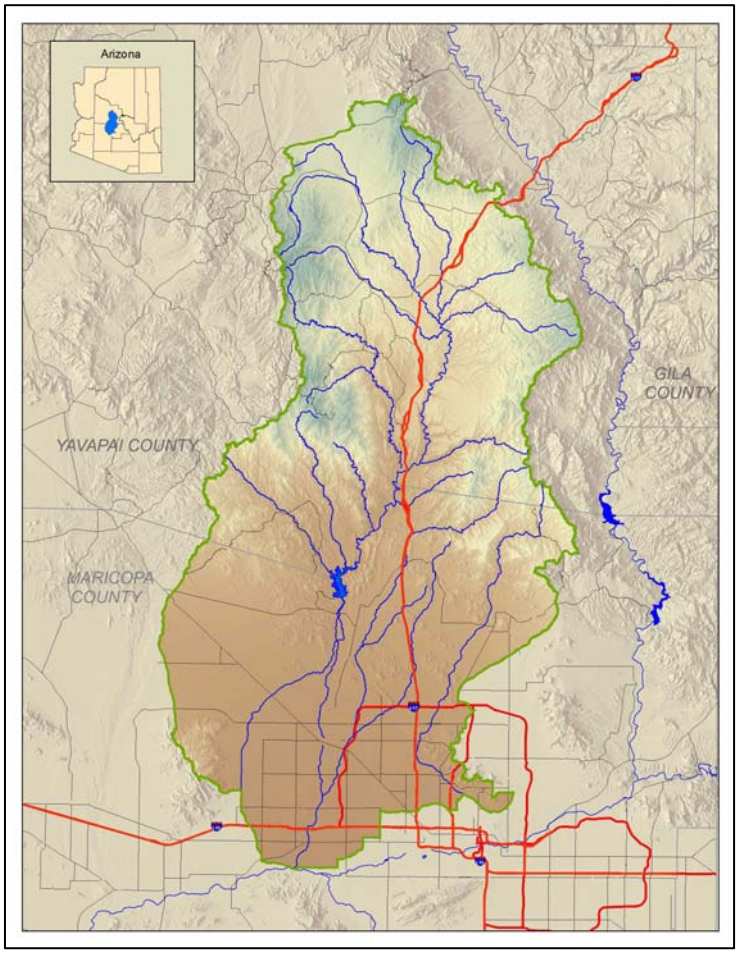
# Agua Fria River Watershed – Arizona
## Rapid Watershed Assessment
**June 2007**

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**Agua Fria River – 15070102**
**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 and for use as a building block for future planning. RWAs look at physical and socioeconomic characteristics and trends, as well as current and future conservation work.

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 technology, assessing current levels of resource management, identifying priority resource concerns, and making estimates of future conservation work. Conservation Districts and other local leaders, along with public land management agencies, are involved in the assessment process.

An RWA can be used as a communication tool between the Natural Resources Conservation Service (NRCS) and partners for describing and prioritizing conservation work in selected watersheds. RWAs provide initial estimates of conservation investments needed to address the identified resource concerns in the watershed. 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 watershed planning.

### General Description of the Agua Fria River Watershed

The Agua Fria River Watershed is located in the central portion of the state of Arizona, southeast of the city of Prescott, and north of Phoenix. (Figure 1-1). The watershed can be defined as the area drained by the Agua Fria River to the confluence with the Gila River west of the Phoenix metropolitan area near Avondale. The watershed comprises 1.79 million acres (2,785 square miles), and is located 51% in Yavapai County and 49% in Maricopa County. Thirty-eight percent of the land is managed by BLM, 30% is State Trust Land, 16% is private land, 9% is managed by the Forest Service, 5% is USFS & BLM wilderness areas, and 3% is state park land.

The watershed includes the Cities of Avondale, Carefree, Cave Creek Glendale, Peoria, and Prescott Valley. There are two U.S. Department of Agriculture (USDA) Service Centers located in Avondale and Prescott Valley. Conservation assistance is provided through seven Natural Resource

Conservation Districts: Chino Winds, Verde, Tonto, East Maricopa, Agua Fria-New River, Wickenberg, and Buckeye Valley (Figure 1-1).

The area is mostly rangeland with a mixture of cropland and urban development. The watershed's one large lake, Lake Pleasant, is used for water storage and recreation. Rangeland and most forestlands are grazed year around by cattle, except at lower elevations where grazing is seasonal with stocker cattle in years with good winter-spring rainfall.

Irrigation land is used for cotton, alfalfa, barley, and other small grains. Where water supply is available, lettuce, carrots, cabbage, cauliflower, melons, among other market vegetables, and citrus are grown. Land available for cultivation is being encroached upon by rapid urbanization in the larger communities.

Resource concerns in the watershed include soil erosion, excessive runoff (causing flooding or ponding), aquifer overdraft, contaminants in surface and ground water, air quality, declining threatened plant & animal species, invasive plants, and fish & wildlife habitat degeneration.

## Section 2: Physical Description

The Agua Fria River Watershed in Arizona is defined as the area drained by the Agua Fria River to the confluence with the Gila River west of the Phoenix metropolitan area near Avondale. The watershed is located in the central part of the state, from the western part of Phoenix, north to the Prescott area.

Watershed Size

The Agua Fria River Watershed covers approximately 2,784 square miles, representing about 2.4% of the state of Arizona. The watershed has a maximum approximate width of 46 miles east-west, and a maximum length of 90 miles north-south.

The Agua Fria River 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 (HUC) number 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 Agua Fria has an 8-digit HUC of 15070102 and contains the following 10-digit HUCs:

- 1507010201 (Ash Creek and Sycamore Creek);
- 1507010202 (Big Bug Creek-Agua Fria River);
- 1507010203 (Black Canyon Creek);
- 1507010204 (Bishop Creek);
- 1507010205 (Agua Fria River-Lake Pleasant), 1507010206 (Cave Creek-AZ Canal Diversion Channel), 1507010207 (Trilby Wash-Trilby Wash Basin);
- 1507010208 (New River); and,
- 1505010209 (Agua Fria River below Lake Pleasant, Figure 1-2).

Geology

The Agua Fria River Watershed is characterized by a narrow, rugged valley rising up from the desert floor of the Phoenix Basin, steadily gaining in elevation as the watershed extends up and over a lava plateau and to the edge of the southern boundary of the Verde River Watershed. The geology of the watershed is complex, varying widely in age, rock-type, and structure (Figure 2-1).

The Agua Fria Valley is formed by erosion of the Bradshaw Mountains. Subsidence along this zone eventually caused both the Verde River to the north and west, and the Agua Fria, to stop flowing, forming a series of ancient lakes and deposition of lake sediments.

Damming of the Agua Fria also occurred due to multiple lava flows which originated from a source to the northeast. The mountains and ridges that border the watershed are composed of metamorphic rocks (rocks that undergo change due to extreme heat or pressure) which form mountains in the southern portion of the watershed; mesas to the east; and the Bradshaw Mountains to the west. The central portion of the valley consists of stream deposits of sand, silt and gravel with

stream-rounded pebbles and lava flows, commonly lying on soil zones baked by the heat of the flowing lava.

The rocks consist primarily of granite that weathers to rounded boulders and knobs, and flaky, silvery rocks. Flat-lying layers of whitish limestone, siltstone, and water-laid volcanic ash are found in lake sediments, and lava flows cap the higher mesas. Near Cordes Junction, loosely consolidated stream and lake deposits are capped with volcanic rock, and a lava plateau forms the drainage divide between Turkey Creek (an Agua Fria tributary) and the Verde River Watershed to the west (Chronic, 1983).

Sunset Point Rest Area on Interstate Route 17 looks down on Black Canyon, named for the dark metamorphic rocks that give it its name. The Bradshaw Mountains are walled with the same rock but also is composed of a larger mass of granite.

Along the edge of the Mogollon Rim (the boundary of the Colorado Plateau Highlands), lava flows cascaded from the plateau surface, draining and forming poorly drained, nearly flat-lying mesas in the eastern margin of the Agua Fria.

Figure 2-1 shows the geology of the Agua Fria River Watershed,

Soils

Soils within the Agua Fria River Watershed are diverse and formed as the result of differences in climate, vegetation, geology, and physiography.

Detailed 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 following NRCS Soil Surveys: “Soil Survey of Yavapai County, AZ, Western Part”; “Soil Survey of the Black Hills-Sedona Area, AZ, Parts of Coconino and Yavapai Counties”; “Soil Survey of Maricopa County, AZ, Central Part”; “Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, AZ”; and “Soil Survey of Aguila-Carefree Area, AZ, Parts of Maricopa and Pinal Counties, AZ.” Soils data and maps from these Soil Surveys 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 Agua Fria River Watershed is comprised of 6 Common Resource Areas (Figure 2-2 and Table 2-1).

Beginning at the lower end of the watershed, CRA 40.3 “Colorado Sonoran Desert” occurs at elevations ranging from 300 to 1200 feet. Precipitation averages 3 to 7 inches per year. Vegetation includes creosotebush, white bursage, brittlebush, Mormon tea, teddybear cholla, elephant tree, smoke tree, ocotillo, and big galleta. The soils in the area have a hyperthermic soil temperature regime and a typic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep, stratified, coarse to fine-textured soils occur on floodplains and alluvial fans. Deep, medium and moderately coarse-textured limy soils occur on fan terraces.

CRA 40.2 “Middle Sonoran Desert” occurs at slightly higher elevations, ranging from 1200 to 2000 feet with precipitation averaging 7 to 10 inches per year. Vegetation includes saguaro, palo verde, creosotebush, triangle bursage, brittlebush, prickly pear, cholla, desert saltbush, wolfberry, bush muhly, threeawns, and big galleta. The soils in the area have a hyperthermic soil temperature regime and a typic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep, stratified, coarse to fine-textured soils occur on floodplains and alluvial fans. Deep, moderately fine and fine-textured and gravelly, moderately fine-textured soils occur on fan terraces. Shallow to a hardpan, limy, gravelly, medium and moderately coarse-textured soils occur on fan terraces. Shallow, very gravelly and cobbly, moderately coarse to moderately fine-textured soils and rock outcrop occur on hills and mountains.

CRA 40.1 “Upper Sonoran Desert” occurs at elevations ranging from 2000 to 3200 feet with precipitation averaging 10 to 13 inches per year. Vegetation includes saguaro, palo verde, mesquite, creosotebush, triangle bursage, prickly pear, cholla, wolfberry, bush muhly, threeawns, ocotillo, and globe mallow. The soils in the area have a thermic soil temperature regime and a typic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Shallow, cobbly and gravelly soils and rock outcrop occur on hills and mountains. Deep, gravelly, medium to fine-textured soils occur on fan terraces.

These three Common Resource Areas (40.3, 40.2 and 40.1) occur within the Basin and Range Physiographic Province which is characterized by numerous mountain ranges rising abruptly from broad, plain-like valleys and basins. Igneous and metamorphic rock classes dominate the mountain ranges and sediments filling the basins represent combinations of fluvial, lacustrine, colluvial and alluvial deposits.

*Table 2-1: Agua Fria River Watershed - Common Resource Areas*

| Common Resource Area Type | Area (sq. mi.) | Percent of Watershed |
|---|---|---|
| 40.3 Colorado Sonoran Desert | 97.30 | 3.5 |
| 40.2 Middle Sonoran Desert | 935.84 | 33.6 |
| 40.1 Upper Sonoran Desert | 374.64 | 13.5 |
| 38.1 Lower Interior Chaparral | 1,299.05 | 46.6 |
| 38.2 Interior Chaparral – Woodlands | 23.97 | 0.8 |
| 35.1 Colorado Plateau Mixed Grass Plains | 54.37 | 1.9 |

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

Moving up the watershed, CRA 38.1 "Lower Interior Chaparral" occurs at elevations ranging from 3000 to 4500 feet. Precipitation averages 12 to 16 inches per year. Vegetation includes canotia, one-seed juniper, mesquite, catclaw acacia, jojoba, turbinella oak, ratany, shrubby buckwheat, algerita, skunkbush, tobosa, vine mesquite, bottlebrush squirreltail, grama species, curly mesquite, desert needlegrass and New Mexico feathergrass. The soils in the area have a thermic soil temperature regime and an ustic aridic moisture regime. The dominant soil orders are Aridisols and Mollisols. Shallow, gravelly and cobbly, moderately coarse to moderately fine-textured soils and rock outcrop occur on hills and mountains. Shallow to deep, gravelly, cobbly and stony, fine-textured soils occur on basaltic plains, mesas and hills. Deep, gravelly, medium to fine-textured soils occur on fan terraces.

CRA 38.2 "Interior Chaparral – Woodlands" occurs at elevations ranging from 4000 to 5500 feet with precipitation averaging 16 to 20 inches per year. Vegetation includes turbinella oak, hollyleaf buckthorn, desert buckbrush, one-seed juniper, alligator juniper, pinyon, algerita, sugar sumac, prairie junegrass, blue grama, curly mesquite, bottlebrush squirreltail, muttongrass, cane beardgrass, plains lovegrass and bullgrass. The soils in the area have a thermic to mesic soil temperature regime and an aridic ustic soil moisture regime. The dominant soil orders are Alfisols and Mollisols. Moderately deep and deep, gravelly and cobbly, moderately coarse to fine-textured soils occur on mountains.

