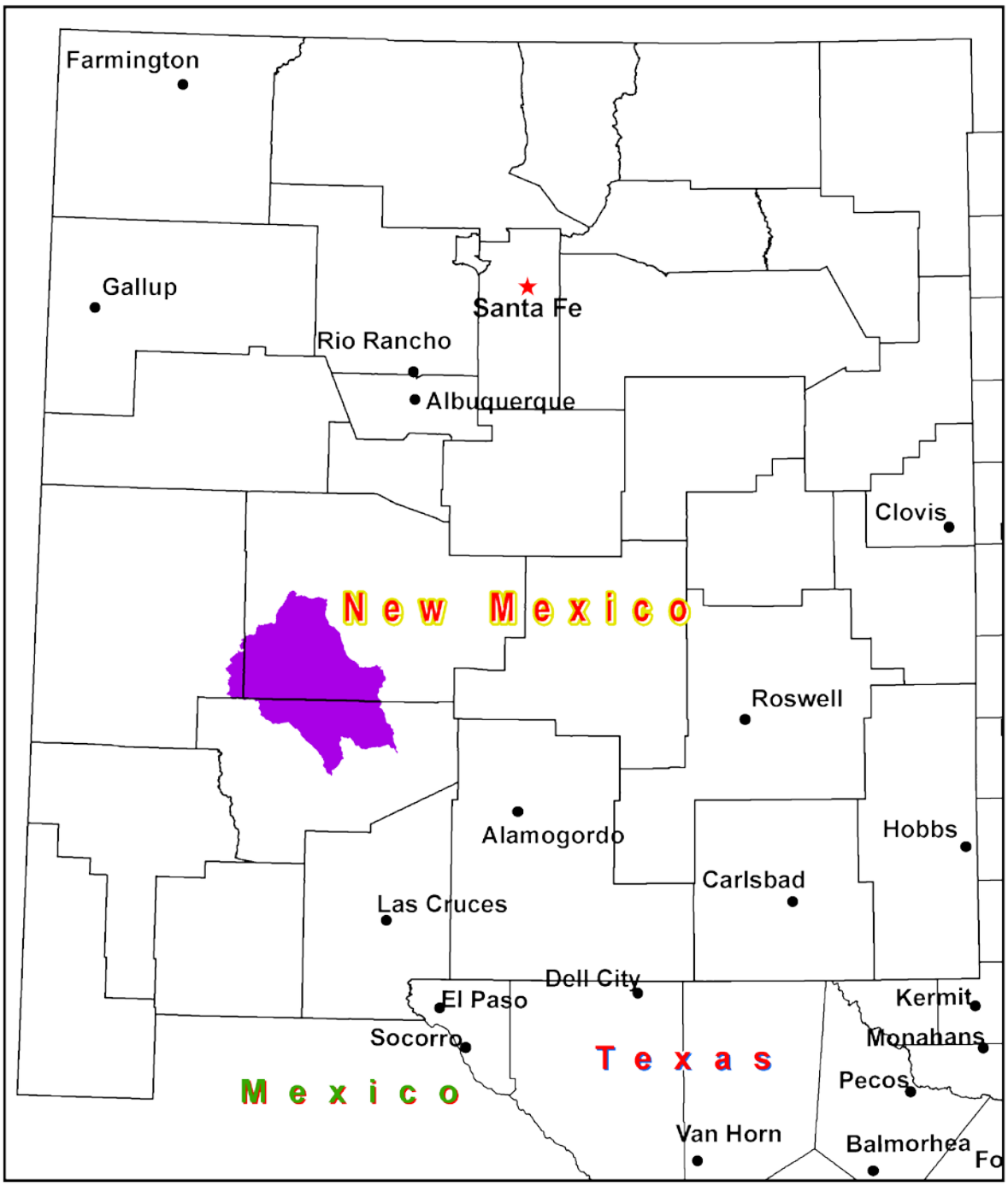
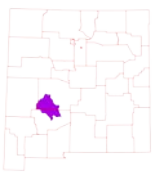


