified as "undeveloped private" areas, while 6% is classified as "rural" areas (Figure 4-4 and Table 4-4). For 2030, Figure 4-5 and Table 4-5 project that "undeveloped private" areas are reduced to about 7% of the watershed, and "rural" areas remain the same with 6% of the watershed.

Table 4-1: Little Colorado Headwaters Watershed 1990 Population Density (people/square mile)

10-digit Watershed Name	Area (sq. miles)	Population Density (people/sq.mi.)		
		Min	Max	Mean
Nutrioso Creek – 1502000101	172	0	1,000	14
South Fork Little Colorado River-Little Colorado River Headwaters – 1502000102	162	0	1,220	28
Coyote Creek – 1502000103	231	0	2	0.1
Canero Creek-Little Colorado River Headwaters – 1502000104	242	0	44	0.4
Total Little Colorado River Headwaters Watershed	807	0	1,220	7

Note: Adjacent watersheds may share a grid square. Data Sources: Census block statistics for 1990 were compiled from a CD prepared by Geo-Lytics (GeoLytics Inc., 1998). Census 1990. Census CD + Maps. Release 3.0.) New Mexico Resource Geographic Information (RGIS 2007).

Table 4-2: Little Colorado Headwaters Watershed 2000 Population Density (people/square mile)

10-digit Watershed Name	Area (sq. miles)	Population Density (people/sq.mi.)		
		Min	Max	Mean
Nutrioso Creek – 1502000101	172	0	1,092	15
South Fork Little Colorado River-Little Colorado River Headwaters – 1502000102	162	0	1,227	28
Coyote Creek – 1502000103	231	0	12	0.4
Canero Creek-Little Colorado River Headwaters – 1502000104	242	1	91	2
Total Little Colorado River Headwaters Watershed	807	0	1,227	8

Note: Adjacent watersheds may share a grid square. Data Sources: Census block statistics for 2000 were compiled from a CD prepared by Geo-Lytics (GeoLytics, Inc.1998. Census 2000. Census CD + Maps. Release 3.0. New Mexico Resource Geographic Information (RGIS 2007).

Table 4-3: Little Colorado Headwaters Watershed Population Density Change 1990 – 2000 (people/square mile)

10-digit Watershed Name	Area (sq. miles)	Population Density (people/sq.mi.)		
		Min	Max	Mean
Nutrioso Creek – 1502000101	172	-144	92	0.6
South Fork Little Colorado River-Little Colorado River Headwaters – 1502000102	162	-154	92	-0.1
Coyote Creek – 1502000103	231	-1.5	12	0.2
Canero Creek-Little Colorado River Headwaters – 1502000104	242	-10	91	1.4
Total Little Colorado River Headwaters Watershed	807	-154	91	0.6

Note: Adjacent watersheds may share a grid square. Data Sources: Derived from data from the GIS data used for tables 4-1 and 4-2.

Table 4-4: Little Colorado River Headwaters Watershed Housing Density 2000 (Percent of Watershed)

Housing Density	Nutrioso Creek 1502000101	South Fork Little Colorado River-Little Colorado River Headwaters 1502000102	Coyote Creek 1502000103	Canero Creek-Little Colorado River Headwaters 1502000104	Little Colorado River Headwaters Watershed	Little Colorado River Headwaters Watershed (sq. miles)
Undeveloped Private	2%	5%	11%	12%	8%	65
Rural	9%	2%	7%	5%	6%	45
Exurban	8%	6%	0.3%	0.2%	3%	25
Suburban	0.3%	0.6%	-	> 0.00%	0.1%	1
Urban	0.03%	0.06%	-	-	0.01%	0.1

Source: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. [online] URL: http://www.ecology and society.org/vol10/iss1/art32/

Table 4-5: Little Colorado River Headwaters Watershed Housing Density 2030 (Percent of Watershed)

Housing Density	Nutrioso Creek 1502000101	South Fork Little Colorado River-Little Colorado River Headwaters 1502000102	Coyote Creek 1502000103	Canero Creek-Little Colorado River Headwaters 1502000104	Little Colorado River Headwaters Watershed	Little Colorado River Headwaters Watershed (sq. miles)
Undeveloped Private	1%	3%	11%	12%	7 %	60
Rural	8%	3%	7%	5%	6%	47
Exurban	9%	6%	0.4%	0.4%	3%	25
Suburban	0.5%	2%	-	> 0.00%	0.5%	4
Urban	> 0.00%%	0.1%	-	-	0.04%	0.3

Source: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. [online] URL: http://www.ecology and society.org/vol10/iss1/art32/

Little Colorado River Headwaters Watershed Agricultural Statistics

Arizona is known as one of the most productive and efficient agricultural regions in the world, with beauty that also provides the food and fiber to sustain life in the desert. Arizona is also one of the most diverse agricultural producing states in the nation, producing more than 160 varieties of vegetables, livestock, field crops and nursery stock. The climate, natural resources, agribusiness infrastructure and farm heritage help make agriculture a $9.2 billion dollar industry employing more than 72,000 individuals.

According to the United States Department of Agriculture's, 2002

Census, there are more than 7,000 farms and ranches, seventy-eight percent of which are owned by individuals or families. The total farmland in Arizona is comprised of more than 26,000,000 acres with irrigated crops on 1,280,000 acres and pasture for animals on 23,680,000.

Agriculture in general on the Little Colorado River Headwaters Watershed is comprised of:

- A large number of livestock operations
- A large swine operation
- A large dairy operation
- A large greenhouse operation, which grows tomatoes, cucumbers and peppers
- A few small apiary (beekeeping) operations
- A number of farming operations which produce a variety of crops, including:
    - Wheat
    - Silage corn
    - Sweet corn
    - Pasture grass

Most farms in the Little Colorado River Headwaters Watershed (Arizona and New Mexico combined) are small or moderately sized. Eighty-five percent of all farms in the watershed are less than 1,000 acres in size, and 45% are less than 50 acres (Table 4-6 and Figure 4-6). Of the 143 farms that have pasture and rangeland, 82 have 100 or more acres (Table 4-7 and Table 4-7). Of the 73 farms that harvest crops, 92% are 49 acres or less in size (Table 4-8 and Figure 4-8).

