

Rapid Watershed Assessment Arroyo Chico Watershed



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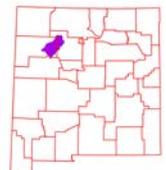


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Overview

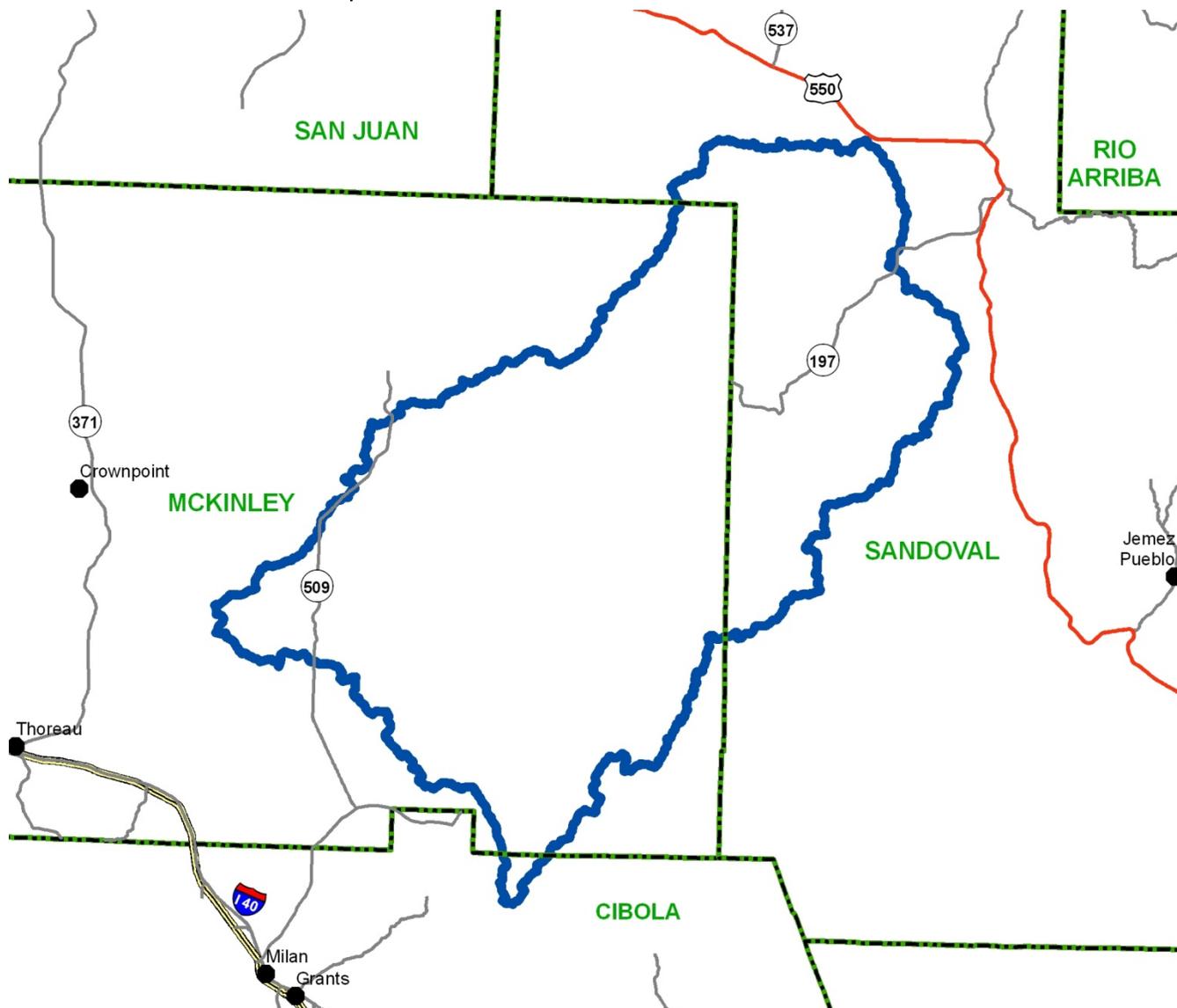


Figure 1. Arroyo Chico Watershed Overview



Overview

The Arroyo Chico Watershed is located in northwestern New Mexico. It covers 880,595 total acres (11,862 sq. km). The counties it covers are Cibola, McKinley, and Sandoval. Table 1 summarizes the distribution of the Arroyo Chico watershed.

Table 1. Arroyo Chico watershed acreage distribution.

| | County Acres Total | Acres in HUC | % of HUC in County | % of County in HUC |
|----------------------------------|---------------------------|---------------------|---------------------------|---------------------------|
| Cibola | 2,909,925 | 4,436 | 1 | <1 |
| McKinley | 3,496,292 | 607,086 | 69 | 17 |
| Sandoval | 2,377,011 | 269,073 | 31 | 77 |
| Sum (Σ) | -- | 880,595 | 100 | -- |



Physical Setting

Geology:

The watershed originates on the eastern side of the Continental Divide and proceeds east northeastwards to the confluence of Arroyo Chico with the Rio Puerco near Guadalupe. The San Juan Basin lies on the Colorado Plateau. Several formations of Tertiary and Cretaceous age compose the consolidated geology of the San Juan River basin. The predominant geologic formation in New Mexico is the Nacimiento Formation of Tertiary age which underlies the soils. The Cretaceous Kirtland and Fruitland Formation and the Mancos Shale layers underlie the soils and crop out west of the Hogback. These two formations underlie tile soils and compose the outcrop in most of the upland area south of the San Juan River. All of the shales of Cretaceous age consist at least in part of gray arid black shale. Several Tertiary Period volcanic necks are in the eastern portion of the watershed. The valley is composed in part of Quaternary unconsolidated sand, gravel, silt, clay, and terrace gravel and boulder deposits. Valley soils typically are derived from sandstone, shale, siltstone, and mudstone and range in permeability from moderately rapid to moderately slow.

Resource concerns are high sediment erosion and water runoff. In addition the lowering of valleys by river incision is a continuing process. Many valleys are flanked by terraces. Rivers respond by aggrading during climates that promote large sediment yield and large, stable discharges; and incise during climates that produce flashy flows and reduce the sediment supply. This can be exasperated by the mining of sand and gravel from the river channels.

Groundwater quality and quantity is a concern. Groundwater occurs to a greater or lesser extent in all of these geologic units. Depth to groundwater is a concern if the shallow unconfined aquifer does not produce enough water for the resource or increased population demands are 'mining' the water. Groundwater in the igneous rocks and volcanics is usually along fracture zones which are hard to intercept with water wells. Groundwater quality ranges from good to poor for livestock or crops.



Soils:

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the Arroyo Chico are assigned to four groups (A, B, C, and D).



Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.



Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.



Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.



Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.



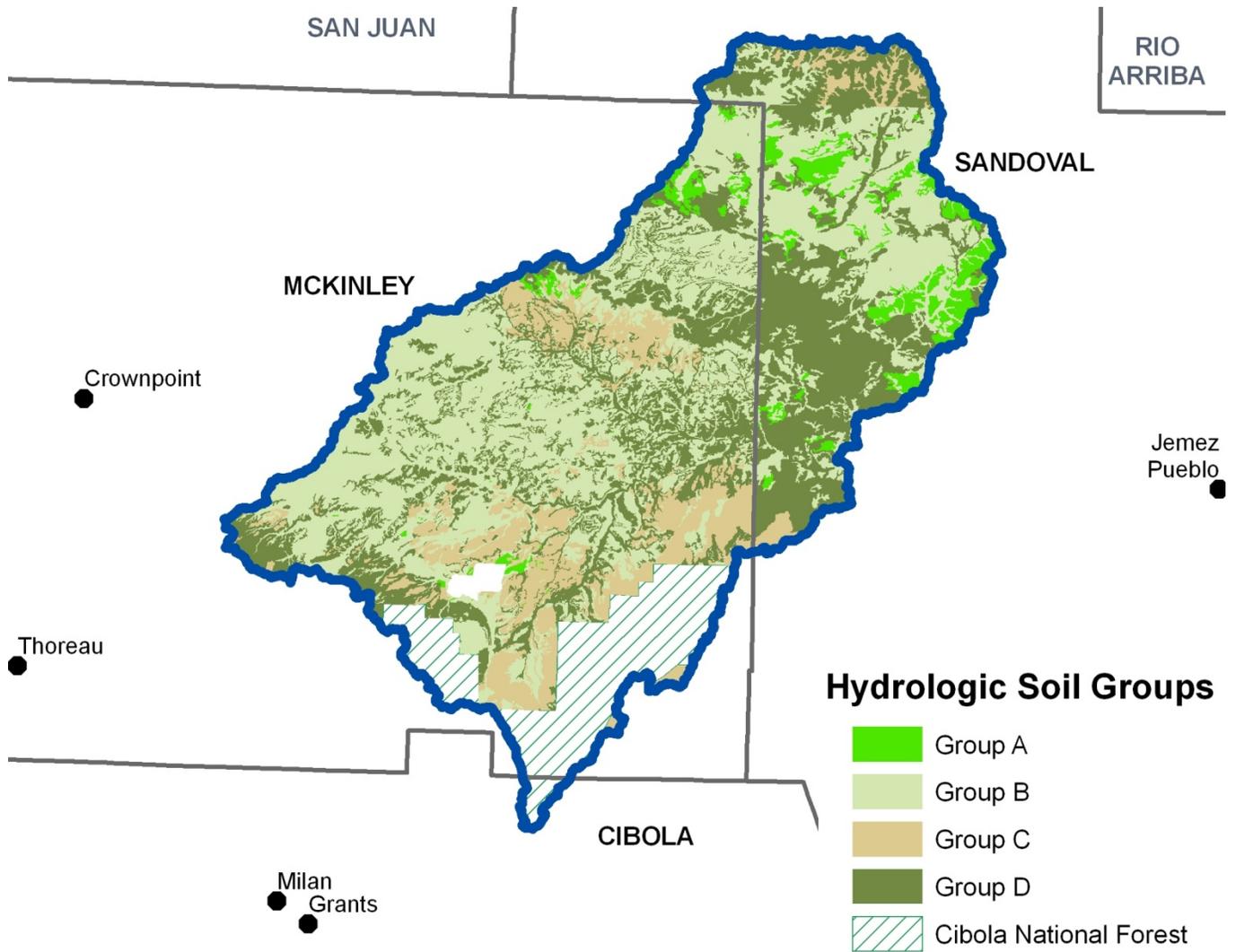
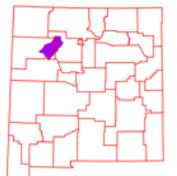