Rapid Watershed Assessment
Elephant Butte Reservoir Watershed



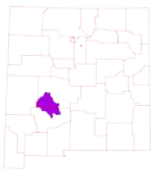
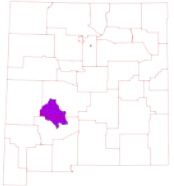
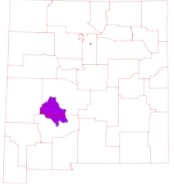


Table of Contents

List of Tables



List of Figures



Overview

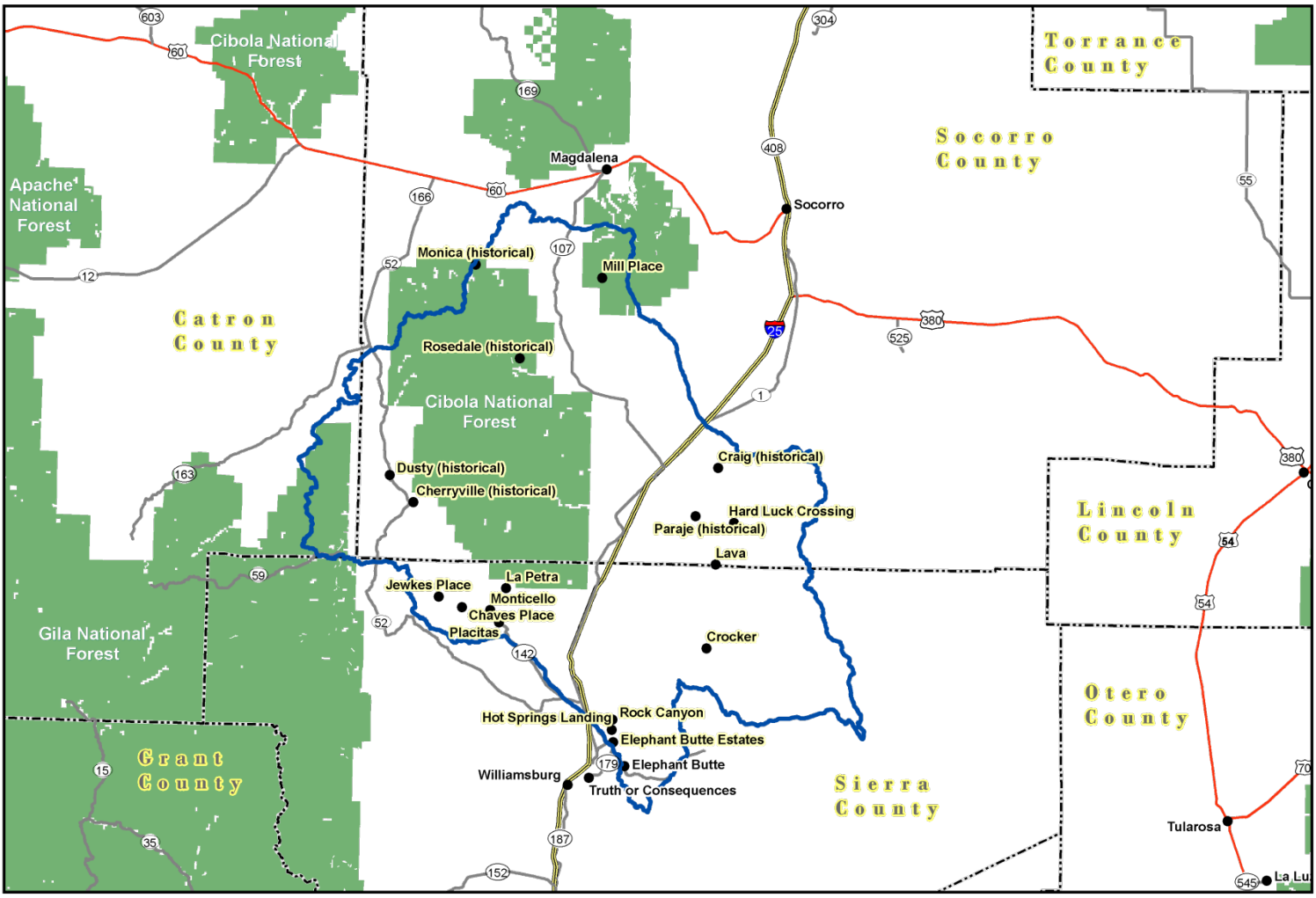
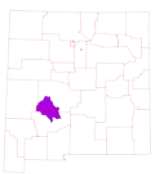


Figure 1. Elephant Butte Reservoir Watershed Overview.