These two Common Resource Areas (38.1 and 38.2) occur within the Transition Zone Physiographic Province which is characterized by canyons and structural troughs or valleys. Igneous, metamorphic and sedimentary rock classes occur on rough mountainous terrain in association with less extensive sediment filled valleys.

At the upper end of the watershed occurs CRA 35.1 "Colorado Plateau Mixed Grass Plains" with eelevations ranging from 5100 to 6000 feet. Precipitation averages 10 to 14 inches per year. Vegetation includes Stipa species, Indian ricegrass, galleta, and 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, gravelly, moderately fine and fine-textured soils occur on floodplains and valley slopes and plains. Shallow, gravelly, medium-textured and deep, medium and moderately fine-textured soils occur on plains and hills.

CRA 35.1 occurs 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.

## Slope Classifications

Slope, as well as soil characteristics and topography, are important when assessing the vulnerability of a watershed to erosion. Approximately 42.6% of the Agua Fria Watershed has a slope greater than 15%, while 39.1% of the watershed has a slope less than 5%. The Agua Fria River Watershed below Lake Pleasant watershed is relatively flat, with only 11.6% of its area over 15% slope, and 80.1% less than 5% slope. The Black Canyon Creek and Agua Fria – Lake Pleasant watersheds are relatively steep, with 74.7% and 77.9% of the area greater than 15% slope, respectively (Table 2-2 and Figure 2-3).

*Table 2-2: Agua Fria River Watershed Slope Classifications.*

| Watershed Name | Area (sq. mi.) | Percent Slope | | |
|---|---|---|---|---|
| | | 0-5% | 5-15% | >15% |
| Ash Creek and Sycamore Creek 1507010201 | 261 | 15.1 | 34.2 | 50.7 |
| Big Bug Creek-Agua Fria River 1507010202 | 324 | 22.3 | 31.1 | 46.6 |
| Black Canyon Creek 1507010203 | 244 | 7.4 | 17.9 | 74.7 |
| Bishop Creek 1507010204 | 236 | 18.1 | 24.2 | 57.7 |
| Agua Fria River-Lake Pleasant 1507010205 | 372 | 6.2 | 15.9 | 77.9 |
| Cave Creek-Arizona Canal Diversion Channel 1507010206 | 288 | 51.0 | 14.7 | 34.2 |
| Trilby Wash-Trilby Wash Basin 1507010207 | 242 | 71.1 | 10.9 | 18.0 |
| New River 1507010208 | 353 | 56.9 | 15.3 | 27.8 |
| Agua Fria River below Lake Pleasant 1507010209 | 464 | 80.1 | 8.3 | 11.6 |
| Agua Fria River Watershed | 2,784 | 39.1 | 18.4 | 42.6 |

*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. Agua Fria River near Rock Springs has the largest annual stream flow with 78.80 cfs. Skunk Creek near Phoenix has the lowest annual stream flow with 1.48cfs. Table 2.3.2 lists major lakes and reservoirs in the Agua Fria River Watershed, as well as their watershed position, surface area, elevation and dam name. Trilby Wash Basin and Lake Pleasant are the largest surface waters with areas of 2,068 and 2,042 acres respectively. The next largest water body is Fain Lake which covers 1,015 acres. Table 2-3.3 lists the major streams and their lengths. Stream lengths range from 167.6 miles

for Agua Fria to 29.0 miles for Big Bug Creek (Figure 2-4).

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 Agua Fria Watershed (Figure 2-5).

Seven of the ten types of riparian areas occur within this watershed. Riparian areas encompass approximately 1,715 acres (2.7 sq. mi.) or 0.04% of the entire watershed. Mixed Broadleaf comprises about 1,025 acres (1.6 sq. mi., or 59.8%) of the riparian areas, and Strand (the area alongside the stream channel, or shore) comprises about 337.9 acres (0.53 sq. mi., or 19.7%).

The Ash Creek and Sycamore Creek watershed has the greatest amount of riparian vegetation with about 577 acres (0.90 square miles). The Bishop Creek and Agua Fria – Lake Pleasant watersheds also have large amounts of riparian vegetation with 421 acres (0.66 sq. mi.) and 338 acres (0.51 sq. mi.) respectively. The Trilby Wash-Trilby Wash Basin and New River watersheds have no riparian vegetation associated with perennial waters. Table 2-4 lists riparian vegetation types and areas for each watershed.

*Table 2-3.1: Agua Fria River 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 | | | |
| 9512280 | Cave Creek Below Cottonwood Creek near Cave Creek | 1981 | 2005 | 6.57 |
| 9512450 | Agua Fria River near Humboldt | 1/1/2001 | 12/30/2004 | 3.89 |
| 9512500 | Agua Fria River near Mayer | 1/1/1940 | 12/30/2004 | 22.25 |
| 9512800 | Agua Fria River near Rock Springs | 1/1/1971 | 12/30/2004 | 78.89 |
| 9513780 | New River near Rock Springs | 1/1/1966 | 12/30/2004 | 12.06 |
| 9513860 | Skunk Creek, near Phoenix | 1/1/1968 | 12/30/2004 | 1.48 |
| | | | | |
| | Inactive Gages | | | |
| 9512300 | Cave Creek near Cave Creek | 1959 | 1967 | 4.07 |
| 9512400 | Cave Creek at Phoenix | 1990 | 1991 | 3.17 |
| 9512495 | Perry Canal near Mayer | 1/1/1941 | 12/30/1958 | 0.45 |
| 9512501 | Sycamore Dam Site Total * | 1/1/1941 | 12/30/1959 | 24.09 |
| 9512501 | Sycamore Dam Site Total * | 1/1/1978 | 12/30/1980 | 85.3 |
| 9512600 | Turkey Creek near Cleator | 1/1/1980 | 12/30/1991 | 11.26 |
| 9512830 | Boulder Creek near Rock Springs | 1/1/1984 | 12/30/1992 | 3.25 |
| 9512970 | Cottonwood Creek near Waddell Dam | 1/1/1984 | 12/30/1992 | 0.35 |
| 9513000 | Agua Fria River at Waddell Dam | 1/1/1915 | 12/30/1918 | 320.87 |
| 9513500 | Lake Pleasant at Waddell Dam | N/A | N/A | N/A |
| 9513650 | Agua Fria River at El Mirage | 1/1/1994 | 12/30/1997 | 0.085 |
| 9513700 | Agua Fria River Tributary at Youngtown | 1/1/1962 | 12/30/1967 | 0.016 |
| 9513800 | New River at New River | 1/1/1961 | 12/30/1981 | 13.96 |
| 9513835 | New River at Bell Road, near Peoria * | 1/1/1968 | 12/30/1983 | 11.31 |
| 9513835 | New River at Bell Road, near Peoria * | 1/1/1991 | 12/30/1992 | 7.78 |
| 9513910 | New River near Glendale * | 1/1/1965 | 12/30/1969 | 11.19 |
| 9513910 | New River near Glendale * | 1/1/1991 | 12/30/1997 | 32.41 |
| 9513970 | Agua Fria River at Avondale | 1/1/1968 | 12/30/1981 | 35.25 |

**Discontinuous years of data*
*Data Sources: USGS website, National Water Information System*
*http://waterdata.usgs.gov/nwis/*

*Table 2-3.2: Agua Fria River Watershed Major Lakes and Reservoirs.*

| Lake Name (if known) | Watershed | Surface Area (acre) | Elevation (feet above mean sea level) | Dam Name (if known) |
|---|---|---|---|---|
| Trilby Wash Basin | Trilby Wash-Trilby Wash Basin | 2,068 | 1,348 | McMicken Dam |
| Lake Pleasant | Agua Fria River-Lake Pleasant | 2,042 | 1,570 | Carl Pleasant Dam |
| Fain Lake | Big Bug Creek-Agua Fria River | 1,015 | 4,600 | not known |
| Flood Pool for White Tanks #3 Flood Retarding Structure | Agua Fria River below Lake Pleasant | 261 | 1,202 | White Tanks #3 Flood Retarding Structure |
| Hank Raymond Lake | Agua Fria River below Lake Pleasant | 78 | 1,438 | Camp Dyer Diversion Dam |
| Lynx Lake | Big Bug Creek-Agua Fria River | 49 | 5,532 | Lynx Lake Dam |
| Dawn Lake | New River | 36 | 1,160 | not known |
| Viewpoint Lake | New River | 32 | 1159 | not known |
| Lake Bonita | Agua Fria River below Lake Pleasant | 29 | 1,409 | not known |
| Caterpillar Tank | Agua Fria River below Lake Pleasant | 12 | 1,535 | not known |
| Layton Tank | Agua Fria River-Lake Pleasant | 8 | 2,786 | not known |
| Mesa Reservoir | Big Bug Creek-Agua Fria River | 6 | 5,108 | Mesa Reservoir 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: Agua Fria River Watershed Major Streams and Lengths.*

| Stream Name | Watershed | Stream Length (miles) |
|---|---|---|
| Agua Fria River | Agua Fria River below Lake Pleasant; Agua Fria River-Lake Pleasant; Ash Creek and Sycamore Creek; Big Bug Creek-Agua Fria River; Bishop Creek | 167.6 |
| New River | New River | 58.7 |
| Cave Creek | Cave Creek-Arizona Canal Diversion Channel | 45.6 |
| Ash Creek | Ash Creek and Sycamore Creek | 39.7 |
| Beardsley Canal | Agua Fria River below Lake Pleasant | 30.6 |
| Castle Creek | Agua Fria River-Lake Pleasant | 30.4 |
| Skunk Creek | Bishop Creek | 30.4 |
| Trilby Wash | Trilby Wash-Trilby Wash Basin | 30.3 |
| Turkey Creek | Black Canyon Creek | 30.2 |
| Big Bug Creek | Big Bug Creek-Agua Fria River | 29.0 |

*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*

*Table 2-4: Agua Fria River Watershed Riparian Vegetation (acres) by 10-digit Watershed (Part 1 of 2).*

| Riparian Vegetation Community | Ash Creek and Sycamore Creek 1507010201 | Big Bug Creek-Agua Fria River 1507010202 | Black Canyon Creek 1507010203 | Bishop Creek 1507010204 | Agua Fria River-Lake Pleasant 1507010205 |
|---|---|---|---|---|---|
| Conifer Oak | - | 1.78 | - | - | - |
| Cottonwood Willow | - | - | - | - | 2.16 |
| Flood Scoured | - | 2.58 | - | 9.94 | 148.03 |
| Mesquite | - | 93.85 | 0.26 | 6.99 | 83.43 |
| Mixed Broadleaf | 545.52 | 82.34 | - | 355.79 | 17.76 |
| Strand | 31.63 | 55.29 | - | 48.10 | 86.30 |
| Tamarisk | - | - | - | - | - |
| Total Area (acres) | 577.15 | 235.85 | 0.26 | 420.84 | 337.67 |

*Table 2-4: Agua Fria River Watershed Riparian Vegetation (acres) by 10-digit Watershed (Part 2 of 2).*

| Riparian Vegetation Community | Cave Creek-Arizona Canal Diversion Channel 1507010206 | Trilby Wash-Trilby Wash Basin 1507010207 | New River 1507010208 | Agua Fria River below Lake Pleasant 1507010209 | Agua Fria River Watershed |
|---|---|---|---|---|---|
| Conifer Oak | - | - | - | - | 1.78 |
| Cottonwood Willow | 1.13 | - | - | - | 3.29 |
| Flood Scoured | - | - | - | - | 160.56 |
| Mesquite | - | - | - | - | 184.53 |
| Mixed Broadleaf | 24.11 | - | - | - | 1025.53 |
| Strand | - | - | - | 116.60 | 337.93 |
| Tamarisk | - | - | - | 1.07 | 1.07 |
| Total Area (acres) | 25.24 | 0.00 | 0.00 | 117.67 | 1714.68 |

*Data Sources: GIS data layer "natveg", 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 2-5) and Land Cover map (Figure 2-6) were created from the Southwest Regional Gap Analysis Project land cover map (Lowry et. al, 2005).

The Land Cover map, and Table 2-5, show 10 different land cover types are found within the watershed, including vegetation communities, developed land, open water, and agriculture. The most common land cover type over the entire watershed is Sonoran Paloverde Mixed Cacti Desert Scrub encompassing 21.59% of the watershed. The next most common

types are Developed, Medium-High Intensity (14.18%), Mogollon Chaparral (12.94%), and Sonora-Mojave Creosote bush – White Bursage Desert Scrub (10.65%).

*Note:* There are a total of 26 GAP vegetation categories present within the Agua Fria River 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. It was decided that some of the vegetation categories would be logically grouped in order to increase the legibility of the map. In collaboration with NRCS, Project NEMO staff were able to create a total of 10 grouped GAP vegetation categories.