The NASS (National Agricultural Statistics Service, United States Department of Agriculture) has farm data by zip code. We used the U.S. Census Bureau ZIP Census Tabulation Areas (ZCTA) to generate maps. A typical 5-digit ZCTA (there are 3-digit ZCTAs as well) is typically nearly identical to a 5-digit U.S. Postal Service ZIP code, but there are some distinctions. Unlike ZIP codes, ZCTA areas are spatially complete and they are easier to map. The Bureau created special `XX ZCTAs (ZCTAs with a valid 3-digit ZIP but with “XX” as last two characters of the code) which represent large unpopulated areas where it made no sense to assign a census block to an actual ZIP code. Similarly, HH ZCTAs represent large bodies of water within a 3-digit zip area. There is typically no population in either an XX or HH ZCTA.

Data is withheld by NASS for categories with one to four farms. This is to protect the identity of individual farmers. Farm counts for these zip codes are included in the "State Total" category. Some categories only contained stars instead of numbers. Each star was counted as one farm. But because each star could represent as many as 4 farms, each number on the tables are actually greater than or equal to the number listed. In some cases this results in percentages that add up to more or less that 100 percent.

Tables Include data from zip codes both contained within the watershed and zip codes crossing watershed boundaries.

Only two zip code areas contained no NASS data about agricultural practices. NASS assumes that no information for those areas means that there was no agricultural activity takes place within that zip code area.

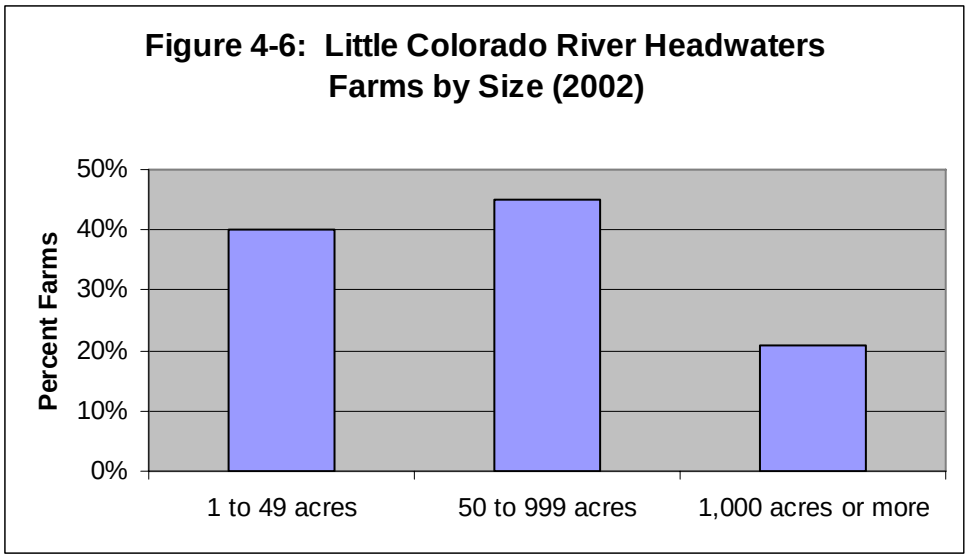


Table 4-6: Little Colorado River Headwaters Watershed Farms by Size

All farms	1 to 49 acres	50 to 999 acres	>1000 acres
218	40%	45%	21%

NASS defines a "farm" as an operation with at least $1000 in agricultural sales from agriculture. Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

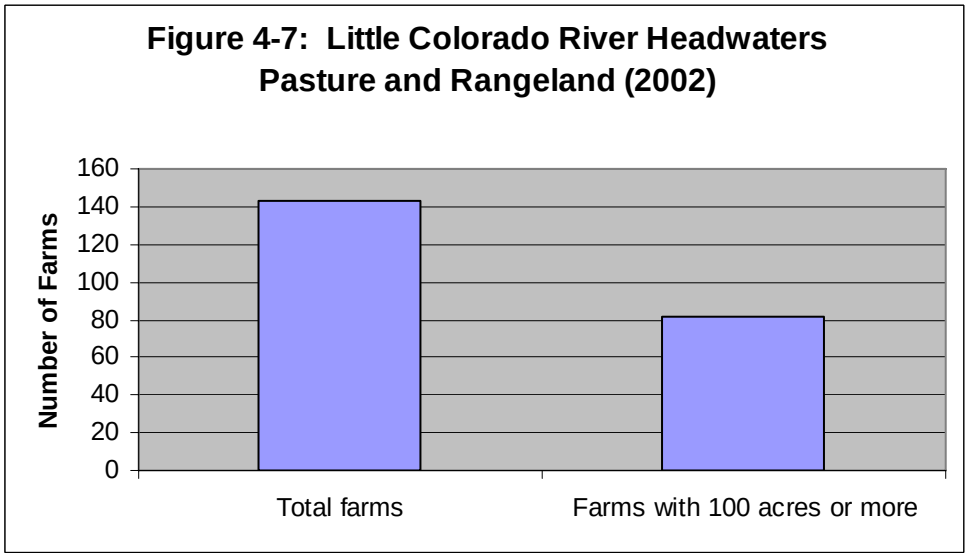


Table 4-7: Little Colorado River Headwaters Watershed Pasture and Rangeland (2002)

Category	Total farms	Farms 100 acres or more
Permanent pasture and rangeland	143	82

Grazing lands are the USDA Pastureland, as defined by NASS, includes cropland used only for pasture or grazing, woodland pastured, and other pastureland and rangeland.
Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

Figure 4-8 Little Colorado River Headwaters Cropland Harvested (2002)

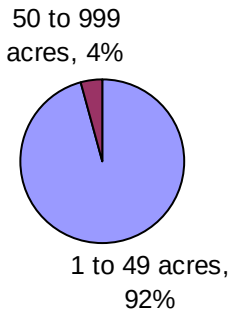


Table 4-8: Little Colorado River Headwaters Watershed Cropland Harvested

Total farms	1 to 49 acres	50 to 999 acres	>1000 acres
75	92%	4%	0%

According to the NASS, "harvested cropland" includes all land from which crops were harvested, including: cut hay; all land in orchards; citrus groves; and, nursery and greenhouse crops. Land from which two or more crops were harvested was counted only once even though there was more than one use of that land. Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture).