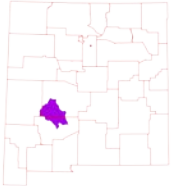


Overview

The Elephant Butte Reservoir Watershed is located in southwestern New Mexico and covers 1,400,945 acres (5,669 sq. km). Portions of the Elephant Butte Reservoir Watershed are in Catron, Sierra and Socorro counties. Table 1 summarizes the distribution of the Elephant Butte Reservoir Watershed.

County	County Acres Total	Acres in HUC	% of HUC in County	% of County in HUC
Catron	4,442,108	60,813	4%	1%
Sierra	2,711,883	467,735	33%	17%
Socorro	4,255,295	872,397	62%	21%
Sum (∑)	--	1,400,945	100	--

Table 1. Elephant Butte Reservoir Watershed acreage distribution.



Physical Setting

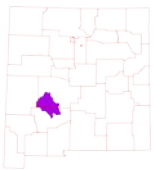
Geology: [1]

The watershed is part of the Rio Grande Rift physiographic province from San Marcial to Elephant Butte Lake Dam. The rift is a graben with fault block mountains forming the eastern and western boundaries. Mountains to the west are usually volcanic in origin and to the east volcanic or sedimentary.

The mountain ranges consist of Paleoproterozoic Eon aged granitic plutons or quartzite; Tertiary Period aged volcanic (basalt, basaltic-andesite or rhyolite); and Paleoproterozoic Eon aged or earlier volcanic or metamorphic rocks. Pennsylvanian limestone, shale and sandstone occur on the eastern side. The valley floors consist of Tertiary Period partly compacted sands and gravels of the Santa Fe group or Quaternary Period alluvium. The Santa Fe Group consists of alluvial fans, river channel deposits and inter-bedded volcanic rocks preserved in a complex of depressed fault blocks within the Rio Grande depression.

The ancestral Middle Rio Grande developed into a single river system about 5 million years ago (Crawford et al. 1993). Incision of the Middle Rio Grande Valley has been cyclic, and has produced gravel, sand, and silt terraces 9 to 53 meters (m) (30 to 175 feet (ft)) above the current floodplain. The Rio Grande is thought to have reached maximum entrenchment between 10,000 and 20,000 years ago, at a depth 18 to 40 m (60 to 130 ft) below the current valley floor. Since that time, sediment influx from tributaries has resulted in a gradual aggradation of the river bed. Historically, this process led to frequent avulsions of the river channel. The historic river channel was braided and sinuous with a shifting sand substrate that freely migrated across the floodplain, limited only by valley terraces and bedrock outcroppings (Crawford et al. 1993).

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. The most significant aquifer is the Santa Fe Group, particularly its lower member, the Tesuque Formation. The upper member, the Ancha, is typically more conductive than the Tesuque but occurs above the water table in much of the Santa Fe watershed. Deeper groundwater is nearly continuous in the Tesuque Formation throughout the watershed area, to depths of 2000 feet or greater in some areas. This deep groundwater dates from the Ice Age and is recharged little if at all by present-day rainfall and snowmelt. Volcanics often serve as a “floor” or channel to concentrate percolating groundwater and cause it to emerge as spring flow.



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.

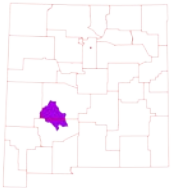
The soils in the Elephant Butte Reservoir Watershed are assigned to four groups (A, B, C, and D).


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.