*Table 2-5: Agua Fria River Watershed Southwest Regional GAP Analysis Project Land Cover, Percent of 10-digit Watershed (Part 1 of 2).*

| Watershed / Land Cover | Ash Creek and Sycamore Creek 1507010201 | Big Bug Creek-Agua Fria River 1507010202 | Black Canyon Creek 1507010203 | Bishop Creek 1507010204 | Agua Fria River-Lake Pleasant 1507010205 |
|---|---|---|---|---|---|
| Agriculture* | 0.10% | 0.30% | -- | -- | -- |
| Apacherian-Chihuahuan Grassland and Mesquite Scrub | 22.95% | 23.18% | 24.38% | 42.23% | *11.14%* |
| Developed | 0.58% | 9.56% | 0.61% | 1.53% | *0.36%* |
| Madrean Pine Oak Woodland | 3.30% | 5.80% | 11.50% | 2.15% | *1.71%* |
| Madrean Pinyon-Juniper Woodland | 42.72% | 25.33% | 7.81% | 19.06% | *1.80%* |
| Mogollon Chaparral | 26.59% | 27.11% | 31.46% | 23.01% | *18.35%* |
| Open Water | | 0.03% | | | *3.81%* |
| Rocky Mountain Ponderosa Pine Woodland | 3.41% | 8.50% | 6.41% | 0.43% | *0.57%* |
| Sonora-Mojave Desert Scrub | 0.03% | 0.04% | 17.81% | 0.09% | *0.25%* |
| Sonoran Desert Scrub | 0.32% | 0.16% | 0.02% | 11.51% | *62.02%* |
| Area (Sq.mi.) | 260.56 | 324.13 | 244.06 | 236.44 | 371.83 |

***Not necessarily irrigated land.***

*Table 2-5: Agua Fria River Watershed Southwest Regional GAP Analysis Project Land Cover, Percent of10-digit Watershed (Part 2 of 2)*

| Watershed / Land Cover | Cave Creek-Arizona Canal Diversion Channel 1507010206 | Trilby Wash – Trilby Wash Basin 1507010207 | New River 1507010208 | Agua Fria River below Lake Pleasant 1507010209 | Percent Of Total |
|---|---|---|---|---|---|
| Agriculture* | -- | -- | 1.08% | 21.90% | 3.84% |
| Apacherian-Chihuahuan Grassland and Mesquite Scrub | 8.80% | 0.12% | 5.79% | 33.65% | 13.68% |
| Developed | 43.51% | 2.21% | 27.06% | -- | 15.15% |
| Madrean Pine Oak Woodland | 1.25% | -- | 0.65% | -- | 2.61% |
| Madrean Pinyon-Juniper Woodland | 9.16% | 0.18% | 7.46% | -- | 11.38% |
| Mogollon Chaparral | 4.14% | 0.47% | 3.66% | -- | 13.72% |
| Open Water | 0.03% | -- | 0.09% | -- | 0.54% |
| Rocky Mountain Ponderosa Pine Woodland | -- | -- | -- | -- | 1.98% |
| Sonora-Mojave Desert Scrub | 5.01% | 45.13% | 15.84% | 17.29% | 9.40% |
| Sonoran Desert Scrub | 28.10% | 51.90% | 38.36% | 27.17% | 27.72% |
| Area (Sq.mi.) | 288.39 | 242.17 | 353.18 | 464.30 | 2785.06 |

**Not necessarily irrigated land.*
*Data Sources: GIS data layer "Arizona Gap Analysis Project Vegetation Map", University of Arizona, Southern Arizona Data Services Program, 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'.*

## Meteorological Stations, Precipitation and Temperature

For the 30 years (1961-1990) of precipitation data used in this report, the average annual precipitation for the Agua Fria River Watershed is 15.1 inches. The Black Canyon Creek watershed receives the most rainfall with 19.9 inches of rain in an average year, while the Agua Fria River below Lake Pleasant watershed typically receives only 9.8 inches. The valley floor surrounding the Agua Fria main channel receives less rain than the surrounding mountains. The Agua Fria River below Lake Pleasant watershed had the highest maximum temperature at 87.3 $^{o}$F, while the Black Canyon Creek watershed had the lowest temperature at 39.0 $^{o}$F. Figure 2-7 shows the meteorological station locations and the distribution of precipitation over the watershed, and Table 2-6 shows the precipitation,

temperatures and names of the meteorological stations. Some stations have more than one location on the figure because they have been moved from one site to another by the National Weather Service.

*Table 2-6: Agua Fria River Watershed Meteorological Stations, Temperature ($^{o}$F) and Precipitation (in/yr) with Recent Long-term Records.*

| 10-digit Watershed Name | Meteorological Stations and Map ID | Temperature ($^{o}$F) | | | Precipitation (in/yr) | | |
|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Avg. | Min. | Max. | Weighted Average |
| Ash Creek and Sycamore Creek 1507010201 | None | - | - | - | 15.0 | 25.0 | 18.4 |
| Big Bug Creek-Agua Fria River 1507010202 | None | - | - | - | 15.0 | 27.0 | 18.8 |
| Black Canyon Creek 1507010203 | Cordes (N)<br>Crown King (O) | 46.9<br>39.0 | 75.7<br>67.9 | 61.3<br>53.5 | 13.0 | 31.0 | 19.9 |
| Bishop Creek 1507010204 | Black Canyon City (C) | 55.9 | 83.6 | 69.8 | 13.0 | 23.0 | 17.4 |
| Agua Fria River-Lake Pleasant 1507010205 | Castle Hot Springs 4 N (I) | 56.0 | 83.6 | 69.8 | 11.0 | 31.0 | 16.6 |
| Cave Creek-Arizona Canal Diversion Channel 1507010206 | Carefree (E)<br>Cave Creek (J)<br>Deer Valley (P) | 56.6<br>53.4<br>54.2 | 82.0<br>83.1<br>85.2 | 69.3<br>68.3<br>69.7 | 9.0 | 23.0 | 14.0 |
| Trilby Wash-Trilby Wash Basin 1507010207 | Wittmann (AL) | 54.4 | 84.2 | 69.3 | 9.0 | 17.0 | 12.1 |
| New River 1507010208 | Marinette (U) | 52.9 | 86.9 | 69.9 | 9.0 | 25.0 | 13.2 |
| Agua Fria River below Lake Pleasant 1507010209 | Alhambra (A)<br>Litchfield Park (T)<br>Thornburg Ranches (AF) | 53.0<br>53.6<br>50.5 | 86.1<br>87.3<br>84.8 | 69.6<br>70.5<br>67.6 | 7.0 | 17.0 | 9.8 |
| *Agua Fria River Watershed* | - | - | - | - | *7.0* | *31.0* | *15.1* |

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

Land Ownership/Management

In the Agua Fria River Watershed, there are 8 different land ownership/management entities (Figure 2-8 and Table 2-7). Private individuals are the largest land owners, representing 33.91% of the watershed. The Forest Service and the State of Arizona (State Trust Lands) are the next most significant land owners with 26.65% and 22.47% of the watershed.

*Table 2-7: Agua Fria River Watershed Land Ownership/Management (Percent of each 10-digit Watershed) (part 1 of 2).*

| Land Owner | Ash Creek and Sycamore Creek 1507010201 | Big Bug Creek-Agua Fria River 1507010202 | Black Canyon Creek 1507010203 | Bishop Creek 1507010204 | Agua Fria River-Lake Pleasant 1507010205 |
|---|---|---|---|---|---|
| BLM | 1.86% | 11.34% | 25.43% | 8.65% | 37.68% |
| Military | - | 27.28% | - | - | - |
| Private | - | 37.47% | 3.96% | 3.67% | 16.15% |
| State Parks and Recreation Areas | - | - | - | - | 3.20% |
| State Trust | 4.83% | 23.90% | 6% | 32.54% | 29.65% |
| State Wildlife & Management Areas | - | - | - | - | - |
| USFS | 87.50% | - | 49.91% | 52.29% | 8.64% |
| USFS & BLM Wilderness Areas | 2.72% | - | 14.68% | 2.85% | 4.69% |
| *Area (square miles)* | *261* | *325* | *244* | *236* | *372* |

Table 2-7: Agua Fria River Watershed Land Ownership/Management (Percent of each 10-digit Watershed) (part 2 of 2).

| Land Owner | Cave Creek-Arizona Canal Diversion Channel 1507010206 | Trilby Wash-Trilby Wash Basin 1507010207 | New River 1507010208 | Agua Fria River below Lake Pleasant 1507010209 | Agua Fria River Watershed |
|---|---|---|---|---|---|
| BLM | 1.45% | 8.32% | 3.08% | 9.17% | 12.28% |
| Military | - | 0.15% | - | 0.72% | 0.13% |
| Private | 58.46% | 36.38% | 39.05% | 72.74% | 33.91% |
| State Parks and Recreation Areas | 2.39% | 10.95% | 0.50% | 2.06% | 2.03% |
| State Trust | 13.15% | 44.21% | 33.65% | 15.10% | 22.47% |
| State Wildlife & Management Areas | 0.01% | - | 0.67% | - | 0.09% |
| US Forest Service | 25.54% | - | 23.08% | - | 26.65% |
| USFS & BLM Wilderness Areas | - | - | - | 0.21% | 2.44% |
| *Area (square miles)* | *288* | *24* | *353* | *464* | *2,78* |

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

Land Use

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; however, these categories have been consolidated into five land cover types (Figure 2-9 and Table 2-8). The five groupings for the land cover categories are:

- 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, 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 cover type is Range which makes up 76.04% of the watershed. Urban land is the next most common type with 19.41% of the total area.

USGS, NLCD Land Cover Class Definitions, http://landcover.usgs.gov/classes.php

Mines - Primary Ores

There are1,061 mineral extraction mines recorded with the Office of the Arizona State Mine Inspector in the Agua Fria River Watershed. Table 2-9 and Figure 2-10 show the types of ores being mined in the Agua Fria watershed. There are 386 mines whose ore type is unknown. The most common known ore types are gold, copper, silver, and sand and gravel.

*2-8: Agua Fria River Watershed Land Use, Percent of 10-digit Watershed*

| Land Cover/Location | Crop | Forest | Urban | Range | Water | Area (sq.mi.) |
|---|---|---|---|---|---|---|
| Ash Creek and Sycamore Creek | 0.10% | 6.66% | 0.57% | 92.68% | -- | 260.56 |
| Big Bug Creek-Agua Fria River | 0.30% | 14.17% | 9.51% | 76.00% | 0.03% | 324.13 |
| Black Canyon Creek | -- | 17.65% | 0.61% | 81.74% | -- | 244.06 |
| Bishop Creek | -- | 2.54% | 1.51% | 95.95% | -- | 236.44 |
| Agua Fria River-Lake Pleasant | -- | 2.28% | 0.35% | 93.57% | 3.80% | 371.83 |
| Cave Creek-Arizona Canal Diversion Channel | -- | 1.24% | 43.15% | 55.60% | 0.03% | 288.39 |
| Trilby Wash-Trilby Wash Basin | -- | -- | 2.20% | 97.80% | -- | 242.17 |
| New River | 1.07% | 0.65% | 26.91% | 71.28% | 0.09% | 353.18 |
| Agua Fria River below Lake Pleasant | 21.83% | -- | 33.54% | 44.55% | 0.08% | 464.30 |
| Percent of Agua Fria Watershed | 3.82% | 4.55% | 15.06% | 76.04% | 0.54% | 2785.06 |

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

*Table 2-9: Agua Fria River Watershed Mines – Primary Ores.*

| Ore Type | Total Number of Mines | Ore Type | Total Number of Mines |
|---|---|---|---|
| Unknown | 386 | Sodium | 3 |
| Gold | 260 | Calcium | 2 |
| Copper | 125 | Clay | 2 |
| Silver | 81 | Pumice | 2 |
| Sand & Gravel | 55 | Zinc | 2 |
| Lead | 27 | Aluminum | 1 |
| Iron | 19 | Antimony | 1 |
| Tungsten | 19 | Arsenic | 1 |
| Stone | 16 | Barium | 1 |
| Manganese | 14 | Chlorine | 1 |
| Mica | 12 | Columbium | 1 |
| Uranium | 8 | Diatomite | 1 |
| Mercury | 6 | Geothermal | 1 |
| Beryllium | 5 | Magnesium | 1 |
| Feldspar | 3 | Perlite | 1 |
| Gemstone | 3 | Vermiculite | 1 |

*Note: If a mine contains more than one ore, only the major ore is noted.*
*Data Source: Natural Resource Conservation Service (NRCS).*

## 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 Agua Fria River Watershed.

### 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.

### Soil Condition

Soil condition is a resource concern on cropland whenever soil tilth is poor or soil compaction is excessive. Poor soil tilth results whenever unsuitable combinations of minerals, air, water, and organic matter occur, resulting in low microbial activity and chemical reactions. Soil compaction results from excessive compressing of soil particles and aggregates by machines or livestock, thus affecting plant-soil-moisture-air relationships. Soil condition can become a problem whenever a field is excessively tilled or tilled when the soil is wet, lack of crop rotation, and lack of addition of organic matter. Poor soil condition reduces root growth and plant productivity.