Figure 2. Hydrologic Soil Groups



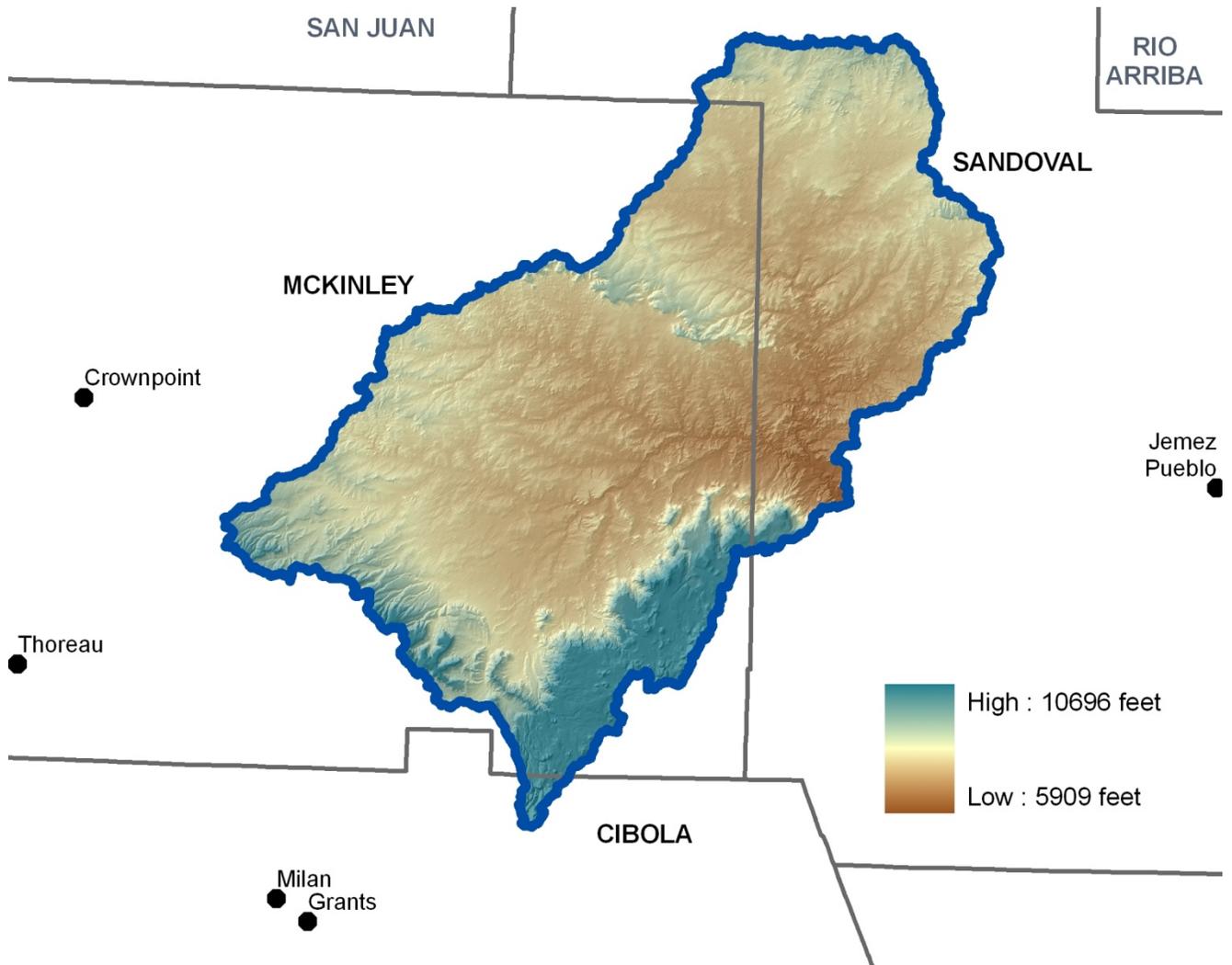


Figure 3. Arroyo Chico Watershed Shaded Relief



Precipitation

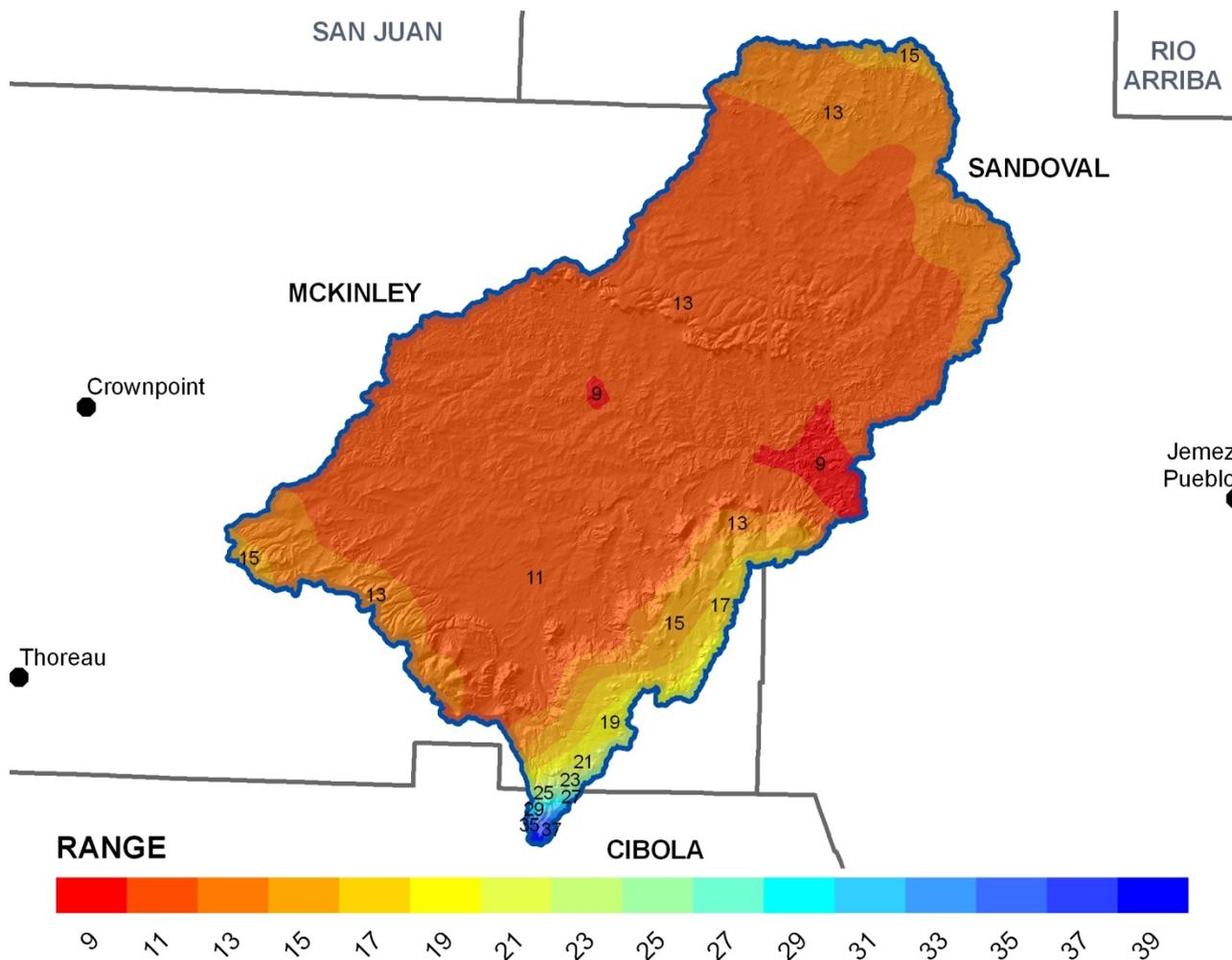


Figure 4. Arroyo Chico Watershed Annual Precipitation.