Section 5: Resource Assessment Tables

The following Resource Assessment Tables summarize current and desired future natural resource conditions for the Little Colorado River Watershed. The tables present information on benchmark and future conservation systems and practices, qualitative effects on primary resource concerns, and estimated costs for conservation implementation. Conservation District board members, NRCS conservationists, and other people familiar with conservation work in the watershed were consulted for estimating current and future natural resource conditions.

The tables show three levels of conservation treatment (Baseline, Progressive, Resource Management System) for each of the major land uses (range and urban) within the watershed. **Baseline** is defined as a low level of conservation adoption with landowners who are typically not participating in conservation programs. There are, however, a few practices that have been commonly adopted by all landowners in this watershed. **Progressive** is defined as an intermediate level of conservation adoption with landowners who are actively participating in conservation programs and have adopted several practices but not satisfied all of the Quality Criteria in the NRCS Field Office Technical Guide. **Resource Management System** (RMS) is defined as a complete system of conservation practices that addresses all of the Soil, Water, Air, Plant, and Animal (SWAPA) resource concerns typically seen for this land use in this watershed.

For each land use, the results of the assessment are presented in two parts. Part 1 (Assessment Information) summarizes the conservation practices at each treatment level and the quantities of practices for current benchmark conditions and projected future conditions. Part 1 also displays the four primary resource concerns, along with individual practice effects and an overall Systems Rating (ranging from a low of 1 to a high of 5) indicating the effectiveness of the conservation system used at each treatment level. Part 2 (Conservation Cost Table) summarizes the installation, management, and related costs by conservation practice and treatment level for the projected future conditions by federal and private share of the costs. Part 2 also displays the benchmark and future conservation conditions status bars.

Credit goes to NRCS in Oregon for development of the template for these Resource Assessment Tables.

NOTE: the numbers in the first column of each table represent NRCS conservation practice codes.

WATERSHED NAME & CODE	LITTLE COLORADO RIVER HEADWATERS - 15020001				LANDUSE ACRES			1,500
LANDUSE TYPE	CROP				TYPICAL UNIT SIZE ACRES			500
ASSESSMENT INFORMATION					CALCULATED PARTICIPATION			49%
	Benchmark Conditions	Future Conditions			RESOURCE CONCERNS			
Conservation Systems by Treatment Level	Total Units	Existing Unchanged Units	New Treatment Units	Total Units	Soil Condition – Organic Matter Depletion	Water Quantity – Inefficient Water Use on Irrigated Land	Water Quality – Excessive Suspended Sediment and Turbidity in Surface Water	Plant Condition – Productivity, Health and Vigor
Baseline				**System Rating ->**	**1**	**5**	**3**	**1**
Irrigation Land Leveling (ac.) 464	319	159	0	159	1	5	3	1
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	2,550	1,275	0	1,275	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	1,275	638	0	638	1	5	3	1
Total Acreage at Baseline	**1,275**	**638**	**0**	**638**				
Progressive				**System Rating ->**	**3**	**5**	**4**	**4**
Conservation Crop Rotation (ac.) 328	38	28	159	188	5	1	3	5
Irrigation Land Leveling (ac.) 464	38	108	80	188	1	5	3	1
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	300	863	638	1,500	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	150	431	319	750	1	5	3	1
Irrigation Water Management (ac.) 449	38	28	159	188	1	5	5	3
Total Acreage at Progressive Level	**75**	**56**	**319**	**375**				
RMS				**System Rating ->**	**4**	**5**	**5**	**5**
Conservation Crop Rotation (ac.) 328	150	159	328	488	5	1	3	5
Irrigation Land Leveling (ac.) 464	150	239	248	488	1	5	3	1
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	1,500	2,213	2,663	4,875	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	600	956	994	1,950	1	5	3	1
Irrigation Water Management (ac.) 449	150	159	328	488	1	5	5	3
Nutrient Management (ac.) 590	150	150	338	488	1	1	5	5
Pest Management (ac.) 595	150	150	338	488	1	1	3	3
Residue Management, Seasonal (ac.) 344	150	150	338	488	5	1	3	5
Total Acreage at RMS Level	**150**	**150**	**338**	**488**	**NOTE: Effectiveness ranges from 1 (low) to 5 (high)**			

WATERSHED NAME & CODE	LITTLE COLORADO RIVER HEADWATERS - 15020001				LANDUSE ACRES	1,500	
LANDUSE TYPE	CROP				TYPICAL UNIT SIZE ACRES	500	
CONSERVATION COST TABLE					CALCULATED PARTICIPATION	49%	