Conservation practices applied to address this resource concern are generally those that improve plant cover, improve soil organic matter, improve soil microbial activity, reduce tillage operations, or mechanically break up compacted soils. Practices may include deep tillage, conservation cover, conservation crop rotation, cover & green manure crop, irrigation water management, mulching, nutrient management, pest management, residue management, tree and shrub establishment, and waste utilization. Reduced tillage passes and addition of

*Table 3-1: Agua Fria 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 |
| Soil Condition | Soil Compaction & Organic Matter Depletion | | | |
| Water Quality | Excessive Nutrients & Organics & Pesticides in Ground Water | Excessive Suspended Sediment in Surface Water | Excessive Suspended Sediment in Surface Water | Excessive Nutrients & Organics & Pesticides in Ground Water |
| Water Quantity | Inefficient Use on Irrigated Land & Aquifer Overdraft | | | Inefficient Use on Irrigated Land & Aquifer Overdraft |
| Air Quality | Particulate Matter (PM 10) | | | Particulate Matter (PM 10) |
| 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 | Inadequate Quantities & Quality of Feed & Forage & Water | |
| Species of Concern | | T&E Species & Declining Species & Species of Concern | T&E Species & Declining Species & Species of Concern | |

*(NRCS, 2007)*

organic matter from cover crops or residue will improve soil condition.

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. Impaired waters, as defined by Section 303(d) of the federal Clean Water Act, are those waters that are not meeting the state's water quality standards for designated uses. Attaining waters meet state water quality standards for designated uses. Strategies are 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 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* (ADEQ 2007) indicates that generally surface water quality is excellent where monitored and assessed (Figure 3-1). However, the following surface waters in the Agua Fria Basin are impaired:

- Cortez Park Lake is a 2 acre lake in the Phoenix metropolitan area, and located in the Agua Fria Below Lake Pleasant Sub-Basin. It is impaired based on high pH and low dissolved oxygen, which may indicate excessive nutrient loading. Added to impaired waters list in 2004, a TMDL is scheduled to be initiated in 2007.

- Turkey Creek, from an unnamed tributary to Poland Creek, is in the Black Canyon Sub-Basin. This 21 miles long reach is impaired by copper and lead. A TMDL has been completed and is in the final stages of review for approval by EPA (January 2007).

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

- Lynx Lake is a 50 acre lake near Prescott and located in the Big Bug-Agua Fria Sub-Basin. Attaining some uses, lead exceeded a standard in one of three sampling events and manganese exceeded standards in four of five sampling events. (Note that EPA may add this to the impaired waters list due to manganese.)

- Lake Pleasant was recently expanded to 8900 acres and is located in the Agua Fria-Lake Pleasant Sub-Basin. Attaining all uses although low dissolved oxygen occurred during two of 15 sampling events and high pH in one of 15 sampling events may indicate occasional excessive nutrient loading.

- Fain Lake is a 1015 acre reservoir in Lynx Creek near Prescott, and located in the Big Bug Creek-Agua Fria Sub-Basin. Assessed as attaining some uses, low dissolved oxygen occurred during one of three sampling events.

- Turkey Creek, from headwaters to an unnamed tributary, is a 9.1 mile reach located in the Black Canyon Sub-Basin. It was assessed as attaining some uses. Insufficient monitoring data to assess some designated uses. No exceedances.

- Agua Fria River, from State Route 169 to Yarber Wash, is a 17.8 mile reach in the Big Bug Creek-Agua Fria Sub-Basin.

Attaining all uses and no exceedances.

- Agua Fria River, from Sycamore Creek to Big Bug Creek, is a 9.1 mile reach primarily located in the Big Bug Creek-Agua Fria Sub-Basin. Attaining all uses and no exceedances.

- Agua Fria River, from Little Squaw Creek to Cottonwood Creek, is a 5.8 mile reach in the Agua Fria-Lake Pleasant Sub-Basin. Attaining all uses and no exceedances.

- Cave Creek, from headwaters to Cave Creek Dam, is a 32.9 mile reach in the Cave Creek-Arizona Canal Diversion Channel Sub-Basin. Attaining all uses and no exceedances.

- Sycamore Creek, from Tank Canyon to Agua Fria River, is a 17.6 mile reach in the Ash Creek-Sycamore Creek Sub-Basin. Attaining all uses and no exceedances.

Water Quantity

The Agua Fria and its tributaries are generally intermittent streams except for some perennial stretches where impermeable bedrock forces groundwater into the streambed. The basin is bounded on the north by Hickey Mountain, on the west by the Bradshaw and Buckhorn Mountains, on the south by Lake Pleasant, and on the east by the Black Hills and New River Mountains.

Development of groundwater resources is increasing in the Agua Fria basin. Population growth in recent years has resulted in increased pumpage. Despite increased groundwater pumpage, water levels generally have not declined in the basin. The only area of declining water levels is around Cordes Junction where declines of several feet have been reported (Wilson, 1988). This suggests that overall the basin is still in a steady-state situation. Total groundwater reserves in the Agua Fria basin are estimated to be 3.5 million acre-feet.

*(http://www.azwater.gov/dwr/Content/Find_by_Program/Rural_Programs/content/map/UppAguFri.htm)*

Air Quality

Northern Maricopa County, which constitutes the lower section of the Agua Fria Watershed, is designated by EPA as a Non-Attainment Area because it does not meet EPA PM-10 Standards (Figure 3-2). The non-attainment area is identified as the “PM-10 Boundary” on Figure 3-2. The county is required to draw up and follow a plan to reduce the amount of PM-10 generated in order to put the area in compliance with the EPA standard. Local sources of PM-10 include agricultural operations, housing construction, vacant lots and unpaved roads. The implementation plan and a history of the process are found at ADEQ, http://www.azdeq.gov/environ/air/plan/notmeet.html#phoenix.

The EPA defines particulate matter as the term for solid or liquid particles found in the air. Some particles are large enough to be seen as soot or smoke. Other particles are so small

they can only be detected with an electron microscope. PM-10 particles are very small and can have adverse health effects because of their ability to reach the lower regions of the respiratory tract. Exposure to PM-10 can result in: effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. Children, older people, and people with chronic lung disease, are particularly sensitive to particulate matter (EPA website http://epa.gov/air/airtrends/aqtrnd95/pm10.html ).

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 on rangeland 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, forest stand improvement, herbaceous wind barriers, nutrient management, pest management, prescribed grazing, prescribed burning, range planting, recreation area improvement, riparian forest buffers, tree and shrub establishment, wetland development or restoration, wildlife upland habitat management, wildlife watering facility, wildlife wetland 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 result from control of wildfires, poor grazing management, 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 Ips beetles and the western pine beetle. 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.

The vegetation communities in the Agua Fria Watershed are mostly desert

shrubland and grassland, with only about 29% being forested lands subject to bark beetle infestation. Based on an analysis of the Forest Service GIS data, approximately 100 acres of forested federal lands in the Agua Fria have been affected by bark beetles, or only about 0.02 percent. This analysis only addresses Federal forested lands. The four forest types where bark beetles occur in the Agua Fria Watershed are Madrean Pine-Oak Forest and Woodland, Rocky Mountain Ponderosa Pine Woodland, Mogollon chaparral, and Madrean Pinyon-Juniper Woodland.

The Climate Assessment for the Southwest (CLIMAS) website (www.ispe.arizona.edu/climas) provides information on Arizona's drought status. Recent precipitation events have placed the area of Arizona that encompasses the Agua Fria Watershed in moderate drought status. However, the watershed remains abnormally dry. The long term drought status remains moderate, persisting throughout the watershed, but possibly intensifying in the northern portion of the watershed, with some improvement possible in the southern portion.

The Southwest Coordination Center (gacc.nifc.gov/swcc/predictive/outlooks/outlooks.htm) places the northern portion of the Agua Fria Watershed in the Normal category for significant wildland fire activity potential due to favorably moist conditions. However, the southern portion remains in the Above Normal category due to persisting drought conditions.

## 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 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, http://ecos.fws.gov) 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, http://www.azgfd.gov/w_c/heritage_program.shtml )

The Agua Fria Watershed contains 8 of the 55 threatened or endangered species listed for Arizona (Table 3-2). One of the species found in the Agua Fria watershed is the Mexican Spotted Owl (U.S. Fish & Wildlife Service, 2004). The Upper Agua Fria River contains the entire Mexican spotted owl habitat that occurs in the Agua Fria watershed. The Mexican spotted owl was listed as threatened on April 14, 1993, and a recovery plan was approved in December 1995. The distributional pattern of the Mexican spotted owl is more distinct than that of the other subspecies (Noon and McKelvey 1992).

The Mexican spotted owl appears to use a wider range of habitat types than the other subspecies. These unique aspects of the ecology of this owl require unique approaches for management. Habitat management plans may need to consider not only areas occupied by owls but also intervening areas, even where such areas are very different in habitat structure from areas typically occupied by spotted owls. (U.S. Fish & Wildlife Service, 2004)

The watershed also contains portions of desert tortoise habitat. The desert tortoise is listed as a wildlife of special concern by Arizona Game and Fish. The desert tortoise generally occupies Sonoran Desert habitat, along rocky slopes and bajadas, ranging from 508 feet to 5,250 feet in elevation. Although the desert tortoise is not listed as threatened or endangered, Arizona law prohibits removing these creatures from the wild or taking them across state lines. Desert tortoise are threatened by habitat fragmentation, illegal capture, invasion of exotic species, road kill, and predation. (Arizona Game & Fish website, 2006, http://www.gf.state.az.us/w_c/desert_tortoise.shtml ).

*Table 3-2: Agua Fria River Watershed Species of Concern Classifications and Observation [(1)]*

| Common Name | Species Name | USESA (2) | USFS (3) | BLM (4) | STATE (5) | Range of Observation |
|---|---|---|---|---|---|---|
| American Peregrine Falcon | Falco peregrinus anatum | SC | S | | WSC | 2005 |
| Arizona Agave | Agave arizonica | No status | | | HS | 1987-1992 |
| Arizona Giant Sedge | Carex ultra | | S | S | | 2001 |
| Arizona Phylox | Phlox amabilis | | S | | | 1970-1973 |
| Arizona Myotis (bat) | Myotis occultus | SC | | S | | 1986-1994PRE |
| Arizona Toad | Bufo microscaphus | SC | S | | | 1978-1996 |
| Bald Eagle | Haliaeetus leucocephalus | LT,PDL | S | | WSC | 2004 |
| Bald Eagle | Haliaeetus leucocephalus (wintering pop.) | LT,PDL | S | | WSC | 2005 |
| Bat Colony | | | | | | 1993-2003 |
| Belted Kingfisher | Ceryle alcyon | | | | WSC | 1994 |
| Bigelow Onion | Allium bigelovii | | | | SR | 1977-1980 |
| California Fan Palm | Washingtonia filifera | | | | SR | 1981 |
| California Leaf-nosed Bat | Macrotus californicus | SC | | | WSC | 1993-2000 |
| Cave Myotis (bat) | Myotis velifer | SC | | S | | 1986-1999PRE |
| Common Black-Hawk | Buteogallus anthracinus | | S | | WSC | 1993-2005 |
| Desert Pupfish | Cyprinodon macularius | LE | | | WSC | 1993-2004 |
| Desert Sucker | Catostomus clarki | SC | | S | | 1980-2003 |
| Designated Critical Habitat for Gila chub | CH for Gila intermedia | | | | | |
| Designated Critical Habitat for Mexican spotted owl | CH for Strix occidentalis lucida | | | | | |
| Eastwood Alum Root | Heuchera eastwoodiae | | S | | | 1976-2001SU |
| Flannel Bush | Fremontodendron californicum | | | S | SR | 1985-2002 |
| Fringed Myotis (bat) | Myotis thysanodes | SC | | S | | 1994 |
| Gila Chub | Gila intermedia | LE | S | | WSC | 1980-2003 |
| Gila Longfin Dace | Agosia chrysogaster chrysogaster | SC | | S | | 1980-2003 |
| Gila Topminnow | Poeciliopsis occidentalis occidentalis | LE | | | WSC | 1975-2004 |
| Greater Western Bonneted Bat | Eumops perotis californicus | SC | | | | 1986PRE |
| Maricopa Tiger Beetle | Cicindela oregona maricopa | SC | S | S | | 1978-1995 |
| Mazatzal Triteleia | Triteleia lemmoniae | | | | SR | 1965 |

| Common Name | Species Name | USESA (2) | USFS (3) | BLM (4) | STATE (5) | Range of Observation |
|---|---|---|---|---|---|---|
| Mexican Spotted Owl | Strix occidentalis lucida | LT | S | | WSC | 1997-2004 |
| Mt. Dellenbaugh Sandwort | Arenaria aberrans | | S | | | 2003 |
| Northern Goshawk | Accipiter gentilis | SC | S | | WSC | 1993 |
| Northern Mexican Gartersnake | | SC | S | | WSC | 1980-1992 |
| Pale Townsend's Big-eared Bat | Corynorhinus townsendii pallescens | SC | | | | 1994 |
| Pocketed Free-tailed Bat | Nyctinomops femorosaccus | | | S | | 1993 |
| Roundtail Chub | Gila robusta | SC | S | | WSC | 1965 |
| Sonoran Desert Tortoise | Gopherus agassizii (Sonoran Population) | SC | | | WSC | 1977-2004 |
| Southwestern Willow Flycatcher | Empidonax traillii extimus | LE | S | | WSC | 2004 |
| Speckled Dace | Rhinichthys osculus | SC | | S | | 1980-2003 |
| Toumey Agave | Agave toumeyana var. bella | | | | SR | 1976-1980 |
| Verde Rim Springsnail | Pyrgulopsis glandulosa | SC | S | S | | 2001 |
| Western Burrowing Owl | Athene cunicularia hypugaea | SC | | S | | 2001-2005 |
| Western Red Bat | Lasiurus blossevillii | | | | WSC | 2002 |
| Western Yellow Bat | Lasiurus xanthinus | | | | WSC | 2002 |
| Western Yellow-billed Cuckoo | Coccyzus americanus occidentalis | C | S | | WSC | 1993-2003PR |
| Yuma Clapper Rail | Rallus longirostris yumanensis | LE | | | WSC | 2003 |
| | Opuntia engelmannii var. flavispina | | | | SR | 1977 |
| | Opuntia engelmannii var. flavispina | | | | SR | NO DATE |

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

**(1)** Proposed for Listing: **(USESA) 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.

SC Species of Concern. The terms "Species of Concern" or "Species at Risk" should be considered as terms-of-art that describe the entire realm of taxa whose conservation status may be of concern to the US Fish and Wildlife Service, but neither term has official status (currently all former C2 species).