Land Ownership ³

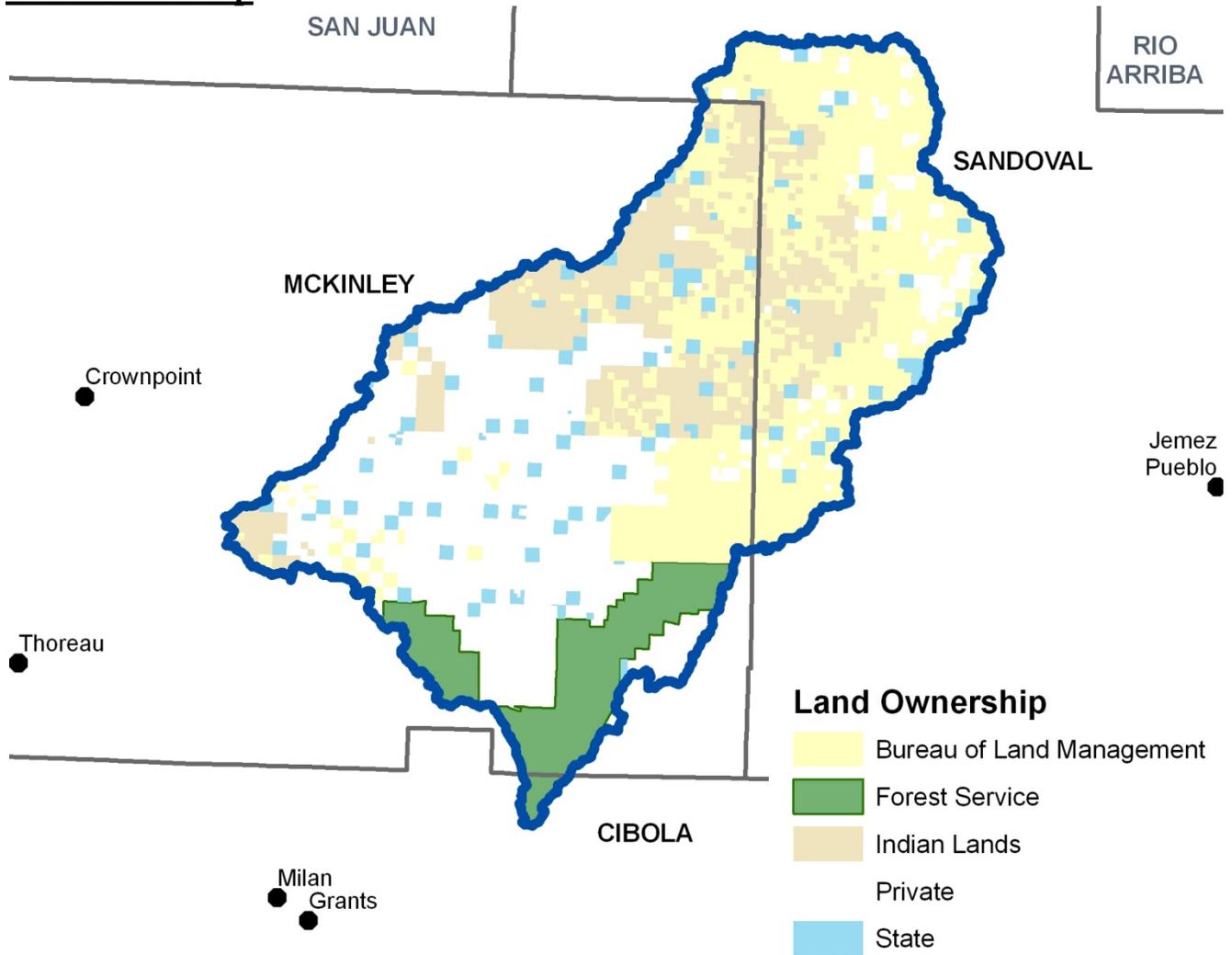


Figure 5. Arroyo Chico Watershed Land Ownership



Land Ownership

| <u>COUNTY</u> | <u>BLM</u> | <u>Forest Service</u> | <u>Indian Lands</u> | <u>Private</u> | <u>State</u> |
|--|----------------|-----------------------|---------------------|----------------|---------------|
| Cibola | | 4,435 | | | |
| McKinley | 103,888 | 73,505 | 115,628 | 275,034 | 39,031 |
| Sandoval | 183,944 | | 43,955 | 27,259 | 13,916 |
| Watershed (Σ) | 287,832 | 77,940 | 159,583 | 302,293 | 52,947 |
| % Watershed | 33 | 9 | 18 | 34 | 6 |

Table 2. Land ownership in the Arroyo Chico watershed.



Land Use / Land Cover ^{3,4}

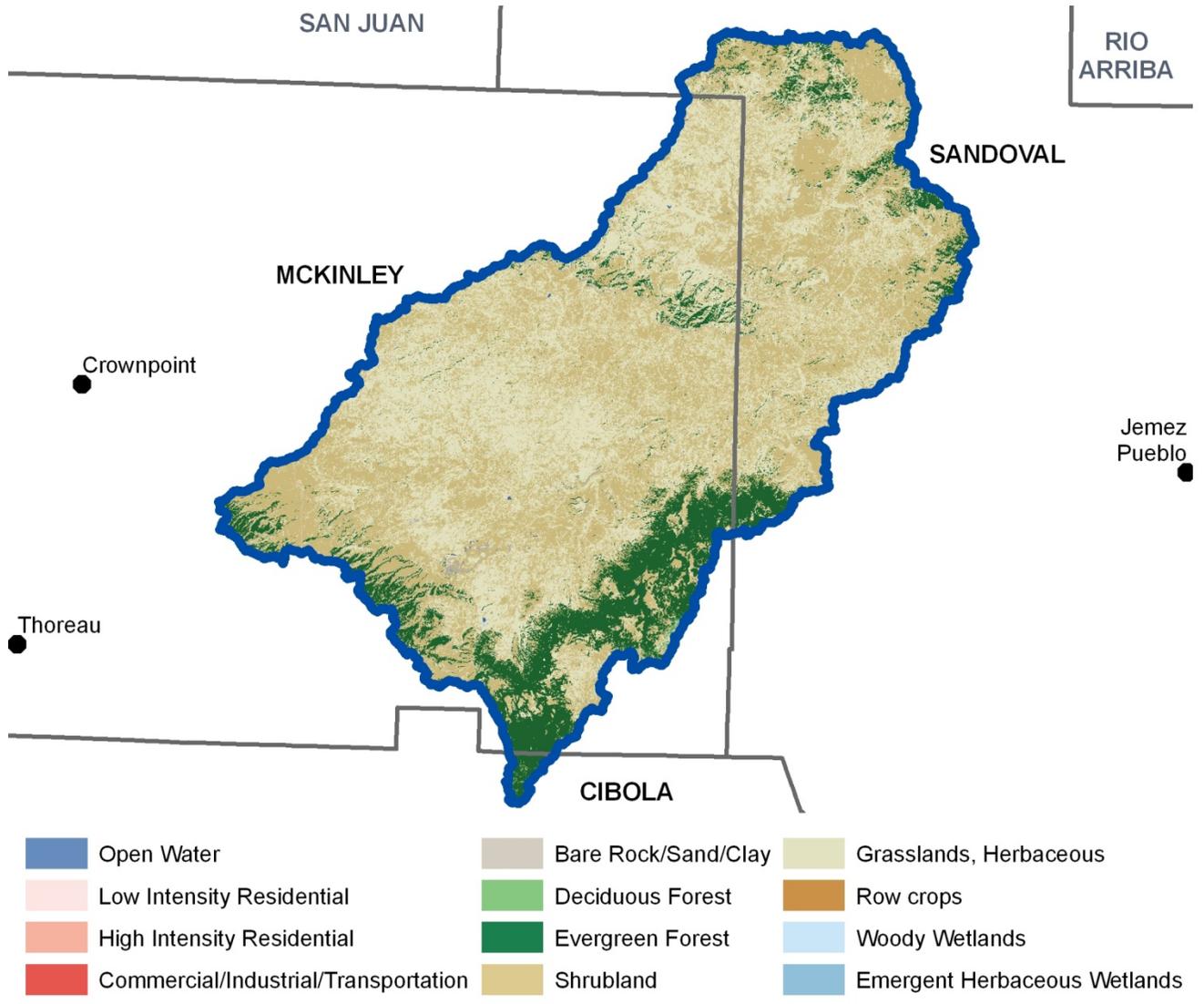


Figure 6. Subset of the National Land Cover Dataset in the Arroyo Chico Watershed.