	FUTURE	FEDERAL				PRIVATE		
Conservation Systems by Treatment Level	New Treatment Units	Installation Cost 50%	Management Cost - 3 yrs 100%	Technical Assistance 20%	Total Present Value Cost	Installation Cost 50%	Annual O & M + Mgt Costs 100%	Total Present Value Cost
Progressive								
Conservation Crop Rotation (ac.) 328	159	$0	$4,781	$956	$5,216	$0	$1,594	$2,453
Irrigation Land Leveling (ac.) 464	80	$39,844	$0	$7,969	$47,813	$39,844	$2,391	$49,914
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	638	$2,550	$0	$510	$3,060	$2,550	$102	$2,980
Irrigation Water Conveyance, Pipeline (ft.) 430	319	$1,594	$0	$319	$1,913	$1,594	$64	$1,862
Irrigation Water Management (ac.) 449	159	$0	$4,781	$956	$5,216	$0	$1,594	$2,453
Subtotal	**319**	**$43,988**	**$9,563**	**$10,710**	**$63,218**	**$43,988**	**$5,744**	**$59,663**
RMS								
Conservation Crop Rotation (ac.) 328	328	$0	$9,844	$1,969	$10,740	$0	$3,281	$5,051
Irrigation Land Leveling (ac.) 464	248	$124,219	$0	$24,844	$149,063	$124,219	$7,453	$155,614
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	2,663	$10,650	$0	$2,130	$12,780	$10,650	$426	$12,444
Irrigation Water Conveyance, Pipeline (ft.) 430	994	$4,969	$0	$994	$5,963	$4,969	$199	$5,806
Irrigation Water Management (ac.) 449	328	$0	$9,844	$1,969	$10,740	$0	$3,281	$5,051
Nutrient Management (ac.) 590	338	$0	$10,125	$2,025	$11,046	$0	$3,375	$5,195
Pest Management (ac.) 595	338	$0	$10,125	$2,025	$11,046	$0	$3,375	$5,195
Residue Management, Seasonal (ac.) 344	338	$0	$6,075	$1,215	$6,628	$0	$2,025	$3,117
Subtotal	**338**	**$139,838**	**$46,013**	**$37,170**	**$218,005**	**$139,838**	**$23,415**	**$197,474**
Grand Total	**656**	**$183,825**	**$55,575**	**$47,880**	**$281,223**	**$183,825**	**$29,159**	**$257,137**

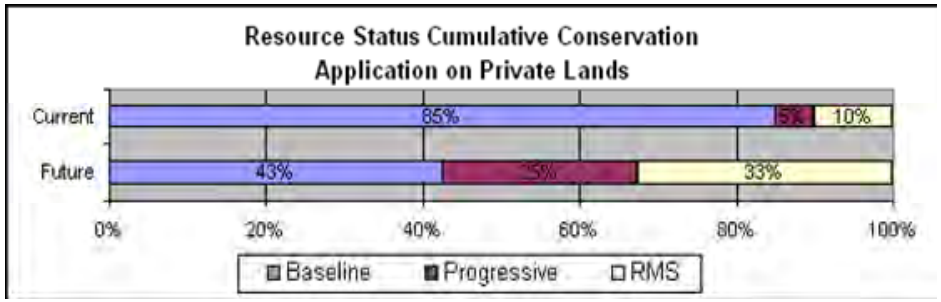


Chart Refers To	
Landuse Type	CROP
Calculated Participation Rate	49%

Average PV Costs per Ac		
System	Federal	Private
Prog	$198.33	$187.18
RMS	$645.94	$585.11

WATERSHED NAME & CODE	LITTLE COLORADO RIVER HEADWATERS - 15020001				LANDUSE ACRES		150,000	
LANDUSE TYPE	FOREST				TYPICAL UNIT SIZE ACRES		40,000	
ASSESSMENT INFORMATION					CALCULATED PARTICIPATION		10%	
	Benchmark Conditions	Future Conditions			RESOURCE CONCERNS			
Conservation Systems by Treatment Level	Total Units	Existing Unchanged Units	New Treatment Units	Total Units	Soil Erosion – Sheet and Rill	Water Quality – Excessive Suspended Sediment and Turbidity in Surface Water	Plant Condition – Productivity, Health and Vigor	Domestic Animals – Inadequate Quantities and Quality of Feed and Forage
Baseline				**System Rating ->**	**2**	**2**	**2**	**4**
Fence (ft.) 382	1,875	1,688	0	1,688	3	3	3	5
Pipeline (ft.) 516	1,875	1,688	0	1,688	3	3	3	5
Total Acreage at Baseline	**15,000**	**13,500**	**0**	**13,500**				
Progressive				**System Rating ->**	**4**	**4**	**4**	**5**
Fence (ft.) 382	84,375	76,125	750	76,875	3	3	3	5
Pipeline (ft.) 516	84,375	76,125	750	76,875	3	3	3	5
Prescribed Grazing (ac.) 528	67,500	60,750	750	61,500	5	5	5	5
Total Acreage at Progressive Level	**135,000**	**121,500**	**1,500**	**123,000**				
RMS				**System Rating ->**	**5**	**5**	**5**	**5**
Fence (ft.) 382	0	8,438	8,438	16,875	3	3	3	5
Pipeline (ft.) 516	0	8,438	8,438	16,875	3	3	3	5
Prescribed Grazing (ac.) 528	0	6,750	6,750	13,500	5	5	5	5
Upland Wildlife Habitat Management (ac.) 645	0	0	1,350	1,350	5	5	5	3
Total Acreage at RMS Level	**0**	**0**	**13,500**	**13,500**	**NOTE: Effectivness ranges from 1 (low) to 5 (high)**			

WATERSHED NAME & CODE	LITTLE COLORADO RIVER HEADWATERS - 15020001				LANDUSE ACRES			150,000
LANDUSE TYPE	FOREST				TYPICAL UNIT SIZE ACRES			40,000
CONSERVATION COST TABLE					CALCULATED PARTICIPATION			10%
	FUTURE	FEDERAL				PRIVATE		
Conservation Systems by Treatment Level	New Treatment Units	Installation Cost 50%	Management Cost - 3 yrs 100%	Technical Assistance 20%	Total Present Value Cost	Installation Cost 50%	Annual O & M + Mgt Costs 100%	Total Present Value Cost
Progressive								
Fence (ft.) 382	750	$1,125	$0	$225	$1,350	$1,125	$45	$1,315
Pipeline (ft.) 516	750	$3,000	$0	$600	$3,600	$3,000	$120	$3,505
Prescribed Grazing (ac.) 528	750	$563	$0	$113	$675	$563	$0	$563
Subtotal	**1,500**	**$4,688**	**$0**	**$938**	**$5,625**	**$4,688**	**$165**	**$5,383**
RMS								
Fence (ft.) 382	8,438	$12,656	$0	$2,531	$15,188	$12,656	$506	$14,789
Pipeline (ft.) 516	8,438	$33,750	$0	$6,750	$40,500	$33,750	$1,350	$39,437
Prescribed Grazing (ac.) 528	6,750	$5,063	$0	$1,013	$6,075	$5,063	$0	$5,063
Upland Wildlife Habitat Management (ac.) 645	1,350	$0	$5,265	$1,053	$5,744	$0	$1,755	$2,702
Subtotal	**13,500**	**$51,469**	**$5,265**	**$11,347**	**$67,507**	**$51,469**	**$3,611**	**$61,990**
Grand Total	**15,000**	**$56,156**	**$5,265**	**$12,284**	**$73,132**	**$56,156**	**$3,776**	**$67,372**