**(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) BLM US Bureau of Land Management** (2000 Animals, 2000 Plants)
US Department of Interior, BLM, Arizona State Office

S Sensitive: those taxa occurring on BLM Field Office Lands in Arizona which are considered sensitive by the Arizona State Office.

**(5) State Status**
NPL Arizona Native Plant Law (1993) Arizona Department of Agriculture

HS Highly Safeguarded: no collection allowed.

SR Salvage Restricted: collection only with permit.

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 Agua Fria River 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 the 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 groundwater, is dependent on this critical interface.

The desert and semi-desert ecosystems have developed in a climatic regime of wide fluctuations of precipitation, ranging from drought to flood. Human uses superimposed on that climatic regime can tend to exacerbate or ameliorate their effects on soils and vegetation. For example, early settlers brought in herds of livestock and eventually exceeded the capacity of the range, especially during drought periods. Changes in vegetation resulted, which in turn affect watershed condition. Large areas have seen increases in pinyon-juniper and reduced grasses and fibrous rooted plants. A number of introduced plants have also increased at the expense of native species. This has been the case on both some of the uplands and in riparian areas. Examples include annual plants such as cheatgrass (*Bromus tectorum*) and foxtail (*Bromus rubens*) on uplands and salt cedar (*Tamarix pentandra*) in riparian areas.

With rapidly increasing development of private lands and accelerated recreational use of public lands, impacts to vegetation and the soil surface may

affect hydrologic function. An increasing concern is the dumping and littering of waste materials, including some which are toxic, on public and private lands. This is particularly the case along major transportation arteries such as I-17 and Highway 69 and on public and state trust lands surrounding communities.

Large areas of the watershed are in chaparral vegetation with lesser portions in ponderosa pine. These were subject to frequent fires prior to European settlement. Many decades of fire suppression have resulted in the buildup of fuel loads which, when ignited, burn with flame height and heat release sufficient to kill ponderosa pine overstory and create a situation vulnerable to heavy storm runoff and erosion during the first monsoon seasons following the fire.

Riparian areas are quite limited in area but highly important to both humans and wildlife. Maintenance of base flow of stream segments and springs is necessary for the health of these critical areas. (adapted from Barnett, Hawkins & Guertin, 2004).

Conservation Progress/Status

Conservation progress for the previous five years in the Agua Fria River Watershed has focused on addressing the following primary resource concerns:

- Soil Condition – Organic Matter Depletion
- Water Quantity – inefficient Water Use on Irrigated Land
- Water Quality – Excessive Nutrients and organics in Ground Water
- Air Quality – Particulate Matter Less than 10 Micrometers (PM10)

The following table presents conservation accomplishments in this watershed during fiscal years (FY) 2002 through 2006, according to the NRCS Progress Reporting (Table 3-3).

Table 3-3: Agua Fria River Watershed Conservation Treatment Applied

| Agua Fria River Watershed (15070102)<br>Conservation Treatment Applied | FY02-06<br>TOTAL |
|---|---|
| Air Management (acres) | 99 |
| Comprehensive Nutrient Management Plan (number) | 3 |
| Conservation Crop Rotation (acres) | 149 |
| Irrigation Land Leveling (acres) | 368 |
| Irrigation System, Sprinkler (acres) | 412 |
| Irrigation Water Conveyance, Ditch and Canal Lining, (feet) | 1,239 |
| Irrigation Water Conveyance, Pipeline, Underground, Plastic (feet) | 12,595 |
| Irrigation Water Management (acres) | 1,868 |
| Nutrient Management (acres) | 752 |
| Pest Management (acres) | 565 |
| Prescribed Grazing (acres) | 1,000 |
| Residue Management, Seasonal (acres) | 696 |
| Upland Wildlife Habitat Management (acres) | 100 |

## 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 watershed. In 1990, the mean population density for the entire watershed was 305 people per square mile. The Agua Fria River below Lake Pleasant watershed had the highest population density with an average of 901 people per square mile, and a maximum of 7179. The Ash Creek and Sycamore Creek watershed had the lowest density with an average of only 1.71 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) and are shown in Table 4-2. A population density map (Figure 4-2) was created from these data. The mean population density in 2000 was 437 people per square mile. The Cave Creek – Arizona Canal Diversion Channel and the Agua Fria River below Lake Pleasant watersheds had nearly the same population density with approximately 1,123 and 1,236 people per square mile, respectively. The Agua Fria River below Lake Pleasant watershed had the highest maximum density of 9,208 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 (Figure 4-3) shows population increase or decrease over the ten year time frame. Overall, mean population density increased by 132 people per square mile during this ten year time period. Three watersheds had similar, large increases in average population: Agua Fria River below Lake Pleasant, New River, and Cave Creek – Arizona Canal Diversion Channel.

Table 4-3 shows the change in population density from 1990 to 2000 in people per square mile. The Ash Creek and Sycamore Creek watershed experienced a mean decrease of 0.22 people per square mile.

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.

Figure 4-4 and Table 4-4, Agua Fria River Watershed Housing Density for 2000, identifies mostly “rural” housing densities (>40 acres per unit) for the Cave Creek/Carefree area. Figure 4-5 and Table 4-5, Agua Fria River Watershed Housing Density for 2030, projects much higher housing “urban” densities (<0.6 acres per unit) for the same area. Similarly, “undeveloped” and “rural” farming areas west of Phoenix in 2000 become “exurban” and “suburban” in 2030.

*Table 4-1: Agua Fria River Watershed 1990 Population Density (people/square mile)*

| 10-digit Watershed Name | Area (sq. miles) | Population Density (people/sq.mi.) | | |
|---|---|---|---|---|
| | | Min | Max | Mean |
| Ash Creek and Sycamore Creek - 1507010201 | 260.55 | 0 | 46.00 | 1.71 |
| Big Bug Creek-Agua Fria River - 1507010202 | 324.14 | 0 | 1,090.86 | 45.14 |
| Black Canyon Creek - 1507010203 | 244.07 | 0 | 167.43 | 6.29 |
| Bishop Creek - 1507010204 | 236.45 | 0 | 167.43 | 6.57 |
| Agua Fria River-Lake Pleasant - 1507010205 | 371.81 | 0 | 129.43 | 2.00 |
| Cave Creek-Arizona Canal Diversion Channel - 1507010206 | 288.47 | 0 | 6,190.29 | 839.43 |
| Trilby Wash-Trilby Wash Basin - 1507010207 | 242.18 | 0 | 137.14 | 12.57 |
| New River - 1507010208 | 353.18 | 0 | 6,190.29 | 488.86 |
| Agua Fria River below Lake Pleasant - 1507010209 | 464.31 | 0 | 7,178.86 | 901.14 |
| *Total Agua Fria Watershed* | *2,785* | *0* | *7,179* | *305* |

*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.)*

*Table 4-2: Agua Fria River Watershed 2000 Population Density (people/square mile)*

| Watershed Name | Area (sq. mi.) | Population Density (people/sq.mi.) | | |
|---|---|---|---|---|
| | | Min | Max | Mean |
| Ash Creek and Sycamore Creek - 1507010201 | 260.55 | 0 | 16.11 | 1.54 |
| Big Bug Creek-Agua Fria River - 1507010202 | 324.14 | 0 | 2,490.12 | 92.84 |
| Black Canyon Creek - 1507010203 | 244.07 | 0 | 526.09 | 15.92 |
| Bishop Creek - 1507010204 | 236.45 | 0 | 526.09 | 13.03 |
| Agua Fria River-Lake Pleasant - 1507010205 | 371.81 | 0 | 341.16 | 4.93 |
| Cave Creek-Arizona Canal Diversion Channel - 1507010206 | 288.47 | 0 | 6,377.48 | 1,123.38 |
| Trilby Wash-Trilby Wash Basin - 1507010207 | 242.18 | 0 | 965.74 | 28.51 |
| New River - 1507010208 | 353.18 | 0 | 6,377.48 | 794.50 |
| Agua Fria River below Lake Pleasant - 1507010209 | 464.31 | 0 | 9,208.12 | 1,235.97 |
| *Total Agua Fria Watershed* | *2,785* | *0* | *9,208* | *437* |

*Note: Adjacent watersheds may share a grid square. Data Sources: ESRI Data Products, Census 2000, October 17, 2003. http://www.esri.com/data/*

*Table 4-3: Agua Fria River Watershed Population Density Change 1990-2000 (people/square mile)*

| Watershed Name | Area (sq. mi.) | Population Density (people/sq.mi.) | | |
|---|---|---|---|---|
| | | Min | Max | Mean |
| Ash Creek and Sycamore Creek - 1507010201 | 260.55 | 0 | -38.07 | -0.22 |
| Big Bug Creek-Agua Fria River - 1507010202 | 324.14 | 0 | 1,399.05 | 47.69 |
| Black Canyon Creek - 1507010203 | 244.07 | 0 | 358.51 | 9.72 |
| Bishop Creek - 1507010204 | 236.45 | 0 | 358.51 | 6.44 |
| Agua Fria River-Lake Pleasant - 1507010205 | 371.81 | 0 | 211.73 | 3.07 |
| Cave Creek-Arizona Canal Diversion Channel - 1507010206 | 288.47 | 0 | 2,468.24 | 283.93 |
| Trilby Wash-Trilby Wash Basin - 1507010207 | 242.18 | 0 | 882.31 | 15.89 |
| New River - 1507010208 | 353.18 | 0 | 2,468.24 | 305.65 |
| Agua Fria River below Lake Pleasant - 1507010209 | 464.31 | 0 | 2,180.42 | 334.69 |
| Total Agua Fria Watershed | 2,785 | 0 | 2,468 | 132 |

*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: Agua Fria River Watershed Housing Density 2000 (Percent of Watershed) (Part 1 of 2)*

| Housing Density | Big Bug Creek-Agua Fria River 1507010202 | Ash Creek and Sycamore Creek 1507010201 | Bishop Creek 1507010204 | New River 1507010208 | Cave Creek-Arizona Canal Diversion Channel 1507010206 |
|---|---|---|---|---|---|
| Undeveloped Private | 4.80% | 1.00% | 1.82% | 7.40% | 7.10% |
| Rural | 6.01% | 2.80% | 0.14% | 4.21% | 4.19% |
| Exurban | 5.17% | 0.86% | 0.95% | 11.61% | 21.47% |
| Suburban | 0.34% | - | 0.27% | 4.14% | 7.13% |
| Urban | 0.15% | - | 0.03% | 7.49% | 10.86% |

*Table 4-4: Agua Fria River Watershed Housing Density 2000 (Percent of Watershed) (Part 2 of 2)*

| Housing Density | Agua Fria River below Lake Pleasant 1507010209 | Trilby Wash-Trilby Wash Basin 1507010207 | Agua Fria River-Lake Pleasant 1507010205 | Black Canyon Creek 1507010203 | Agua Fria River Watershed | Agua Fria River Watershed (sq. miles) |
|---|---|---|---|---|---|---|
| Undeveloped Private | 23.44% | 20.86% | 12.66% | 0.78% | 33.90% | 277 |
| Rural | 14.54% | 12.74% | 7.50% | 1.25% | 22.41% | 183 |
| Exurban | 9.30% | 5.13% | 0.11% | 1.81% | 22.64% | 185 |
| Suburban | 4.49% | 0.25% | 0.05% | 0.13% | 7.22% | 59 |
| Urban | 11.70% | 0.08% | 0.04% | <0.01% | 13.83% | 113 |

*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: Agua Fria River Watershed Housing Density Projections 2030 (Percent of Watershed) (Part 1)*

| Housing Density | Big Bug Creek-Agua Fria River 1507010202 | Ash Creek and Sycamore Creek 1507010201 | Bishop Creek 1507010204 | New River 1507010208 | Cave Creek-Arizona Canal Diversion Channel 1507010206 |
|---|---|---|---|---|---|
| Undeveloped Private | 0.85% | 0.28% | 0.33% | 1.52% | 1.36% |
| Rural | 2.72% | 1.73% | 1.38% | 1.78% | 1.27% |
| Exurban | 10.80% | 2.65% | 0.43% | 8.70% | 13.38% |
| Suburban | 1.00% | 0.01% | 0.27% | 6.04% | 7.72% |
| Urban | 1.10% | - | 0.79% | 16.81% | 27.02% |

*Table 4-5: Agua Fria River Watershed Housing Density Projections 2030 (Percent of Watershed) (Part 2)*

| Housing Density | Agua Fria River below Lake Pleasant 1507010209 | Trilby Wash-Trilby Wash Basin 1507010207 | Agua Fria River-Lake Pleasant 1507010205 | Black Canyon Creek 1507010203 | Agua Fria River Watershed | Agua Fria River Watershed (sq. miles) |
|---|---|---|---|---|---|---|
| Undeveloped Private | 4.94% | 5.11% | 2.03% | 0.39% | 6.98% | 57 |
| Rural | 1.73% | 3.36% | 17.04% | 0.57% | 13.10% | 107 |
| Exurban | 27.32% | 29.02% | 1.12% | 2.56% | 39.16% | 320 |
| Suburban | 5.29% | 1.30% | 0.06% | 0.29% | 9.30% | 76 |
| Urban | 24.20% | 0.27% | 0.10% | 0.17% | 31.46% | 257 |

*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/*

## Agua Fria River 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 Agua Fria River Watershed is comprised of:

- Considerable grazing land for many livestock operations
- Multiple recreational equestrian facilities
- A few equestrian breeding facilities
- Several small dairy facilities
- Multiple nursery facilities
- A few small hog facilities
- A significant number of apiary (honey bee) operations
- A few citrus orchards
- A few plantings of pecans
- A significant amount of rose production
- A mixed variety of crops including:
    - Cotton
    - Alfalfa
    - Corn
- Small grains
- Potatoes
- A variety of melons
- A variety of green leafy vegetables

Data Source:

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.