Land Use / Land Cover

The U.S. Geological Survey (USGS) produced the National Land Cover Dataset (NLCD) as part of a cooperative project between the USGS and the U.S. Environmental Protection Agency (USEPA). The goal of this project was to produce a consistent land cover data layer for the conterminous United States. The Multiresolution Land Characterization (MRLC) Consortium collected the data used to compile the NLCD. The MRLC Consortium is a partnership of Federal agencies that produce or use land cover data; partners include the UNITED STATES GEOLOGICAL SURVEY (National Mapping, Biological Resources, and Water Resources Divisions), USEPA, the U.S. Forest Service, and the National Oceanic and Atmospheric Administration.

| <u>Land use / Land cover</u> | <u>Acres</u> | <u>% of Watershed</u> |
|---|----------------|-----------------------|
| Shrubland | 405,357 | 46 |
| Grasslands, Herbaceous | 343,748 | 39 |
| Evergreen Forest | 121,687 | 14 |
| Bare Rock/Sand/Clay | 6,124 | 1 |
| Deciduous Forest | 1,708 | < 1% |
| Low Intensity Residential | 1,236 | < 1% |
| Open Water | 498 | < 1% |
| Woody Wetlands | 167 | < 1% |
| Emergent Herbaceous Wetlands | 31 | < 1% |
| High Intensity Residential | 27 | < 1% |
| Row crops | 10 | < 1% |
| Commercial/Industrial/Transportation | 2 | < 1% |

Table 3. Extent of NLCD classes in the Arroyo Chico watershed.



Land Use / Land Cover

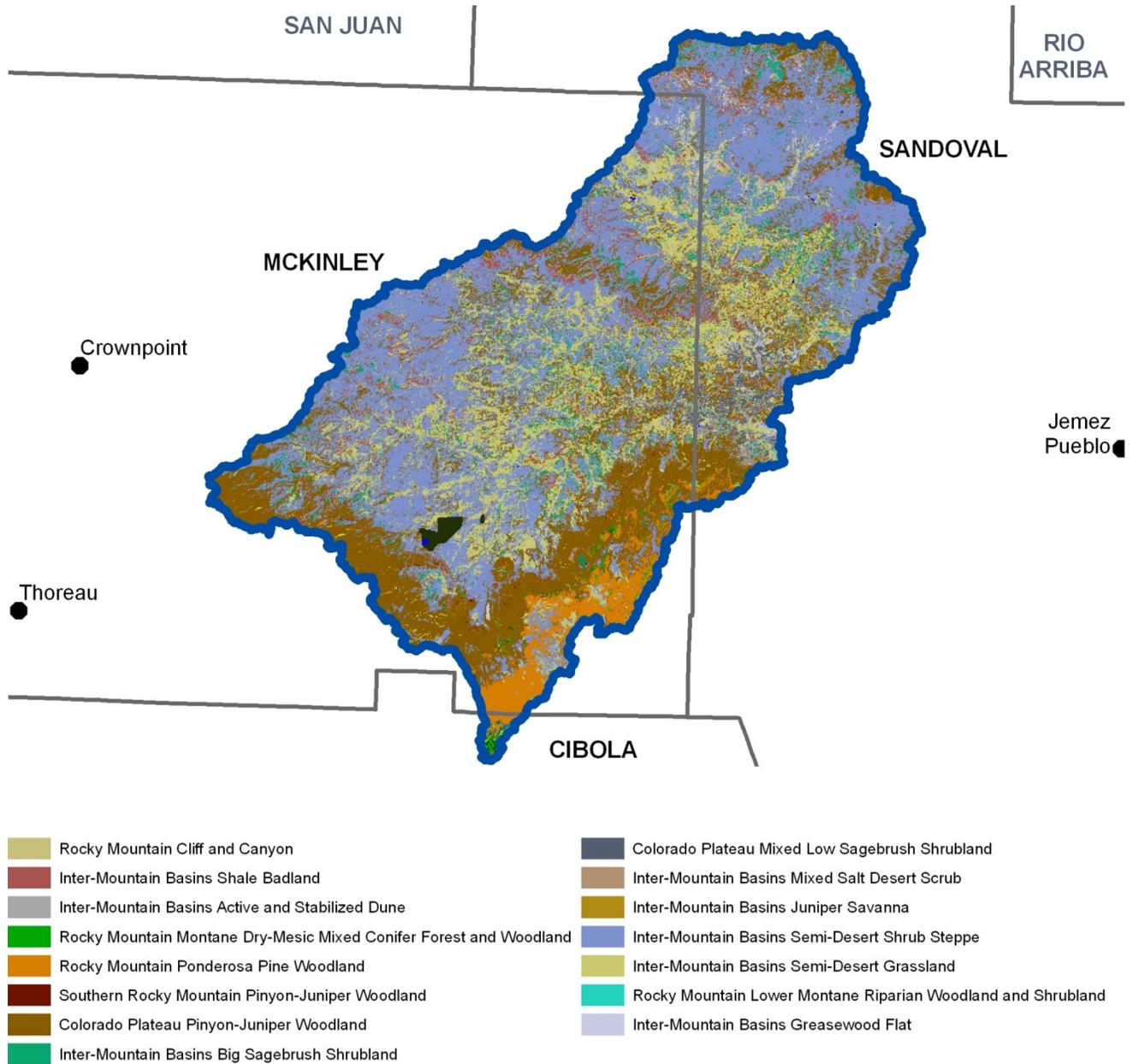


Figure 7. Subset of the SWREGAP over the Arroyo Chico Watershed. The 15 dominant ecosystems are displayed in the legend.



Land Use / Land Cover

The landcover mapping effort for the Southwest Region Gap Analysis Project was a coordinated multi-institution endeavor. This dataset was created for regional terrestrial biodiversity assessment. Additional objectives were to establish a coordinated mapping approach to create detailed, seamless maps of land cover, all native terrestrial vertebrate species, land stewardship, and management status, and to analyze this information to identify those biotic elements that are underrepresented on lands managed for their long term conservation.

| <u>Ecosystem</u> | <u>Acres</u> | <u>% of Watershed</u> |
|--|--------------|-----------------------|
| Inter-Mountain Basins Semi-Desert Shrub Steppe | 348,342 | 40 |
| Colorado Plateau Pinyon-Juniper Woodland | 224,880 | 26 |
| Inter-Mountain Basins Semi-Desert Grassland | 142,737 | 16 |
| Rocky Mountain Ponderosa Pine Woodland | 36,131 | 4 |
| Inter-Mountain Basins Shale Badland | 34,605 | 4 |
| Inter-Mountain Basins Big Sagebrush Shrubland | 32,845 | 4 |
| Inter-Mountain Basins Mixed Salt Desert Scrub | 13,963 | 2 |
| Inter-Mountain Basins Active and Stabilized Dune | 12,275 | 1 |
| Colorado Plateau Mixed Low Sagebrush Shrubland | 9,973 | 1 |
| Inter-Mountain Basins Greasewood Flat | 8,676 | 1 |
| Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland | 2,621 | <1 |
| Inter-Mountain Basins Juniper Savanna | 1,942 | <1 |
| Rocky Mountain Cliff and Canyon | 1,570 | <1 |
| Rocky Mountain Lower Montane Riparian Woodland and Shrubland | 1,403 | <1 |
| Southern Rocky Mountain Pinyon-Juniper Woodland | 1,219 | <1 |

Table 4. SW Region Gap analysis ecosystem acreages.



Hydrology ^{5, 6, 7, 8, 9}

The National Hydrography Dataset (NHD) is a comprehensive set of data that encodes information about naturally occurring and constructed bodies of water, paths through which water flows, and related entities. The NHD identifies 3,337 miles (5,370 km) of water courses in the Arroyo Chico River Watershed. The majority of these courses typically flow intermittently in summer months during periods associated with high intensity convective thunderstorms.