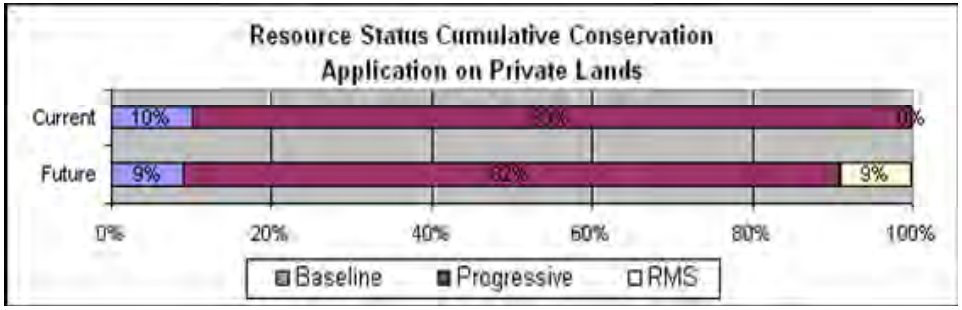


Chart Refers To	
Landuse Type	FOREST
Calculated Participation Rate	10%

Average PV Costs per Ac		
System	Federal	Private
Prog	$3.75	$3.59
RMS	$5.00	$4.59

WATERSHED NAME & CODE	LITTLE COLORADO RIVER HEADWATERS - 15020001				LANDUSE ACRES			350,000
LANDUSE TYPE	RANGE				TYPICAL UNIT SIZE ACRES			50,000
ASSESSMENT INFORMATION					CALCULATED PARTICIPATION			42%
	Benchmark Conditions	Future Conditions			RESOURCE CONCERNS			
Conservation Systems by Treatment Level	Total Units	Existing Unchanged Units	New Treatment Units	Total Units	Soil Erosion – Sheet and Rill	Water Quality – Excessive Suspended Sediment and Turbidity in Surface Water	Plant Condition – Productivity, Health and Vigor	Domestic Animals – Inadequate Quantities and Quality of Feed and Forage
Baseline				**System Rating ->**	**2**	**2**	**2**	**4**
Fence (ft.) 382	17,500	8,750	0	8,750	3	3	3	5
Pipeline (ft.) 516	17,500	8,750	0	8,750	3	3	3	5
Total Acreage at Baseline	**175,000**	**87,500**	**0**	**87,500**				
Progressive				**System Rating ->**	**4**	**4**	**4**	**5**
Fence (ft.) 382	43,750	37,188	17,500	54,688	3	3	3	5
Pipeline (ft.) 516	43,750	37,188	17,500	54,688	3	3	3	5
Prescribed Grazing (ac.) 528	43,750	32,813	21,875	54,688	5	5	5	5
Total Acreage at Progressive Level	**87,500**	**65,625**	**43,750**	**109,375**				
RMS				**System Rating ->**	**5**	**5**	**5**	**5**
Fence (ft.) 382	87,500	102,813	50,313	153,125	3	3	3	5
Pipeline (ft.) 516	87,500	102,813	50,313	153,125	3	3	3	5
Prescribed Grazing (ac.) 528	87,500	98,438	54,688	153,125	5	5	5	5
Upland Wildlife Habitat Management (ac.) 645	8,750	8,750	6,563	15,313	5	5	5	3
Total Acreage at RMS Level	**87,500**	**87,500**	**65,625**	**153,125**	**NOTE: Effectivness ranges from 1 (low) to 5 (high)**			

WATERSHED NAME & CODE	LITTLE COLORADO RIVER HEADWATERS - 15020001				LANDUSE ACRES	350,000	
LANDUSE TYPE	RANGE				TYPICAL UNIT SIZE ACRES	50,000	
CONSERVATION COST TABLE					CALCULATED PARTICIPATION	42%	
	FUTURE	FEDERAL				PRIVATE		
Conservation Systems by Treatment Level	New Treatment Units	Installation Cost 50%	Management Cost - 3 yrs 100%	Technical Assistance 20%	Total Present Value Cost	Installation Cost 50%	Annual O & M + Mgt Costs 100%	Total Present Value Cost
Progressive								
Fence (ft.) 382	17,500	$26,250	$0	$5,250	$31,500	$26,250	$1,050	$30,673
Pipeline (ft.) 516	17,500	$70,000	$0	$14,000	$84,000	$70,000	$2,800	$81,795
Prescribed Grazing (ac.) 528	21,875	$16,406	$0	$3,281	$19,688	$16,406	$0	$16,406
Subtotal	**43,750**	**$112,656**	**$0**	**$22,531**	**$135,188**	**$112,656**	**$3,850**	**$128,874**
RMS								
Fence (ft.) 382	50,313	$75,469	$0	$15,094	$90,563	$75,469	$3,019	$88,185
Pipeline (ft.) 516	50,313	$201,250	$0	$40,250	$241,500	$201,250	$8,050	$235,160
Prescribed Grazing (ac.) 528	54,688	$41,016	$0	$8,203	$49,219	$41,016	$0	$41,016
Upland Wildlife Habitat Management (ac.) 645	6,563	$0	$25,594	$5,119	$27,923	$0	$8,531	$13,133
Subtotal	**65,625**	**$317,734**	**$25,594**	**$68,666**	**$409,204**	**$317,734**	**$19,600**	**$377,493**
Grand Total	**109,375**	**$430,391**	**$25,594**	**$91,197**	**$544,392**	**$430,391**	**$23,450**	**$506,366**