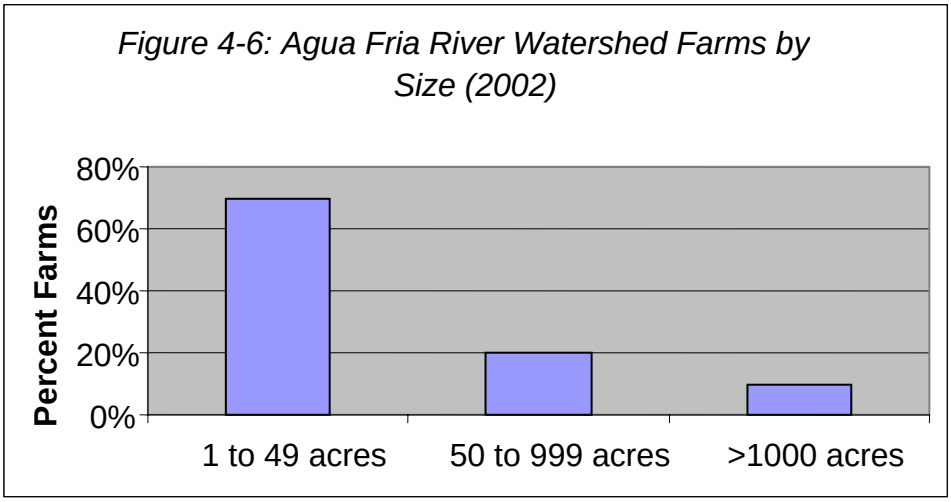
Data is withheld by NASS for categories with one to four farms. This is to protect the identity of individual farmers. Farm counts for these zip codes are included in the "State Total" category. Some categories only contained stars instead of numbers. Each star was counted as one farm. But because each 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.

A total of five zip code areas contained no NASS data about agricultural practices. Three of the zip codes that lie within AF Watershed contained no information from NASS databases. Two of the zip codes that lie partially within AF Watershed had no information in NASS databases. NASS assumed that

no information for those areas meant that there was no agricultural activity taking place within that zip code area. In addition, 13 zip code areas were listed as XX ( 4 ) or HH ( 9 ), meaning that these are new zip code areas formerly covered by water or were uninhabited, respectively.

*Figure 4-6: Agua Fria River Watershed Farms by Size (2002)*



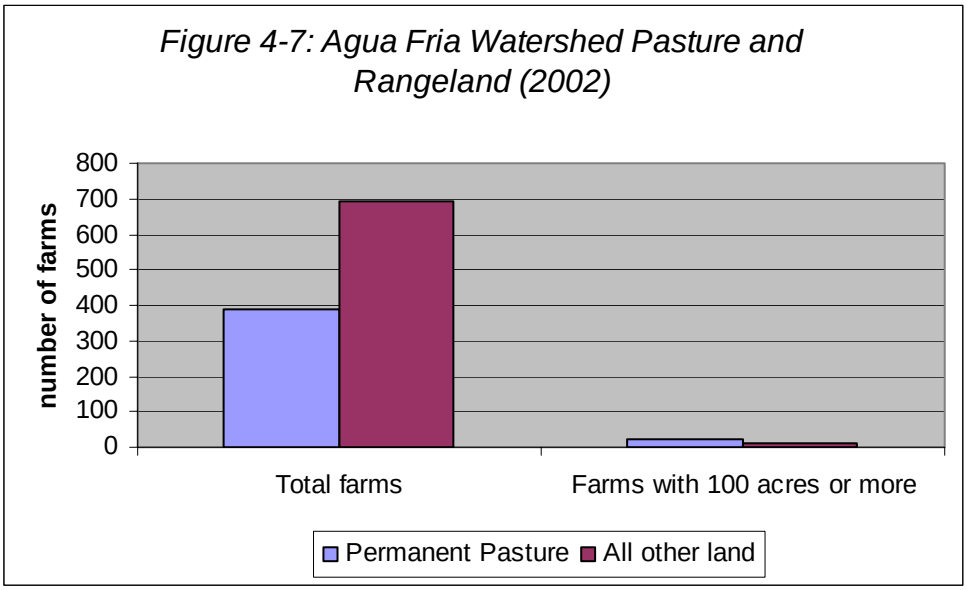

Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

*Table 4-6: Agua Fria Watershed Farms by Size (2002)*

| All farms | 1 to 49 acres | 50 to 999 acres | >1000 acres |
|---|---|---|---|
| 1173 | 70% | 20% | 10% |

*Percents rounded.*
*Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)*

*Figure 4-7: Agua Fria Watershed Pasture and Rangeland (2002)*



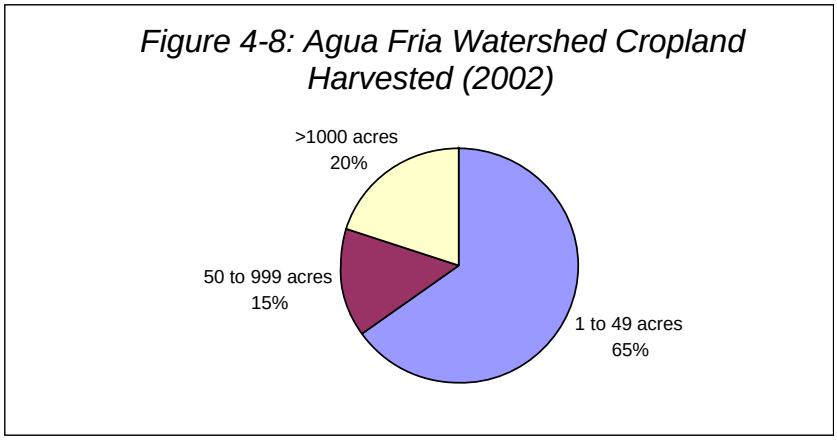

Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

*Table 4-7: Agua Fria Watershed Pasture and Rangeland (2002)*

| Category | Total farms | Farms 100 acres or more |
|---|---|---|
| Permanent pasture and rangeland | 381 | 20% |
| All other land | 694 | 10% |

*Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)*

*Figure 4-8: Agua Fria Watershed Cropland Harvested (2002)*




Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

*Table 4-8: Agua Fria Watershed Cropland Harvested (2002)*

| Total farms | 1 to 49 acres | 50 to 999 acres | >1000 acres |
|---|---|---|---|
| 413 | 65% | 15% | 20% |

*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 Agua Fria 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. To contribute additional or updated information for this watershed, visit the NRCS Arizona website: www.az.nrcs.usda.gov/programs.

The tables show three levels of conservation treatment (Baseline, Progressive, Resource Management System) for each of the major land uses (crop, range, forest, 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.

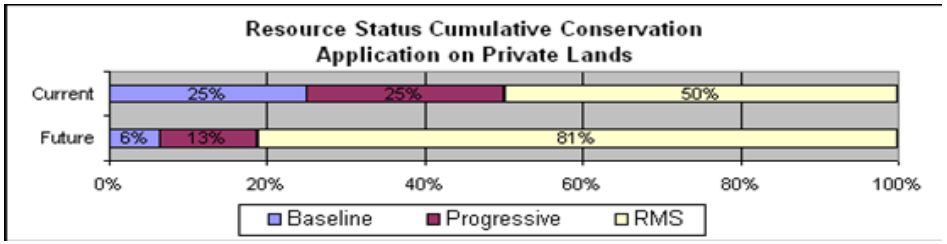
For each land use, the results of the assessment are presented in two parts. Part 1 (Assessment Information) summarizes the conservation practices at each treatment level and the quantities of practices for current benchmark conditions and projected future conditions. Part 1 also displays the four primary 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 | AGUA FRIA RIVER - 15070102 | | | | LANDUSE ACRES | 68,102 | | |
|---|---|---|---|---|---|---|---|---|
| LANDUSE TYPE | CROP | | | | TYPICAL UNIT SIZE ACRES | 1,000 | | |
| ASSESSMENT INFORMATION | | | | | CALCULATED PARTICIPATION | 75% | | |
| | 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 Nutrients and Organics in Groundwater | Air Quality – Particulate matter less than 10 micrometers in diameter (PM 10) |
| **Baseline** | | | | **System Rating ->** | **1** | **5** | **2** | **0** |
| Irrigation Land Leveling (ac.) 464 | 4,256 | 1,064 | 0 | 1,064 | 0 | 4 | 0 | 0 |
| Irrigation System, Surface and Subsurface (ac.) 443 | 17,026 | 4,256 | 0 | 4,256 | 0 | 4 | 0 | 0 |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 | 17,026 | 4,256 | 0 | 4,256 | 2 | 4 | 2 | 0 |
| Irrigation Water Conveyance, Pipeline (ft.) 430 | 8,513 | 2,128 | 0 | 2,128 | 2 | 5 | 3 | 0 |
| Structure for Water Control (no.) 587 | 17 | 4 | 0 | 4 | 0 | 3 | 0 | 0 |
| **Total Acreage at Baseline** | **17,026** | **4,256** | **0** | **4,256** | | | | |
| **Progressive** | | | | **System Rating ->** | **4** | **5** | **4** | **3** |
| Conservation Crop Rotation (ac.) 328 | 17,026 | 4,256 | 4,256 | 8,513 | 4 | 3 | 1 | 3 |
| Irrigation Land Leveling (ac.) 464 | 8,513 | 3,192 | 1,064 | 4,256 | 0 | 4 | 0 | 0 |
| Irrigation System, Surface and Subsurface (ac.) 443 | 8,513 | 4,256 | 0 | 4,256 | 0 | 4 | 0 | 0 |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 | 85,128 | 25,538 | 17,026 | 42,564 | 2 | 4 | 2 | 0 |
| Irrigation Water Conveyance, Pipeline (ft.) 430 | 17,026 | 6,385 | 2,128 | 8,513 | 2 | 5 | 3 | 0 |
| Irrigation Water Management (ac.) 449 | 17,026 | 4,256 | 4,256 | 8,513 | 4 | 5 | 5 | 3 |
| Residue Management, Seasonal (ac.) 344 | 8,513 | 2,128 | 2,128 | 4,256 | 3 | 1 | -1 | 3 |
| Structure for Water Control (no.) 587 | 85 | 26 | 17 | 43 | 0 | 3 | 0 | 0 |
| **Total Acreage at Progressive Level** | **17,026** | **4,256** | **4,256** | **8,513** | | | | |
| **RMS** | | | | **System Rating ->** | **4** | **5** | **4** | **3** |
| Conservation Crop Rotation (ac.) 328 | 34,051 | 46,820 | 8,513 | 55,333 | 4 | 3 | 1 | 3 |
| Irrigation Land Leveling (ac.) 464 | 34,051 | 42,564 | 12,769 | 55,333 | 0 | 4 | 0 | 0 |
| Irrigation System, Microirrigation (ac.) 441 | 3,405 | 3,405 | 2,128 | 5,533 | 0 | 4 | 0 | 0 |
| Irrigation System, Sprinkler (ac.) 442 | 3,405 | 3,405 | 2,128 | 5,533 | 0 | 4 | 0 | 0 |
| Irrigation System, Surface and Subsurface (ac.) 443 | 34,051 | 48,948 | 6,385 | 55,333 | 0 | 4 | 0 | 0 |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 | 340,510 | 412,868 | 140,460 | 553,329 | 2 | 4 | 2 | 0 |
| Irrigation Water Conveyance, Pipeline (ft.) 430 | 68,102 | 85,128 | 25,538 | 110,666 | 2 | 5 | 3 | 0 |
| Irrigation Water Management (ac.) 449 | 34,051 | 46,820 | 8,513 | 55,333 | 4 | 5 | 5 | 3 |
| Nutrient Management (ac.) 590 | 34,051 | 34,051 | 21,282 | 55,333 | 3 | 1 | 5 | 1 |
| Pest Management (ac.) 595 | 34,051 | 34,051 | 21,282 | 55,333 | 0 | 1 | 0 | 0 |
| Residue and Tillage Management, Mulch Till (ac.) 345 | 17,026 | 17,026 | 10,641 | 27,666 | 3 | 1 | -1 | 3 |
| Residue Management, Seasonal (ac.) 344 | 17,026 | 23,410 | 4,256 | 27,666 | 3 | 1 | -1 | 3 |
| Structure for Water Control (no.) 587 | 341 | 413 | 140 | 553 | 0 | 3 | 0 | 0 |
| **Total Acreage at RMS Level** | **34,051** | **34,051** | **21,282** | **55,333** | | | | |