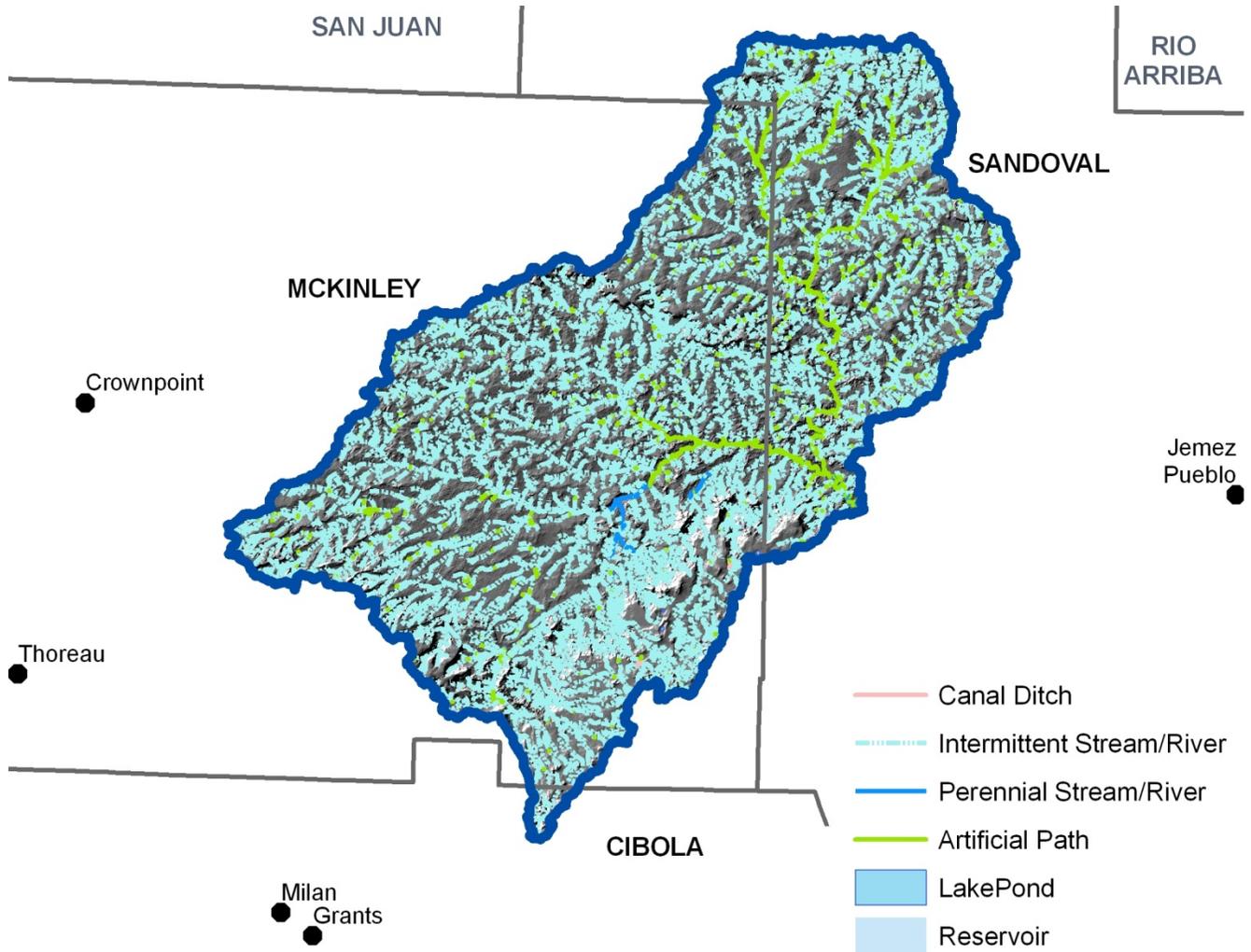


Figure 8. National Hydrologic Dataset (NHD) of the Arroyo Chico.



| Water Course Type | Miles |
|-----------------------------|--------------|
| Artificial Path | 177 |
| Canal / Ditch | 1 |
| Intermittent Stream / River | 3,136 |
| Perennial Stream / River | 23 |
| Sum (Σ) | 3,337 |

Table 5. NHD Water Course Type and Extents



There are 2 water gauging stations in the watershed. USGS Site 08340500 is on the eastern edge of the watershed on the Arroyo Chico near Guadalupe, NM. During the period 2006 – 2011, this site has had mean annual discharge of 9.15 cubic feet per second ranging from 2.69 (2009) to 12.0(2008) cubic feet per second.

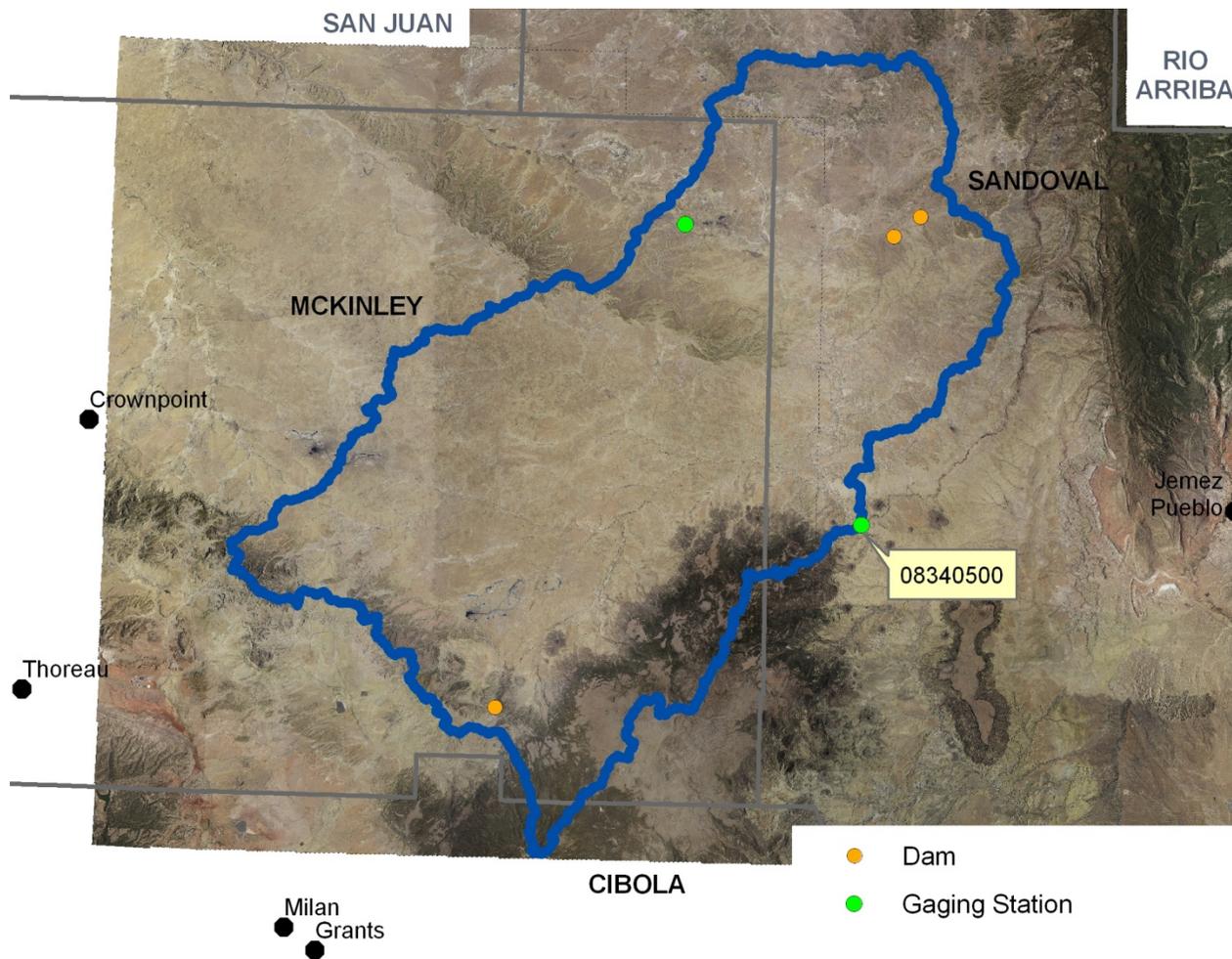


Figure 9. Gauging Stations in the Arroyo Chico Watershed



Hydrology

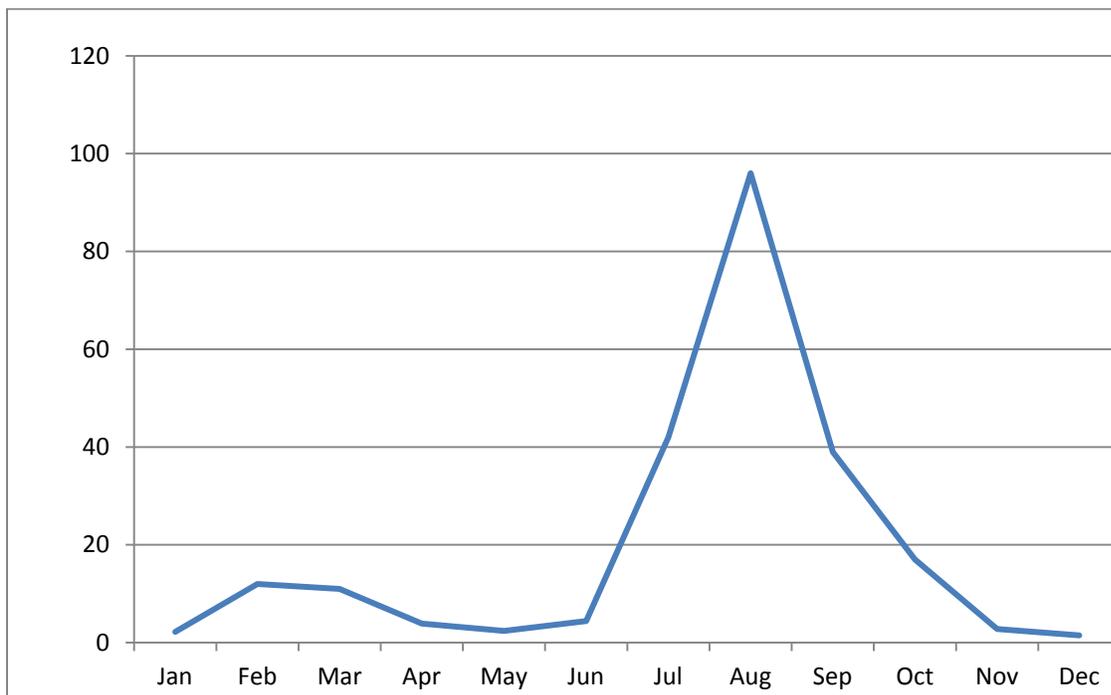


Figure 10. Monthly Average of Mean Daily Flow on the Arroyo Chico River near Waterflow, NM. Period of observation: 1975-1994.

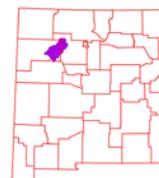


Hydrology

The New Mexico Water Quality Control Commission (NMWQCC) is the issuing agency of water quality standards for interstate and intrastate waters in New Mexico. The NMWQCC has defined the Arroyo Chico watershed as part of the Rio Grande River Basin.