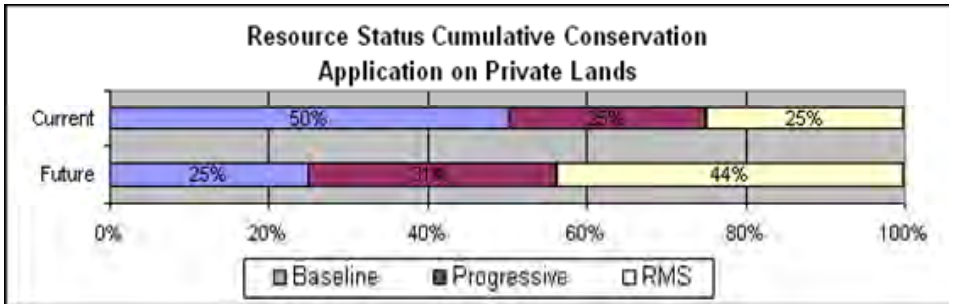


Chart Refers To	
Landuse Type	RANGE
Calculated Participation Rate	42%

Average PV Costs per Ac		
System	Federal	Private
Prog	$3.09	$2.95
RMS	$6.24	$5.75

WATERSHED NAME & CODE	LITTLE COLORADO RIVER HEADWATERS - 15020001				LANDUSE ACRES		4,000	
LANDUSE TYPE	URBAN				TYPICAL UNIT SIZE ACRES		10	
ASSESSMENT INFORMATION					CALCULATED PARTICIPATION		10%	
	Benchmark Conditions	Future Conditions			RESOURCE CONCERNS			
Conservation Systems by Treatment Level	Total Units	Existing Unchanged Units	New Treatment Units	Total Units	Soil Condition – Organic Matter Depletion	Water Quantity – Inefficient Water Use on Irrigated Land	Water Quality – Excessive Suspended Sediment and Turbidity in Surface Water	Plant Condition – Productivity, Health and Vigor
Baseline				**System Rating ->**	**0**	**0**	**0**	**0**
No Conservation Practices being applied at this level	0	0	0	0	0	0	0	0
Total Acreage at Baseline	**3,600**	**3,240**	**0**	**3,240**				
Progressive				**System Rating ->**	**0**	**4**	**3**	**0**
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	10,000	9,000	9,000	18,000	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	10,000	9,000	9,000	18,000	1	5	4	1
Total Acreage at Progressive Level	**400**	**360**	**360**	**720**				
RMS				**System Rating ->**	**1**	**5**	**4**	**3**
Irrigation Land Leveling (ac.) 464	0	0	40	40	1	5	3	1
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	0	1,000	1,000	2,000	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	0	1,000	1,000	2,000	1	5	4	1
Irrigation Water Management (ac.) 449	0	0	40	40	1	5	3	3
Nutrient Management (ac.) 590	0	0	40	40	1	1	3	3
Pest Management (ac.) 595	0	0	40	40	1	1	3	3
Total Acreage at RMS Level	**0**	**0**	**40**	**40**	**NOTE: Effectiveness ranges from 1 (low) to 5 (high)**			

WATERSHED NAME & CODE	LITTLE COLORADO RIVER HEADWATERS - 15020001				LANDUSE ACRES		4,000
LANDUSE TYPE	URBAN				TYPICAL UNIT SIZE ACRES		10
CONSERVATION COST TABLE					CALCULATED PARTICIPATION		10%

	FUTURE	FEDERAL				PRIVATE		
Conservation Systems by Treatment Level	New Treatment Units	Installation Cost 50%	Management Cost - 3 yrs 100%	Technical Assistance 20%	Total Present Value Cost	Installation Cost 50%	Annual O & M + Mgt Costs 100%	Total Present Value Cost
Progressive								
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	9,000	$36,000	$0	$7,200	$43,200	$36,000	$1,440	$42,066
Irrigation Water Conveyance, Pipeline (ft.) 430	9,000	$45,000	$0	$9,000	$54,000	$45,000	$1,800	$52,582
Subtotal	**360**	**$81,000**	**$0**	**$16,200**	**$97,200**	**$81,000**	**$3,240**	**$94,648**
RMS								
Irrigation Land Leveling (ac.) 464	40	$20,000	$0	$4,000	$24,000	$20,000	$1,200	$25,055
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	1,000	$4,000	$0	$800	$4,800	$4,000	$160	$4,674
Irrigation Water Conveyance, Pipeline (ft.) 430	1,000	$5,000	$0	$1,000	$6,000	$5,000	$200	$5,842
Irrigation Water Management (ac.) 449	40	$0	$1,200	$240	$1,309	$0	$400	$616
Nutrient Management (ac.) 590	40	$0	$1,200	$240	$1,309	$0	$400	$616
Pest Management (ac.) 595	40	$0	$1,200	$240	$1,309	$0	$400	$616
Subtotal	**40**	**$29,000**	**$3,600**	**$6,520**	**$38,728**	**$29,000**	**$2,760**	**$37,419**
Grand Total	**400**	**$110,000**	**$3,600**	**$22,720**	**$135,928**	**$110,000**	**$6,000**	**$132,067**

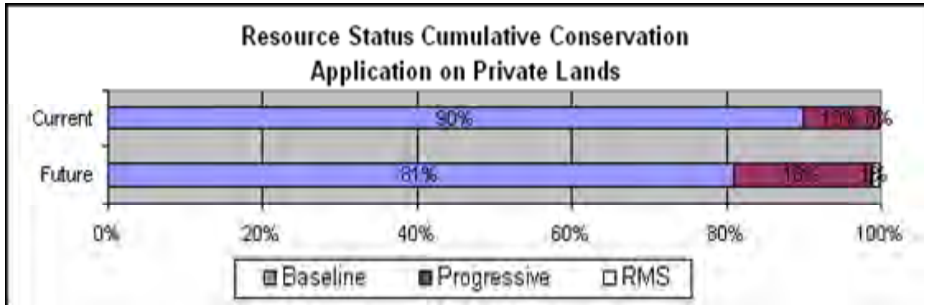


Chart Refers To	
Landuse Type	URBAN
Calculated Participation Rate	10%

Average PV Costs per Ac		
System	Federal	Private
Prog	$270.00	$262.91
RMS	$968.19	$935.46

Section 6: References

Arizona Association of Conservation Districts (http://www.aaocd.org/)

Arizona Dept. of Agriculture (http://www.azda.gov/)

Arizona Department of Environmental Quality. 2007. Antidegradation Implementation Procedures, Draft.