| WATERSHED NAME & CODE | AGUA FRIA RIVER - 15070102 | | | | LANDUSE ACRES | 68,102 | | |
|---|---|---|---|---|---|---|---|---|
| LANDUSE TYPE | CROP | | | | TYPICAL UNIT SIZE ACRES | 1,000 | | |
| CONSERVATION COST TABLE | | | | | CALCULATED PARTICIPATION | 75% | | |
| | 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 | 4,256 | $0 | $127,691 | $25,538 | $139,312 | $0 | $42,564 | $65,521 |
| Irrigation Land Leveling (ac.) 464 | 1,064 | $532,047 | $0 | $106,409 | $638,456 | $532,047 | $31,923 | $666,517 |
| Irrigation System, Surface and Subsurface (ac.) 443 | 0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 | 17,026 | $68,102 | $0 | $13,620 | $81,722 | $68,102 | $2,724 | $79,577 |
| Irrigation Water Conveyance, Pipeline (ft.) 430 | 2,128 | $10,641 | $0 | $2,128 | $12,769 | $10,641 | $426 | $12,434 |
| Irrigation Water Management (ac.) 449 | 4,256 | $0 | $127,691 | $25,538 | $139,312 | $0 | $42,564 | $65,521 |
| Residue Management, Seasonal (ac.) 344 | 2,128 | $0 | $38,307 | | $41,793 | $0 | $12,769 | $19,656 |
| Structure for Water Control (no.) 587 | 17 | $2,554 | $0 | | $3,065 | $2,554 | $102 | $2,984 |
| **Subtotal** | **4,256** | **$613,344** | **$293,690** | **$181,407** | **$1,056,429** | **$613,344** | **$133,071** | **$912,210** |
| **RMS** | | | | | | | | |
| Conservation Crop Rotation (ac.) 328 | 8,513 | $0 | $255,383 | $51,077 | $278,623 | $0 | $85,128 | $131,041 |
| Irrigation Land Leveling (ac.) 464 | 12,769 | $6,384,563 | $0 | $1,276,913 | $7,661,475 | $6,384,563 | $383,074 | $7,998,208 |
| Irrigation System, Microirrigation (ac.) 441 | 2,128 | $1,596,141 | $0 | $319,228 | $1,915,369 | $1,596,141 | $159,614 | $2,268,493 |
| Irrigation System, Sprinkler (ac.) 442 | 2,128 | $1,808,959 | $0 | $361,792 | $2,170,751 | $1,808,959 | $72,358 | $2,113,759 |
| Irrigation System, Surface and Subsurface (ac.) 443 | 6,385 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428 | 140,460 | $561,842 | $0 | $112,368 | $674,210 | $561,842 | $22,474 | $656,509 |
| Irrigation Water Conveyance, Pipeline (ft.) 430 | 25,538 | $127,691 | $0 | $25,538 | $153,230 | $127,691 | $5,108 | $149,207 |
| Irrigation Water Management (ac.) 449 | 8,513 | $0 | $255,383 | $51,077 | $278,623 | $0 | $85,128 | $131,041 |
| Nutrient Management (ac.) 590 | 21,282 | $0 | $638,456 | $127,691 | $696,558 | $0 | $212,819 | $327,603 |
| Pest Management (ac.) 595 | 21,282 | $0 | $638,456 | $127,691 | $696,558 | $0 | $212,819 | $327,603 |
| Residue and Tillage Management, Mulch Till (ac.) 345 | 10,641 | $0 | $271,344 | | $296,037 | $0 | $90,448 | $139,231 |
| Residue Management, Seasonal (ac.) 344 | 4,256 | $0 | $76,615 | | $83,587 | $0 | $25,538 | $39,312 |
| Structure for Water Control (no.) 587 | 140 | $21,069 | $0 | | $25,283 | $21,069 | $843 | $24,619 |
| **Subtotal** | **21,282** | **$10,500,264** | **$2,135,636** | **$2,527,180** | **$14,930,305** | **$10,500,264** | **$1,355,349** | **$14,306,627** |
| **Grand Total** | **25,538** | **$11,113,608** | **$2,429,326** | **$2,708,587** | **$15,986,734** | **$11,113,608** | **$1,488,420** | **$15,218,836** |



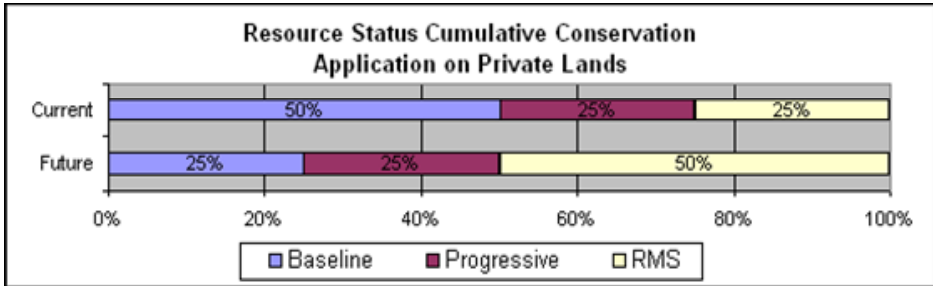

| Chart Refers To | |
|---|---|
| Landuse Type | CROP |
| Calculated Participation Rate | 75% |

| Average PV Costs per Ac | | |
|---|---|---|
| System | Federal | Private |
| Prog | $248.20 | $214.32 |
| RMS | $701.55 | $672.24 |

| WATERSHED NAME & CODE | AGUA FRIA RIVER - 15070102 | | | | LANDUSE ACRES | | 1,355,859 | |
|---|---|---|---|---|---|---|---|---|
| LANDUSE TYPE | RANGE | | | | TYPICAL UNIT SIZE ACRES | | 50,000 | |
| ASSESSMENT INFORMATION | | | | | CALCULATED PARTICIPATION | | 50% | |
| | 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 ->** | **1** | **3** | **0** | **0** |
| Fence (ft.) 382 | 67,793 | 33,896 | 0 | 33,896 | 0 | 1 | 1 | 1 |
| Pipeline (ft.) 516 | 67,793 | 33,896 | 0 | 33,896 | 3 | 3 | 0 | 0 |
| Watering Facility (no.) 614 | 136 | 68 | 0 | 68 | 0 | 4 | 1 | 0 |
| **Total Acreage at Baseline** | **677,930** | **338,965** | **0** | **338,965** | | | | |
| **Progressive** | | | | **System Rating ->** | **4** | **3** | **4** | **4** |
| Fence (ft.) 382 | 169,482 | 101,689 | 67,793 | 169,482 | 0 | 1 | 1 | 1 |
| Pipeline (ft.) 516 | 169,482 | 101,689 | 67,793 | 169,482 | 3 | 3 | 0 | 0 |
| Prescribed Burning (ac.) 338 | 33,896 | 16,948 | 16,948 | 33,896 | 1 | 1 | 4 | 4 |
| Prescribed Grazing (ac.) 528 | 338,965 | 169,482 | 169,482 | 338,965 | 5 | 3 | 5 | 5 |
| Watering Facility (no.) 614 | 136 | 102 | 34 | 136 | 0 | 4 | 1 | 0 |
| **Total Acreage at Progressive Level** | **338,965** | **169,482** | **169,482** | **338,965** | | | | |
| **RMS** | | | | **System Rating ->** | **4** | **4** | **5** | **5** |
| Brush Management (ac.) 314 | 33,896 | 33,896 | 33,896 | 67,793 | 4 | 4 | 5 | 3 |
| Fence (ft.) 382 | 338,965 | 440,654 | 237,275 | 677,930 | 0 | 1 | 1 | 1 |
| Pipeline (ft.) 516 | 338,965 | 440,654 | 237,275 | 677,930 | 3 | 3 | 0 | 0 |
| Prescribed Burning (ac.) 338 | 33,896 | 50,845 | 16,948 | 67,793 | 1 | 1 | 4 | 4 |
| Prescribed Grazing (ac.) 528 | 338,965 | 508,447 | 169,482 | 677,930 | 5 | 3 | 5 | 5 |
| Range Planting (ac.) 550 | 33,896 | 33,896 | 33,896 | 67,793 | 4 | 2 | 5 | 5 |
| Upland Wildlife Habitat Management (ac.) 645 | 338,965 | 338,965 | 338,965 | 677,930 | 0 | 0 | 4 | 1 |
| Watering Facility (no.) 614 | 339 | 441 | 237 | 678 | 0 | 4 | 1 | 0 |
| Wildlife Watering Facility (no.) 648 | 68 | 68 | 68 | 136 | 0 | 4 | 1 | 0 |
| **Total Acreage at RMS Level** | **338,965** | **338,965** | **338,965** | **677,930** | | | | |

| WATERSHED NAME & CODE | AGUA FRIA RIVER - 15070102 | LANDUSE ACRES | 1,355,859 |
|---|---|---|---|
| LANDUSE TYPE | RANGE | TYPICAL UNIT SIZE ACRES | 50,000 |
| CONSERVATION COST TABLE | | CALCULATED PARTICIPATION | 50% |

| | 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 | 67,793 | $101,689 | $0 | $20,338 | $122,027 | $101,689 | $4,068 | $118,824 |
| Pipeline (ft.) 516 | 67,793 | $271,172 | $0 | $54,234 | $325,406 | $271,172 | $10,847 | $316,863 |
| Prescribed Burning (ac.) 338 | 16,948 | $423,706 | $0 | $84,741 | $508,447 | $423,706 | $8,474 | $459,402 |
| Prescribed Grazing (ac.) 528 | 169,482 | $127,112 | $0 | $25,422 | $152,534 | $127,112 | $0 | $127,112 |
| Watering Facility (no.) 614 | 34 | $16,948 | $0 | $3,390 | $20,338 | $16,948 | $1,017 | $21,232 |
| **Subtotal** | **169,482** | **$940,627** | **$0** | **$188,125** | **$1,128,753** | **$940,627** | **$24,405** | **$1,043,432** |
| **RMS** | | | | | | | | |
| Brush Management (ac.) 314 | 33,896 | $2,033,789 | $0 | $406,758 | $2,440,546 | $2,033,789 | $40,676 | $2,205,130 |
| Fence (ft.) 382 | 237,275 | $355,913 | $0 | $71,183 | $427,096 | $355,913 | $14,237 | $415,882 |
| Pipeline (ft.) 516 | 237,275 | $949,101 | $0 | $189,820 | $1,138,922 | $949,101 | $37,964 | $1,109,020 |
| Prescribed Burning (ac.) 338 | 16,948 | $423,706 | $0 | $84,741 | $508,447 | $423,706 | $8,474 | $459,402 |
| Prescribed Grazing (ac.) 528 | 169,482 | $127,112 | $0 | $25,422 | $152,534 | $127,112 | $0 | $127,112 |
| Range Planting (ac.) 550 | 33,896 | $1,016,894 | $0 | $203,379 | $1,220,273 | $1,016,894 | $20,338 | $1,102,565 |
| Upland Wildlife Habitat Management (ac.) 645 | 338,965 | $0 | $1,321,963 | $264,393 | $1,442,266 | $0 | $440,654 | $678,322 |
| Watering Facility (no.) 614 | 237 | $118,638 | $0 | $23,728 | $142,365 | $118,638 | $7,118 | $148,622 |
| Wildlife Watering Facility (no.) 648 | 68 | $33,896 | $0 | $6,779 | $40,676 | $33,896 | $678 | $36,752 |
| **Subtotal** | **338,965** | **$5,059,049** | **$1,321,963** | **$1,276,202** | **$7,513,125** | **$5,059,049** | **$570,139** | **$6,282,807** |
| **Grand Total** | **508,447** | **$5,999,676** | **$1,321,963** | **$1,464,328** | **$8,641,878** | **$5,999,676** | **$594,544** | **$7,326,239** |