Under section 303(d) of the Clean Water Act, states, territories, and authorized tribes, are required to develop lists of impaired waters. These are waters for which technology-based regulations and other required controls are not stringent enough to meet the water quality standards set by states. The law requires that states establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDLs), for these waters. A TMDL is a calculation of the maximum amount of a pollutant a water body can receive and still safely meet water quality standards.

The Arroyo Chico watershed has no reaches listed as 303 (d) Impaired Surface Waters.



Hydrology

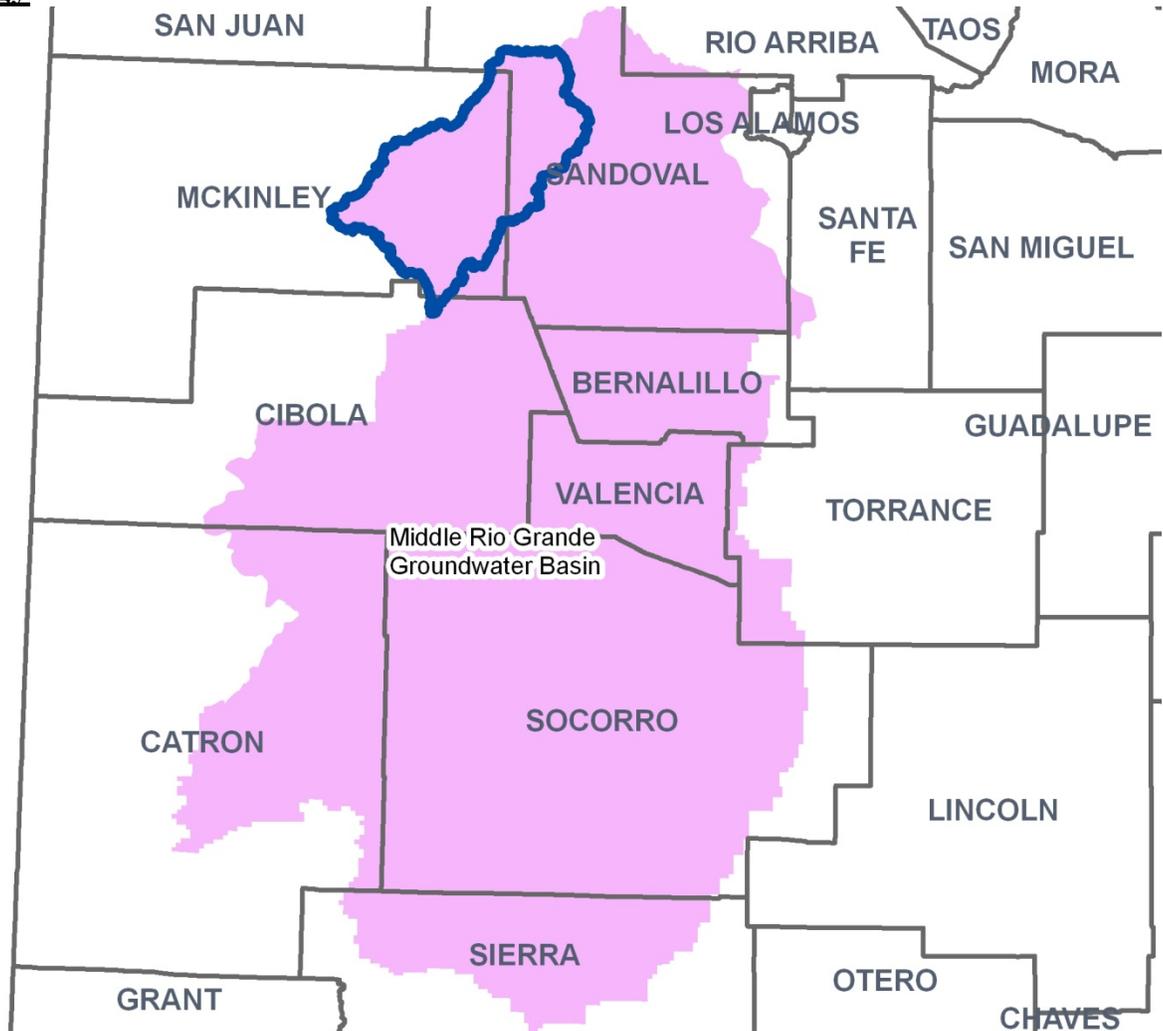
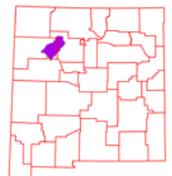


Figure 11. Declared Groundwater Basin.

A declared groundwater basin is an area of the state proclaimed by the State Engineer to be underlain by a groundwater source having reasonably ascertainable boundaries. By such proclamation the State Engineer assumes jurisdiction over the appropriation and use of groundwater from the source. The New Mexico portion of the Arroyo Chico watershed is completely within the Middle Rio Grande Underground Water Basin.



Threatened and Endangered Species ¹⁰

Endangered species are those that are at risk of extinction throughout all or a significant portion of its native range. A threatened species is one that is likely to become endangered in the foreseeable future. The New Mexico Natural Heritage program tracks the status of threatened and endangered species which are listed on both federal and state lists. Table 6 lists those species which are currently listed and tracked in the Arroyo Chico River Watershed.

| <u>Common Name</u> | <u>Scientific Name</u> | <u>Tax.Class</u> | <u>Family</u> | <u>Fed Status</u> | <u>State Status</u> |
|--|--|------------------|---------------|-------------------|---------------------|
| <u>Gray Vireo</u> | <u><i>Vireo vicinior</i></u> | Aves | Vireonidae | | T |
| <u>Parish's Alkali Grass</u> | <u><i>Puccinellia parishii</i></u> | Monocotyledoneae | Poaceae | | E |

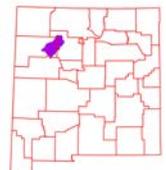
Table 6. Threatened and Endangered Plant and Animal Species.

Invasive Species ¹¹

Invasive species are those which have been introduced into a region or ecosystem and have the ability to out-compete native species for resources (i.e. water, nutrients, sunlight, etc.) The Southwest Exotic Plant Mapping Program (SWEMP) is a collaborative effort between the United States Geological Survey and federal, tribal, state, county and non-government organization partners in the southwest which maintains ongoing efforts to compile and distribute regional data on the occurrence of non-native invasive plants in the southwestern United States. Within the Arroyo Chico watershed, the SWEMP has identified 5 species of invasive plants (Table 7). Each of these species is defined as non-native by the USDA PLANTS database.

| <u>Scientific Name</u> | <u>Common Name</u> |
|---|-------------------------------|
| <i>Brassicaceae</i> (Mustard Family) | Hoary Cress (Whitetop) |
| <i>Asteraceae</i> (Sunflower Family) | Musk Thistle |
| <i>Brassicaceae</i> (Mustard Family) | Perennial Pepperweed |
| <i>Asteraceae</i> (Sunflower Family) | Russian Knapweed |
| <i>Asteraceae</i> (Sunflower Family) | Spotted Knapweed |

Table 7. Invasive Species Recognized by the SWEMP.



Common Resource Areas¹²

A Common Resource Area (CRA) is defined as a geographical area where resource concerns, problems, or treatment needs are similar. It is considered a subdivision of an existing Major Land Resource Area (MLRA) designation. Landscape conditions, soil, climate, human considerations, and other natural resource information are used to determine the geographic boundaries of a Common Resource Area.

Each Common Resource Area will have multiple Conservation System Guides associated with it. A Conservation System Guide associates, for a given CRA and land use, different components of Resource Management Systems and their individual effect on conserving soil and water resources.