Arizona Department of Environmental Quality. 2007. Water Quality Improvement Manual, http://www.azdeq.gov/environ/water/watershed/download/manual.pdf.

Arizona Dept. of Environmental Quality, Water Quality Monitoring & Assessment (http://azdeq.gov/environ/water/assessment/assess.html)

Arizona Department of Environmental Quality (ADEQ). Draft 2006 Status of Ambient Surface Water Quality in Arizona – Arizona's Integrated 305(b) Assessment and 303(d) Listing Report. Arizona Department of Environmental Quality, Phoenix, Arizona.

Arizona Department of Environmental Quality, Air Quality Division, http://www.azdeq.gov/environ/air/plan/notmeet.html#phoenix

Arizona Department of Water Resources, Arizona Drought Preparedness Plan, Background & Impact Assessment Section, Governor's Drought Task Force, Governor Janet Napolitano, October 8, 2004. http://www.azwater.gov/dwr/content/find_by_program/GDTF/conclusion/Background_Section_100804FINAL.pdf

Arizona Department of Water Resources (ADWR), 2007. Arizona Water Atlas, Vol. 2, web published at http://www.azwater.gov/dwr/

Arizona Game & Fish Dept. Heritage Database http://www.azgfd.gov/w_c/edits/species_concern.shtml)

Arizona Game & Fish website, 2006, http://www.azgfd.gov/w_c/heritage_program.shtml.

Arizona State Land Department, Arizona Land Resource Information System (ALRIS), GIS data layer "Geology," February 7, 2003. http://www.land.state.az.us/alris/index.html.

Arizona State Land Department, Arizona Land Resource Information System (ALRIS), GIS data layer "Lakes," February 7, 2003, http://www.land.state.az.us/alris/index.html.

Arizona State Land Department, Arizona Land Resource Information System (ALRIS), GIS data layer “mines”, February 7, 2002 http://www.land.state.az.us/alris/index.html

Arizona State Land Department, Arizona Land Resource Information System (ALRIS), GIS data layer “natveg”, June 12, 2003 http://www.land.state.az.us/alris/index.html

Arizona State Land Department, Arizona Land Resource Information System (ALRIS), *GIS data layer “ownership”, February 7, 2002* *http://www.land.state.az.us/alris/index.html*

Arizona State Land Department, Arizona Land Resource Information System (ALRIS), GIS data layer “Streams”, Arizona, October, 10, 2002 http://www.land.state.az.us/alris/index.html.

Brown, David E., and Charles H. Lowe, Biotic Communities of the Southwest 1:1,000,000 scale, August 1980.

Bureau of Land Management Arizona Website (http://www.blm.gov/az/st/en.html)

Chronic, Halka. 1983. Roadside Geology of Arizona. Mountain Press Publishing Company, Montana.

Climate Assessment for the Southwest (CLIMAS) website www.ispe.arizona.edu/climas, information on Arizona's drought status.

Environmental Protection Agency (EPA) website http://epa.gov/air/airtrends/aqtrnd95/pm10.html

ESRI Data Products, http://arcdata.esri.com/data/tiger2000/tiger_download.cfm Census 2000. October 17, 2003.

Feth, J.H., and N.D. White, J.D. Hem, 1954. Preliminary Report of Investigations of Springs in the Mogollon Rim Region, Arizona. U.S. Geological Survey Open-File Report, Tucson, Arizona.

GeoLytics, Inc. 1998. Census 1990. Census CD + Maps. Release 3.0.

Gordon, N.D., T.A. McMahon, and B.L. Finlayson. 1992. Stream Hydrology; Chapter 4- Getting to know your stream. John Wiley & Sons, New York, NY

Kamilli, R.J. and S.M. Richard, eds. Geologic Highway map of Arizona: Tucson, Arizona Geological Society and Arizona Geological Survey. 1998. 1 sheet containing text and figures, scale 1:1,000,000.

Lowry, J. H, Jr., R. D. Ramsey, K. Boykin, D. Bradford, P. Comer, S. Falzarano, W. Kepner, J. Kirby, L. Langs, J. Prior-Magee, G. Manis, L. O'Brien, T. Sajwaj, K. A. Thomas, W. Rieth, S. Schrader, D. Schrupp, K. Schulz, B. Thompson, C. Velasquez, C. Wallace, E. Waller and B. Wolk. 2005. /Southwest Regional Gap Analysis Project: Final Report on Land Cover Mapping Methods/, RS/GIS Laboratory, Utah State University, Logan, Utah.

National Agricultural Statistics Service (http://www.nass.usda.gov/)

Natural Resources Conservation Service (NRCS), 2007, Table generated by NRCS Phoenix Office.

Natural Resources Conservation Service (NRCS) Fact Sheet, Little Colorado River Headwaters.