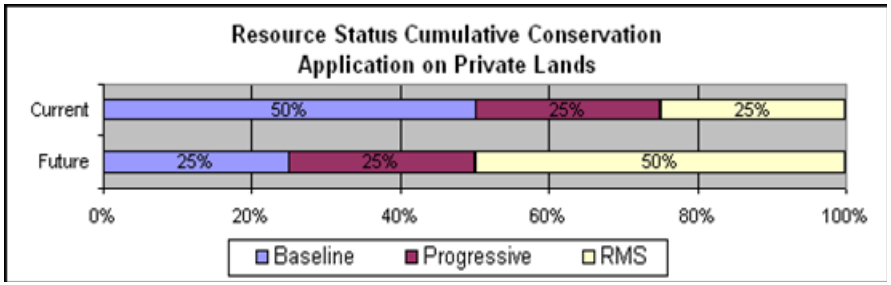

| Chart Refers To | |
|---|---|
| Landuse Type | RANGE |
| Calculated Participation Rate | 50% |

| Average PV Costs per Ac | | |
|---|---|---|
| System | Federal | Private |
| Prog | $6.66 | $6.16 |
| RMS | $22.16 | $18.54 |

| WATERSHED NAME & CODE | AGUA FRIA RIVER - 15070102 | | | | LANDUSE ACRES | | 80,430 | |
|---|---|---|---|---|---|---|---|---|
| LANDUSE TYPE | FOREST | | | | TYPICAL UNIT SIZE ACRES | | 50,000 | |
| ASSESSMENT INFORMATION | | | | | CALCULATED PARTICIPATION | | 50% | |
| | 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 ->** | **1** | **3** | **0** | **0** |
| Fence (ft.) 382 | 4,022 | 2,011 | 0 | 2,011 | 0 | 1 | 1 | 1 |
| Pipeline (ft.) 516 | 4,022 | 2,011 | 0 | 2,011 | 3 | 3 | 0 | 0 |
| Watering Facility (no.) 614 | 8 | 4 | 0 | 4 | 0 | 4 | 1 | 0 |
| **Total Acreage at Baseline** | **40,215** | **20,108** | **0** | **20,108** | | | | |
| **Progressive** | | | | **System Rating ->** | **4** | **3** | **4** | **4** |
| Fence (ft.) 382 | 10,054 | 6,032 | 4,022 | 10,054 | 0 | 1 | 1 | 1 |
| Pipeline (ft.) 516 | 10,054 | 6,032 | 4,022 | 10,054 | 3 | 3 | 0 | 0 |
| Prescribed Burning (ac.) 338 | 2,011 | 1,005 | 1,005 | 2,011 | 1 | 1 | 4 | 4 |
| Prescribed Grazing (ac.) 528 | 20,108 | 10,054 | 10,054 | 20,108 | 5 | 3 | 5 | 5 |
| Watering Facility (no.) 614 | 8 | 6 | 2 | 8 | 0 | 4 | 1 | 0 |
| **Total Acreage at Progressive Level** | **20,108** | **10,054** | **10,054** | **20,108** | | | | |
| **RMS** | | | | **System Rating ->** | **5** | **4** | **5** | **3** |
| Brush Management (ac.) 314 | 2,011 | 2,011 | 2,011 | 4,022 | 4 | 4 | 5 | 3 |
| Fence (ft.) 382 | 20,108 | 26,140 | 14,075 | 40,215 | 0 | 1 | 1 | 1 |
| Pipeline (ft.) 516 | 20,108 | 26,140 | 14,075 | 40,215 | 3 | 3 | 0 | 0 |
| Prescribed Burning (ac.) 338 | 2,011 | 3,016 | 1,005 | 4,022 | 1 | 1 | 4 | 4 |
| Prescribed Grazing (ac.) 528 | 20,108 | 30,161 | 10,054 | 40,215 | 5 | 3 | 5 | 5 |
| Tree/Shrub Establishment (ac.) 612 | 2,011 | 2,011 | 2,011 | 4,022 | 5 | 1 | 4 | -3 |
| Upland Wildlife Habitat Management (ac.) 645 | 20,108 | 20,108 | 20,108 | 40,215 | 0 | 0 | 4 | 1 |
| Watering Facility (no.) 614 | 20 | 26 | 14 | 40 | 0 | 4 | 1 | 0 |
| Wildlife Watering Facility (no.) 648 | 4 | 4 | 4 | 8 | 0 | 0 | 0 | 0 |
| **Total Acreage at RMS Level** | **20,108** | **20,108** | **20,108** | **40,215** | | | | |

| WATERSHED NAME & CODE | AGUA FRIA RIVER - 15070102 | LANDUSE ACRES | 80,430 |
|---|---|---|---|
| LANDUSE TYPE | FOREST | TYPICAL UNIT SIZE ACRES | 50,000 |
| CONSERVATION COST TABLE | | CALCULATED PARTICIPATION | 50% |

| | 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 | 4,022 | $6,032 | $0 | $1,206 | $7,239 | $6,032 | $241 | $7,049 |
| Pipeline (ft.) 516 | 4,022 | $16,086 | $0 | $3,217 | $19,303 | $16,086 | $643 | $18,796 |
| Prescribed Burning (ac.) 338 | 1,005 | $25,134 | $0 | $5,027 | $30,161 | $25,134 | $503 | $27,252 |
| Prescribed Grazing (ac.) 528 | 10,054 | $7,540 | $0 | $1,508 | $9,048 | $7,540 | $0 | $7,540 |
| Watering Facility (no.) 614 | 2 | $1,005 | $0 | $201 | $1,206 | $1,005 | $60 | $1,259 |
| **Subtotal** | **10,054** | **$55,798** | **$0** | **$11,160** | **$66,958** | **$55,798** | **$1,448** | **$61,897** |
| **RMS** | | | | | | | | |
| Brush Management (ac.) 314 | 2,011 | $120,645 | $0 | $24,129 | $144,774 | $120,645 | $2,413 | $130,809 |
| Fence (ft.) 382 | 14,075 | $21,113 | $0 | $4,223 | $25,335 | $21,113 | $845 | $24,670 |
| Pipeline (ft.) 516 | 14,075 | $56,301 | $0 | $11,260 | $67,561 | $56,301 | $2,252 | $65,787 |
| Prescribed Burning (ac.) 338 | 1,005 | $25,134 | $0 | $5,027 | $30,161 | $25,134 | $503 | $27,252 |
| Prescribed Grazing (ac.) 528 | 10,054 | $7,540 | $0 | $1,508 | $9,048 | $7,540 | $0 | $7,540 |
| Tree/Shrub Establishment (ac.) 612 | 2,011 | $9,551 | $0 | $1,910 | $11,461 | $9,551 | $191 | $10,356 |
| Upland Wildlife Habitat Management (ac.) 645 | 20,108 | $0 | $78,419 | $15,684 | $85,556 | $0 | $26,140 | $40,238 |
| Watering Facility (no.) 614 | 14 | $7,038 | $0 | $1,408 | $8,445 | $7,038 | $422 | $8,816 |
| Wildlife Watering Facility (no.) 648 | 4 | $2,011 | $0 | $402 | $2,413 | $2,011 | $40 | $2,180 |
| **Subtotal** | **20,108** | **$249,333** | **$78,419** | **$65,550** | **$384,755** | **$249,333** | **$32,805** | **$317,649** |
| **Grand Total** | **30,161** | **$305,131** | **$78,419** | **$76,710** | **$451,713** | **$305,131** | **$34,253** | **$379,546** |



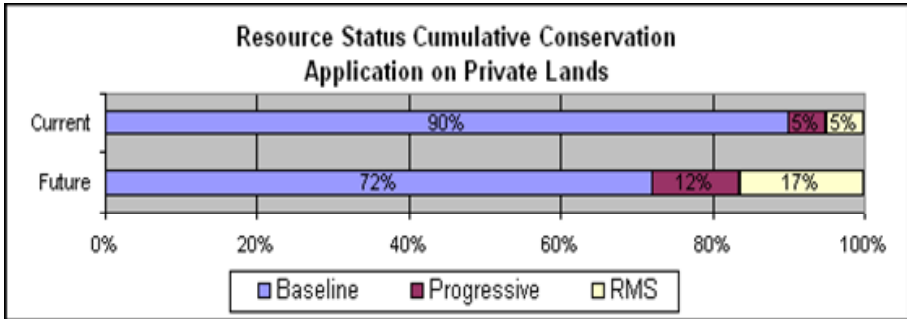

| Chart Refers To | |
|---|---|
| Landuse Type | FOREST |
| Calculated Participation Rate | 50% |

| Average PV Costs per Ac | | |
|---|---|---|
| System | Federal | Private |
| Prog | $6.66 | $6.16 |
| RMS | $19.13 | $15.80 |

| WATERSHED NAME & CODE | AGUA FRIA RIVER - 15070102 | | | | LANDUSE ACRES | | | 268,540 |
|---|---|---|---|---|---|---|---|---|
| LANDUSE TYPE | URBAN | | | | TYPICAL UNIT SIZE ACRES | | | 10 |
| ASSESSMENT INFORMATION | | | | | CALCULATED PARTICIPATION | | | 22% |
| | 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 Nutrients and Organics in Groundwater | Air Quality – Particulate matter less than 10 micrometers in diameter (PM 10) |
| **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** | **241,686** | **193,349** | **0** | **193,349** | | | | |
| **Progressive** | | | | **System Rating ->** | **2** | **3** | **3** | **1** |
| Irrigation System, Surface and Subsurface (ac.) 443 | 6,714 | 3,357 | 12,084 | 15,441 | 0 | 0 | 0 | 0 |
| Irrigation Water Management (ac.) 449 | 13,427 | 6,714 | 24,169 | 30,882 | 4 | 5 | 5 | 3 |
| **Total Acreage at Progressive Level** | **13,427** | **6,714** | **24,169** | **30,882** | | | | |
| **RMS** | | | | **System Rating ->** | **3** | **4** | **4** | **2** |
| Atmospheric Resource Quality Management (ac.) 370 | 13,427 | 13,427 | 30,882 | 44,309 | 2 | 0 | 0 | 3 |
| Irrigation System, Microirrigation (ac.) 441 | 1,343 | 1,343 | 3,088 | 4,431 | 0 | 4 | 0 | 0 |
| Irrigation System, Sprinkler (ac.) 442 | 1,343 | 1,343 | 3,088 | 4,431 | 0 | 4 | 0 | 0 |
| Irrigation System, Surface and Subsurface (ac.) 443 | 13,427 | 16,784 | 27,525 | 44,309 | 0 | 0 | 0 | 0 |
| Irrigation Water Management (ac.) 449 | 13,427 | 20,141 | 24,169 | 44,309 | 4 | 5 | 5 | 3 |
| Nutrient Management (ac.) 590 | 13,427 | 13,427 | 30,882 | 44,309 | 3 | 1 | 5 | 1 |
| Pest Management (ac.) 595 | 13,427 | 13,427 | 30,882 | 44,309 | 0 | 1 | 0 | 0 |
| **Total Acreage at RMS Level** | **13,427** | **13,427** | **30,882** | **44,309** | | | | |

| WATERSHED NAME & CODE | AGUA FRIA RIVER - 15070102 | LANDUSE ACRES | 268,540 |
|---|---|---|---|
| LANDUSE TYPE | URBAN | TYPICAL UNIT SIZE ACRES | 10 |
| CONSERVATION COST TABLE | | CALCULATED PARTICIPATION | 22% |

| | 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 System, Surface and Subsurface (ac.) 443 | 12,084 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Irrigation Water Management (ac.) 449 | 24,169 | $0 | $725,058 | $145,012 | $791,041 | $0 | $241,686 | $372,040 |
| **Subtotal** | **24,169** | **$0** | **$725,058** | **$145,012** | **$791,041** | **$0** | **$241,686** | **$372,040** |
| **RMS** | | | | | | | | |
| Atmospheric Resource Quality Management (ac.) 370 | 30,882 | $0 | $555,878 | $111,176 | $606,465 | $0 | $185,293 | $285,231 |
| Irrigation System, Microirrigation (ac.) 441 | 3,088 | $2,316,158 | $0 | $463,232 | $2,779,389 | $2,316,158 | $231,616 | $3,291,807 |
| Irrigation System, Sprinkler (ac.) 442 | 3,088 | $2,624,979 | $0 | $524,996 | $3,149,974 | $2,624,979 | $104,999 | $3,067,273 |
| Irrigation System, Surface and Subsurface (ac.) 443 | 27,525 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Irrigation Water Management (ac.) 449 | 24,169 | $0 | $725,058 | $145,012 | $791,041 | $0 | $241,686 | $372,040 |
| Nutrient Management (ac.) 590 | 30,882 | $0 | $926,463 | $185,293 | $1,010,775 | $0 | $308,821 | $475,384 |
| Pest Management (ac.) 595 | 30,882 | $0 | $926,463 | $185,293 | $1,010,775 | $0 | $308,821 | $475,384 |
| **Subtotal** | **30,882** | **$4,941,136** | **$3,133,862** | **$1,615,000** | **$9,348,419** | **$4,941,136** | **$1,381,235** | **$7,967,119** |
| **Grand Total** | **55,051** | **$4,941,136** | **$3,858,920** | **$1,760,011** | **$10,139,460** | **$4,941,136** | **$1,622,921** | **$8,339,159** |




| Chart Refers To | |
|---|---|
| Landuse Type | URBAN |
| Calculated Participation Rate | 22% |

| Average PV Costs per Ac | | |
|---|---|---|
| System | Federal | Private |
| Prog | $32.73 | $15.39 |
| RMS | $302.71 | $257.99 |

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# 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.).<br>**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.).<br>**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.<br>**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. |

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