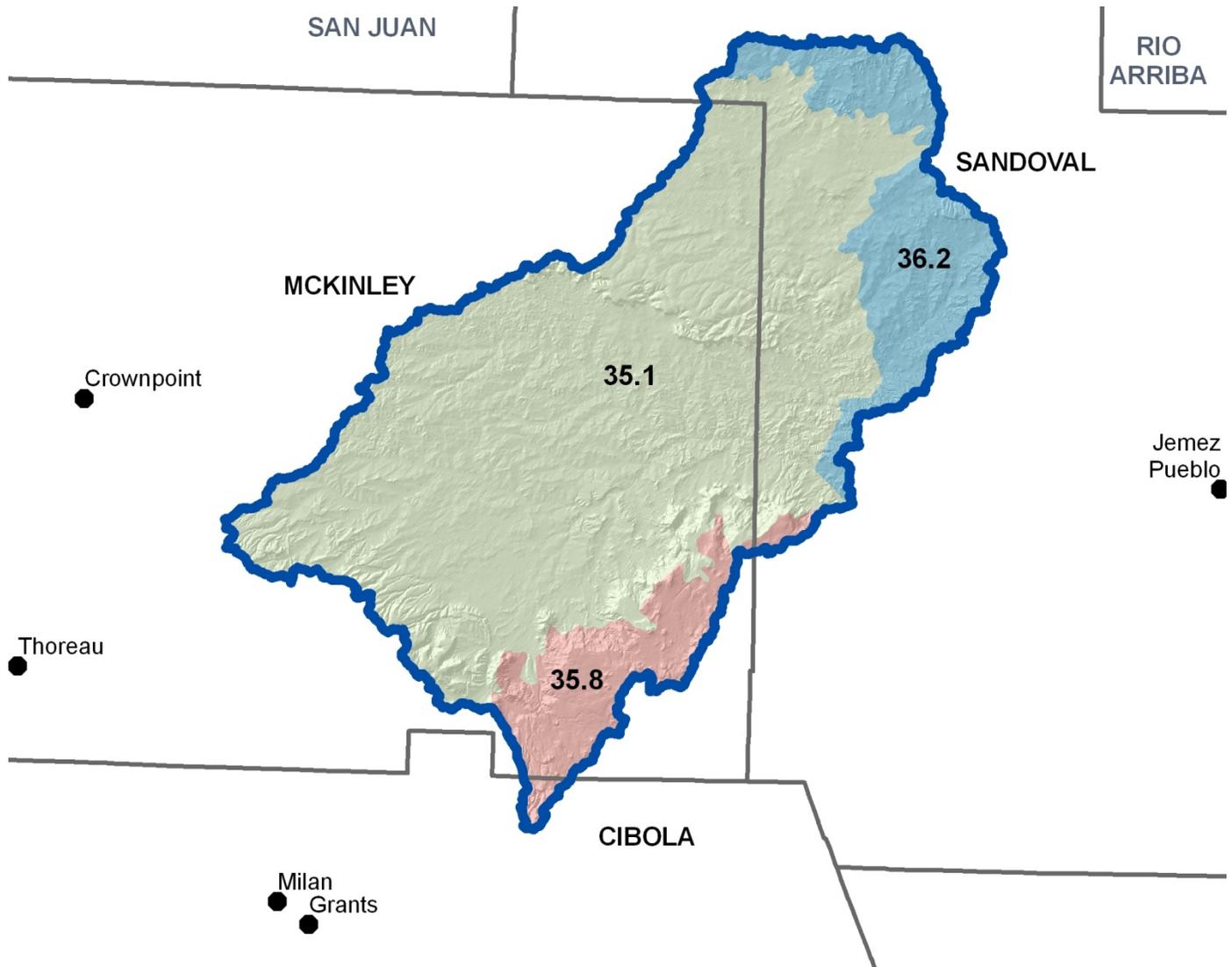


Figure 12. Common Resource Areas of the Arroyo Chico..



Common Resource Areas

35.1 - Colorado Plateau Mixed Grass Plains

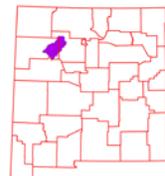
This unit occurs within the Colorado Plateau Physiographic Province and is characterized by flat to gently dipping sedimentary rocks eroded into plateaus, valleys and deep canyons. Volcanic fields occur in places. Elevations range from 5100 to 6000 feet. Precipitation averages 10 to 14 inches per year. The soil temperature regime is mesic. The soil moisture regime is ustic aridic. Vegetation includes Stipa, Indian ricegrass, galleta, blue grama, fourwing saltbush, and scattered juniper.

35.8 - Colorado Plateau Ponderosa Pine Forests

This unit occurs within the Colorado Plateau Physiographic Province and is characterized by gently dipping sedimentary rocks eroded into plateaus, valleys and deep canyons. Volcanic fields occur in places. Elevations range from 6800 to 8500 feet. Precipitation averages 17 to 25 inches per year. The soil temperature regime ranges from mesic to frigid. The soil moisture regime is typic ustic. Vegetation includes ponderosa pine, white fir, aspen, pinyon, juniper, Gambel oak, and big sagebrush.

36.2 – Southwest Plateaus, Mesas, and Foothills – Warm Semiarid Mesas and Plateaus

This area encompasses the lower elevation mesas and plateaus. The temperature regime is mesic and the moisture regime is transitional from ustic to aridic. Vegetation is typically twoneedle pinyon, Utah juniper, and big sagebrush. Cropland is a significant land use in parts of this area, particularly on soils formed in thick deposits of eolian material. Precipitation ranges from 10 to about 16 inches. Elevations range from about 6,000 to 7,000 feet.



Conservation ¹³

The USDA-Natural Resources Conservation Service (NRCS) focuses on the development and delivery of high quality products and services that enable people to be good stewards of our Nation's soil, water, and related natural related resources on non-Federal lands. The Natural Resources Conservation Service's conservation programs aid agricultural producers in their efforts to reduce soil erosion, enhance water supplies, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters. Public benefits include enhanced natural resources that help sustain agricultural productivity and environmental quality while supporting continued economic development, recreation, and scenic beauty.

| Conservation Practice | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | TOTAL | |
|---------------------------|------|-------|------|-------|------|-------|------|-------|------|-------|-------|-------|
| | # | Acres | # | Acres |
| Prescribed Grazing | | | | | 1 | 1455 | 1 | 37777 | | | 2 | 39232 |
| SUM (Σ) | | | | | 1 | 1455 | 1 | 37777 | | | 2 | 39232 |

Table 8. 5 year Trends in Applied Conservation Practices. Reported in Acres.

| Conservation Practice | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | TOTAL | |
|---|------|-------|------|------|------|-------|------|-------|------|-------|-------|-------|
| | # | Feet | # | Feet | # | Feet | # | Feet | # | Feet | # | Feet |
| Conservation Completion Incentive First Year | | | 1 | | | | | | | | 1 | |
| Diversion | | | 2 | 3130 | | | | | | | 2 | 3130 |
| Fence | | | 1 | 6000 | 1 | 8260 | 2 | 13662 | 3 | 19430 | 7 | 47352 |
| Pipeline | 2 | 19749 | | | 4 | 39062 | 2 | 16374 | | | 8 | 75185 |
| Pond | | | | | | | 1 | | | | 1 | |
| Pumping Plant | | | 1 | | 2 | | 2 | | 1 | | 6 | |
| Water Well | | | 1 | | 2 | | 1 | | 3 | | 7 | |
| Watering Facility | 4 | | 1 | | 10 | | 1 | | | | 16 | |
| Wildlife Watering Facility | | | | | 2 | | | | | | 2 | |
| SUM (Σ) | 6 | | 7 | | 21 | | 9 | | 7 | | 50 | |

Table 9. 5 Year Trends in Location Specific Applied Conservation Practices. Reported in Feet if Linear (i.e. Fence).



Soil Resource Inventory ¹⁴

The Arroyo Chico Watershed has a number of certified National Cooperative Soil Survey (NCSS) inventories. Soils data is available from the NRCS Soil Data Mart at <http://soildatamart.nrcs.usda.gov/> and/or the NRCS Geospatial Data Gateway at <http://datagateway.nrcs.usda.gov/>. National Forest data is not available in SSURGO at this time.