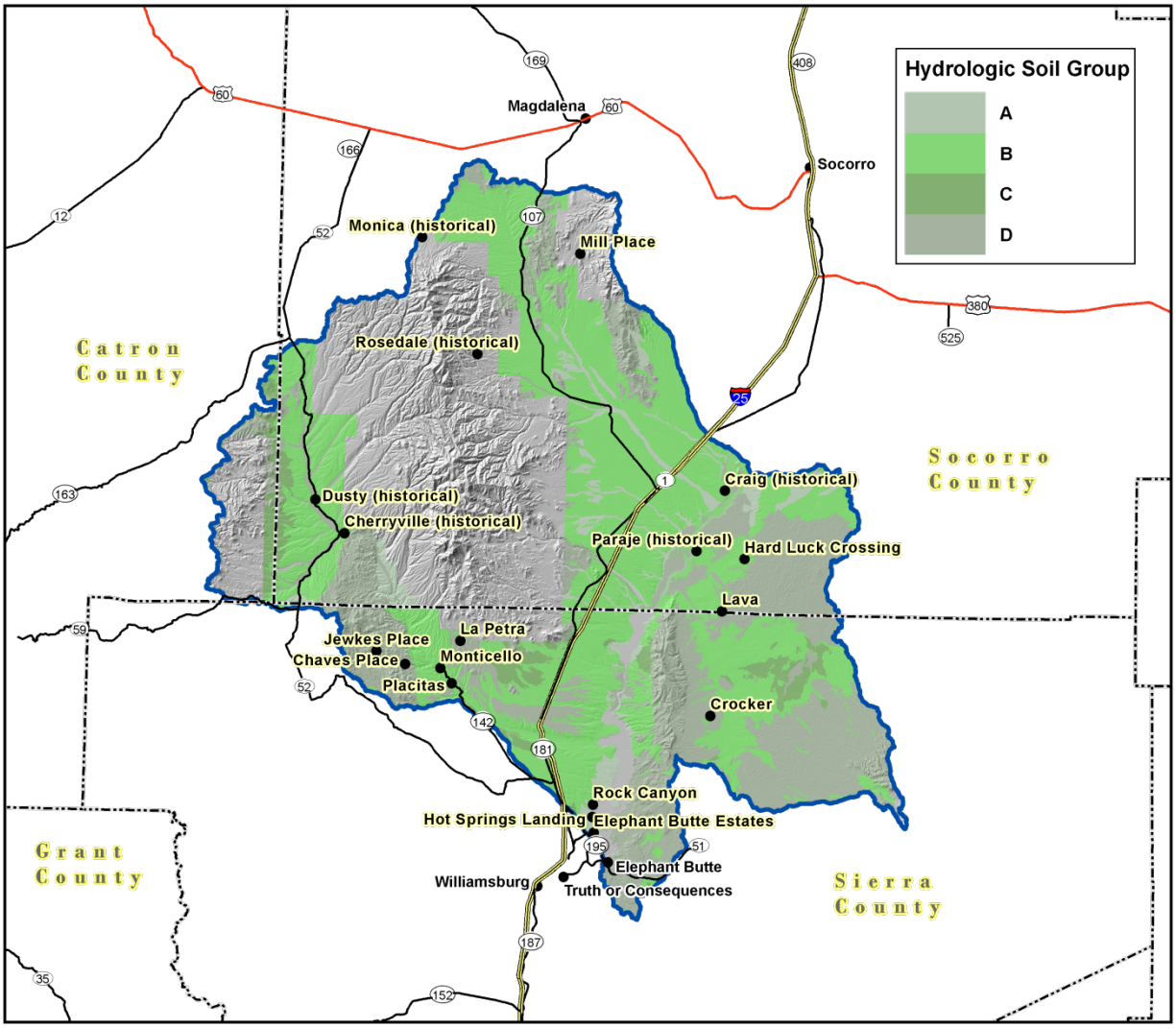
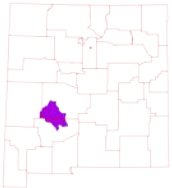


Figure 2. Elephant Butte Reservoir Hydrologic Soil Group.