Natural Resources Conservation Service (NRCS) Website 2006, Technical Guide – New Mexico http://www.nm.nrcs.usda.gov/technical/fotg/transmittals/fotg-1.doc

Natural Resources Conservation Service Arizona Website (http://www.az.nrcs.usda.gov/)

Natural Resources Conservation Service Arizona GIS Webpage (http://www.az.nrcs.usda.gov/technical/gis/index.html)

Natural Resources Conservation Service Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/)

Natural Resources Conservation Service Water & Climate Center (http://www.wcc.nrcs.usda.gov/)

Parker, John T.C., and M. E. Flynn. 2000. Investigation of the Geology and Hydrology of the Mogollon Highlands of Central Arizona: A Project of the Arizona rural Watershed Initiative. In cooperation with the Arizona Department of Water Resources. USGS Fact Sheet 159-00.

Southern Arizona Data Services Program, GIS data layer "Arizona Gap Analysis Project Vegetation Map", University of Arizona, 2004, http://sdrsnet.srnr.arizona.edu/index.php, originated by Arizona Game & Fish Department, Habitat Branch, 1993, this dataset was digitized from the August 1980 David E. Brown & Charles H. Lowe 1:1,000,000 scale, 'Biotic Communities of the Southwest'.

Southwest Regional GAP Project (http://fws-nmcfwru.nmsu.edu/swregap/

Tellman, Barbara, Richard Yard and Mary G. Wallace, 1997, "Arizona's Changing Rivers: How People Have Affected the Rivers," Water Resources Research Center, University of Arizona.

Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. [online] URL: http://www.ecology and society.org/vol10/iss1/art32/.

United States Department of Agriculture, 2004, Arizona Bark Beetle Epidemics Fact Sheet and Information Bulletin, Southwestern Region, USDA Forest Service http://www.fs.fed.us/r3/prescott/forest-health/index.shtml.

United States Department of Agriculture, GIS Data Analysis, obtained from U.S. Forest Service, Southwestern Region, Forest Health office, Feb. 26, 2007

United States Environmental Protection Agency, Surf Your Watershed (http://www.epa.gov/surf/)

United States Environmental Protection Agency, Air Quality Trends, http://epa.gov/air/aritrends/aqtrnd95/pm10.html.

United States Fish & Wildlife Service, Threatened and Endangered Species Listed for Arizona, http://ecos.fws.gov.

United States Fish & Wildlife Service Arizona Ecological Services (http://www.fws.gov/southwest/es/arizona/)

United States Forest Service, Forest Service, Fact Sheet "Arizona Bark Beetle Epidemics," produced by Forest Health Staff, Southwestern Region, USDA Forest Service, January 2004, *http://www.fs.fed.us/r3/prescott/forest-health/index.shtml*

United States Forest Service (USFS), Terrestrial Ecosystem Surveys. Surveys are available for National Forest Lands within the watershed.

United States Forest Service Southwestern Region (http://www.fs.fed.us/r3/)

United States Geological Survey, NLCD Land Cover Class Definitions, http://landcover.usgs.gov/classes.php

United States Geological Survey, April 8, 2003, derived from DEM, http://edc.usgs.gov/geodata/

United States Geological Survey website, National Water Information System http://waterdata.usgs.gov/nwis/

Western Regional Climate Center (WRCC), Temperature data. July 15, 2004. http://www.wrcc.dri.edu/summary/climsmaz.html.

GLOSSARY

Drainage Basin	A region or area bounded by a topographic divide and occupied by a drainage system, also known as a watershed.
Drought	There is no universally accepted quantitative definition of drought. Generally, the term is applied to periods of less than average precipitation over a certain period of time; nature's failure to fulfill the water wants and needs of man.
Flood	A flood is an overflow or inundation that comes from a river or other body of water and causes or threatens damage. It can be any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream. It is also a relatively high flow as measured by either gage height or discharge quantity.
Ground Water	The supply of fresh and saline water found beneath the Earth's surface which is often used for supplying wells and springs. Because ground water is a major source of drinking water, there is a growing concern over areas where leaching agricultural or industrial pollutants are contaminating ground water.
Soil Moisture Regimes	**Aridic** is a soil moisture regime that has no water available for plants for more than half the cumulative time that the soil temperature at 50 cm (20 in.) below the surface is >5°C (41° F.), and has no period as long as 90 consecutive days when there is water for plants while the soil temperature at 50 cm (20 in.) is continuously >8°C (46°F.). **Udic** is a soil moisture regime that is neither dry for as long as 90 cumulative days nor for as long as 60 consecutive days in the 90 days following the summer solstice at periods when the soil temperature at 50 cm (20 in.) below the surface is above 5°C (41° F.). **Ustic** is a soil moisture regime that is intermediate between the aridic and udic regimes and common in temperate subhumid or semiarid regions, or in tropical and subtropical regions with a monsoon climate. A limited amount of water is available for plants but occurs at times when the soil temperature is optimum for plant growth.
Soil Orders	A soil order is a group of soils in the broadest category. In the current USDA classification scheme there are 12 orders, differentiated by the presence or absence of diagnostic horizons.
Soil Temperature Regimes	**Hyperthermic** is a soil temperature regime that has mean annual soil temperatures of 22°C (72°F.) or more and >5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface. **Thermic** is a soil temperature regime that has mean annual soil temperatures of 15°C (59°F.) or more but <22°C (72°F.), and >5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface.

	Mesic A soil temperature regime that has mean annual soil temperatures of 8°C (46°F.) or more but <15°C (59°F.), and >5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface.
Surface Water	Water on the earth's surface. Lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, wetlands, marshes, inlets, canals, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, navigable or non-navigable, and including the beds and banks of all watercourses and bodies of surface water, that are wholly or partially inside or bordering the state or subject to the jurisdiction of the state; except that waters in treatment systems which are authorized by state or federal law, regulation, or permit, and which are created for the purpose of waste treatment.
Watershed	The area of land that contributes surface run-off to a given point in a drainage system and delineated by topographic divides.

Acknowledgements

The following University of Arizona staff and students contributed to the production of this report.

Terry Sprouse
Erin Westfall
Lainie Levick
Cassie Holgren
Ariel Fisher
Melisa Kennedy

NRCS Field Office, Area Office and State Office staff contributed to the development of this assessment.