National Cooperative Soil Survey

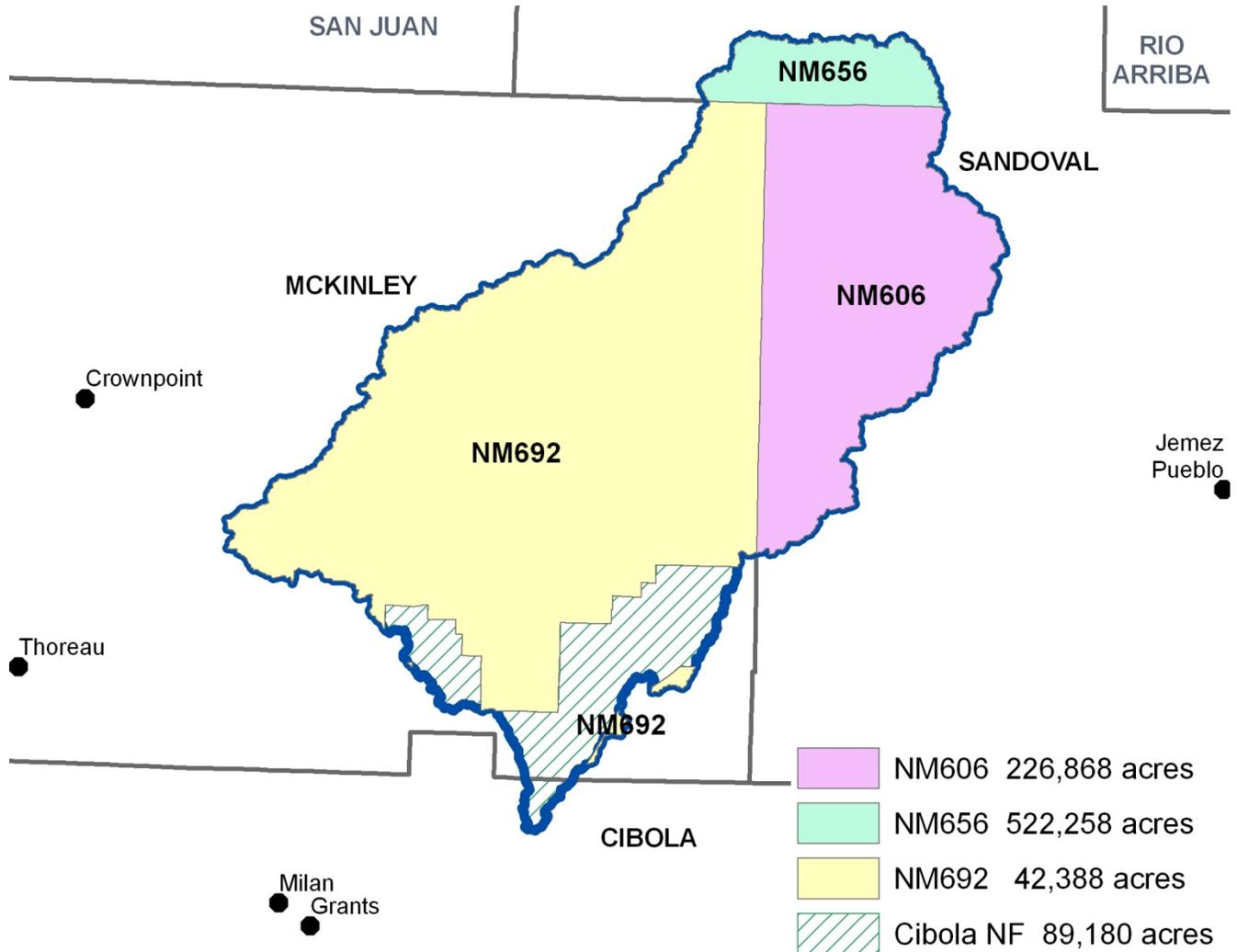


Figure 13. National Cooperative Soil Survey coverage of the Arroyo Chico Watershed.



Soil Resource Inventory

In order to evaluate the susceptibility of erosion within the Arroyo Chico watershed, a model was developed using Soil Survey Geographic Database (SSURGO) information. The soil properties saturated hydraulic conductivity, soil loss tolerance, and wind erodibility group were used in conjunction with slope to assess soil mapunit potential for erosion. Saturated hydraulic conductivity and slope are reported in SSURGO databases as interval/ratio data whereas wind erodibility and soil loss tolerance are ordinal data. Data transformations for the model are listed -

| <u>SSURGO Value</u> | <u>Nominal Description</u> | <u>Model Rank</u> |
|---|----------------------------|-------------------|
| Saturated Hydraulic Conductivity | | |
| $\mu\text{m} / \text{s}$ | | |
| 705.0 - 100.0 | Very High | 0 |
| 100.0 - 10.0 | High | 1 |
| 10.0 - 1.0 | Moderately High | 2 |
| 1.0 - 0.1 | Moderately Low | 3 |
| 0.1 - 0.01 | Low | 4 |
| Slope % | | |
| 0 - 5 | | 0 |
| 6 - 10 | | 1 |
| 11 - 15 | | 2 |
| 16 - 25 | | 3 |
| > 25 | | 4 |
| Soil Loss Tolerance | | |
| 5 | High Tolerance For loss | 0 |
| 4 | ↓ | 1 |
| 3 | ↓ | 2 |
| 2 | ↓ | 3 |
| 1 | Low Tolerance For Loss | 4 |
| Wind Erodibility Group | | |
| 1 | Very High | 4 |
| 2 | Very High | 4 |
| 3 | High | 3 |
| 4 | High | 3 |
| 4L | High | 3 |
| 5 | Moderate | 2 |
| 6 | Moderate | 2 |
| 7 | Moderate | 1 |
| 8 | Slight | 0 |

Table 10. Criteria Used for Soil Erosion Susceptibility Model.



Soil Resource Inventory

For each soil map unit (discrete delineation), the soil properties (named above) of the dominant soil type was used as the condition to be evaluated in the susceptibility to erosion model. Miscellaneous areas such as gravel pits, water, riverwash, etc. were excluded from evaluation. Possible range of values for each map unit are 0 – 16. Increasing values represent a higher susceptibility to soil erosion. Forest Service Soils are not able to be modeled at this time.

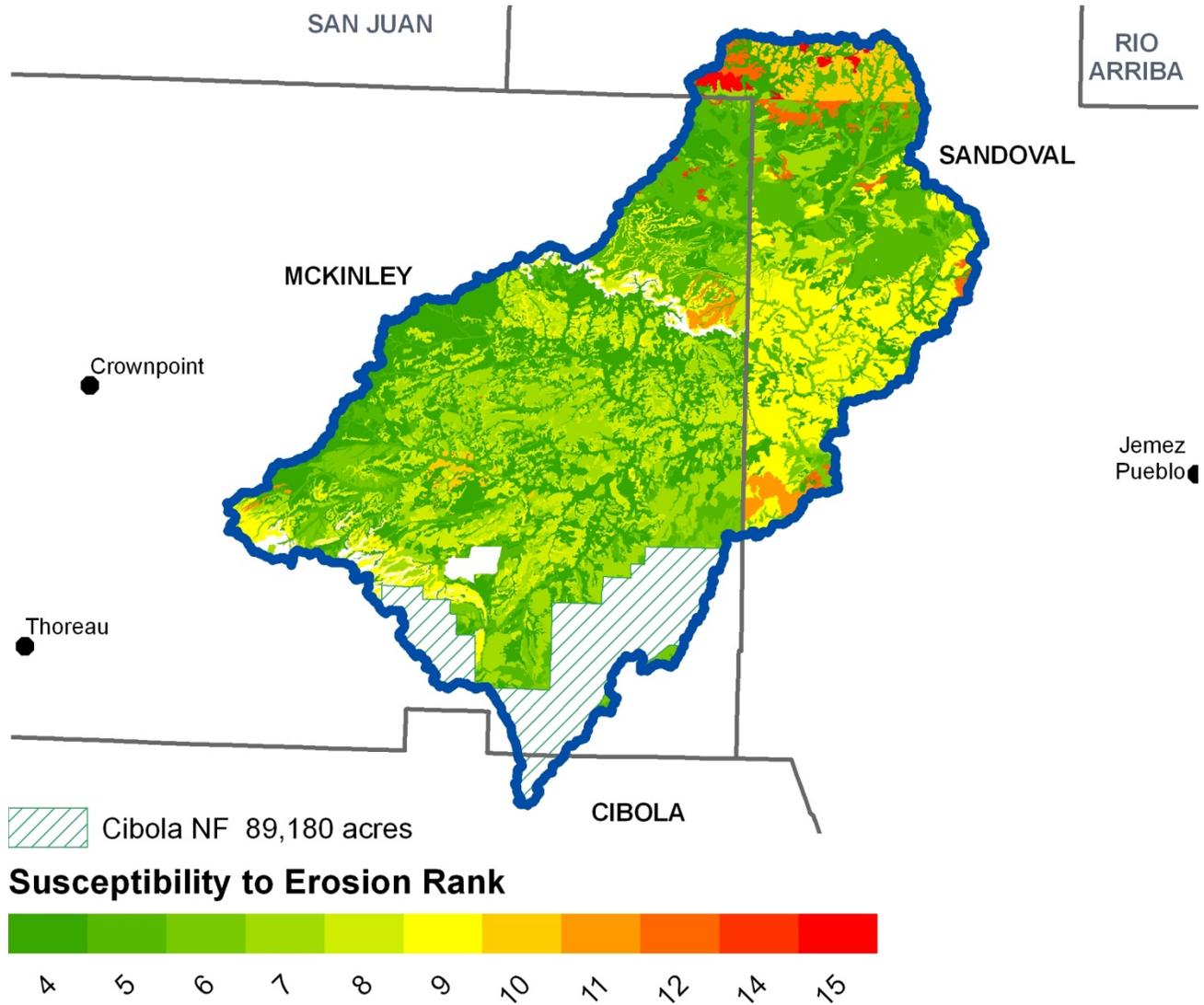


Figure 14. Arroyo Chico Watershed Erosion Potential.



Soil Resource Inventory

| Rank | Acres |
|-----------------------------------|----------------|
| 4 | 226,199 |
| 5 | 139,504 |
| 6 | 45,326 |
| 7 | 103,162 |
| 8 | 99,856 |
| 9 | 111,825 |
| 10 | 21,060 |
| 11 | 10,143 |
| 12 | 11,677 |
| 13 | 0 |
| 14 | 878 |
| 15 | 4,078 |
| Sum(Σ) | 773,708 |

Table 11. Soil Erosion Potential Model Results. A greater rank indicates greater potential for erosion.



Socioeconomic Data ¹⁵

| COUNTY | Total population: Total | Total population: Hispanic or Latino | Total population: White alone | Total population: Black or African American alone | Total population: American Indian and Alaska Native alone | Total population: Asian alone | Total population: Native Hawaiian and Other Pacific Islander alone | Total population: Some other race alone | Total population: Two or more races | Families: Median family income 2010 |
|----------|-------------------------|--------------------------------------|-------------------------------|---|---|-------------------------------|--|---|-------------------------------------|-------------------------------------|
| Cibola | 71,518 | 4,113 | 16,634 | 175 | 52,154 | 203 | 26 | 904 | 1,422 | N/A |
| McKinley | 71,492 | 9,473 | 10,834 | 360 | 53,988 | 568 | 23 | 3,522 | 2,197 | \$29,369 |
| Sandoval | 131,561 | 46,129 | 89,482 | 2,800 | 16,945 | 1,922 | 169 | 15,139 | 5,104 | \$51,959 |

Table 12. Socioeconomic Data of the Counties in the Watershed (2010).



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