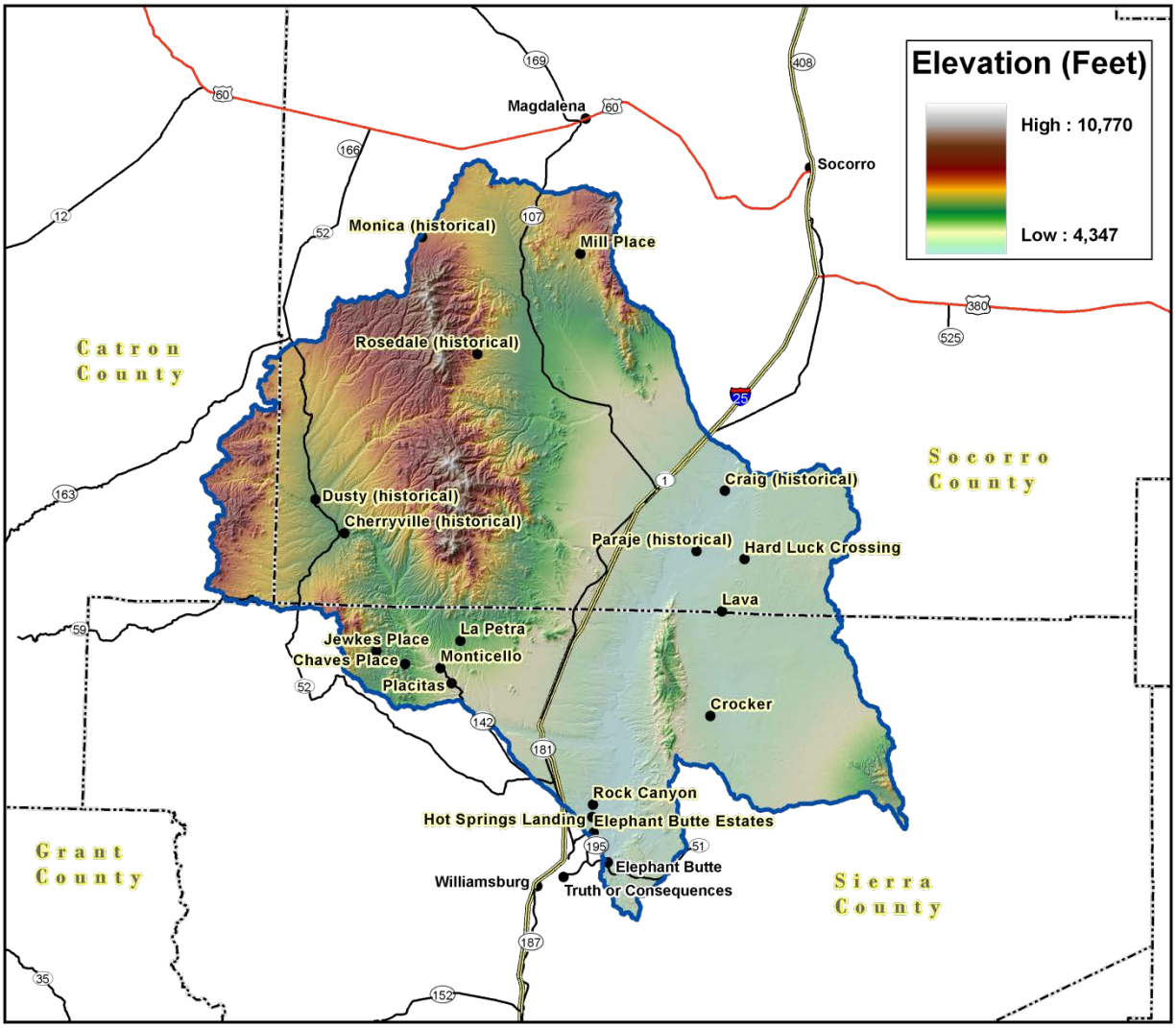
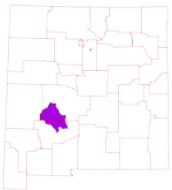


Figure 3. Elephant Butte Reservoir Watershed Shaded Relief.



Precipitation [2]

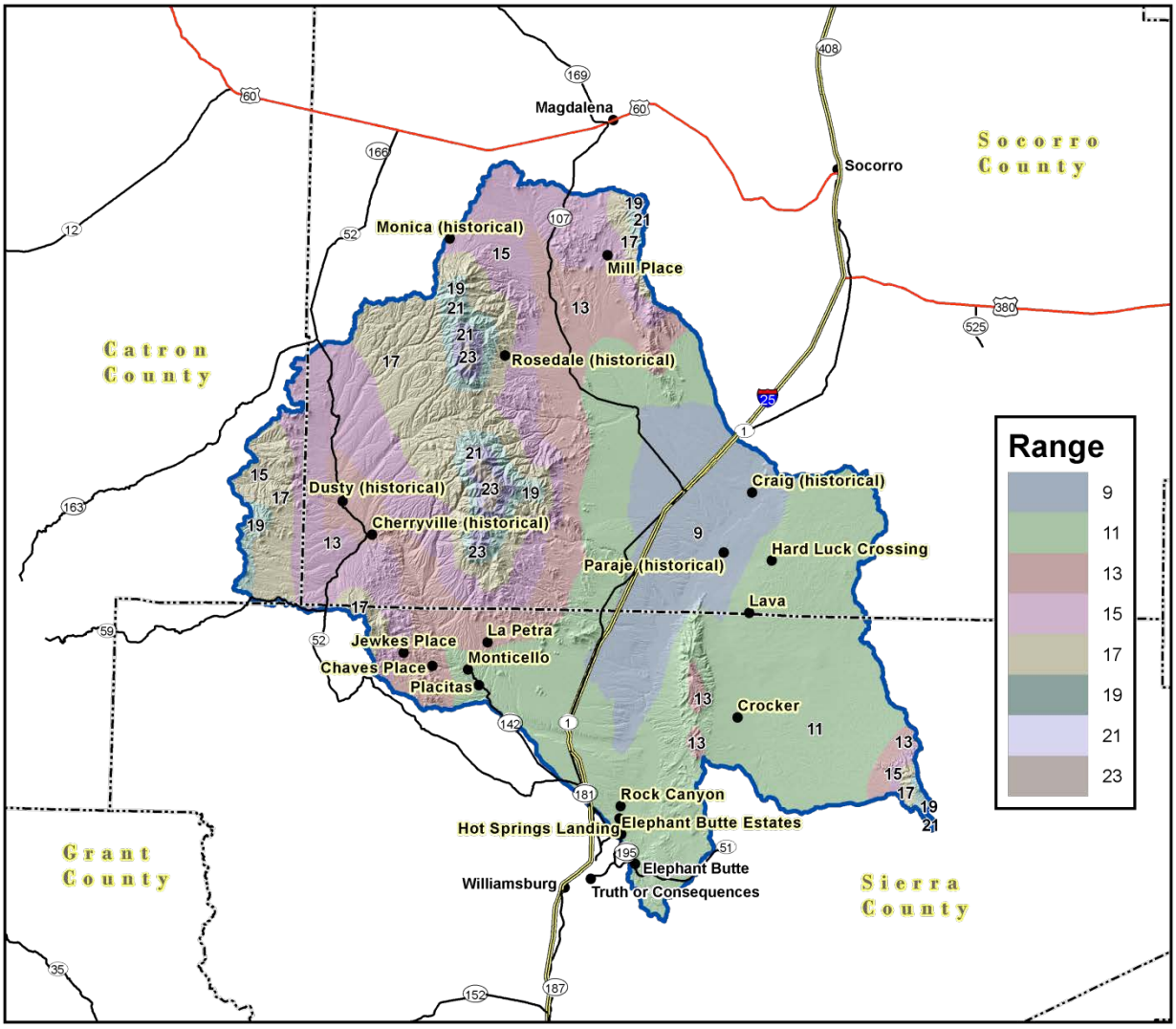


Figure 4. Elephant Butte Reservoir Watershed Annual Precipitation.

Land Ownership [3]

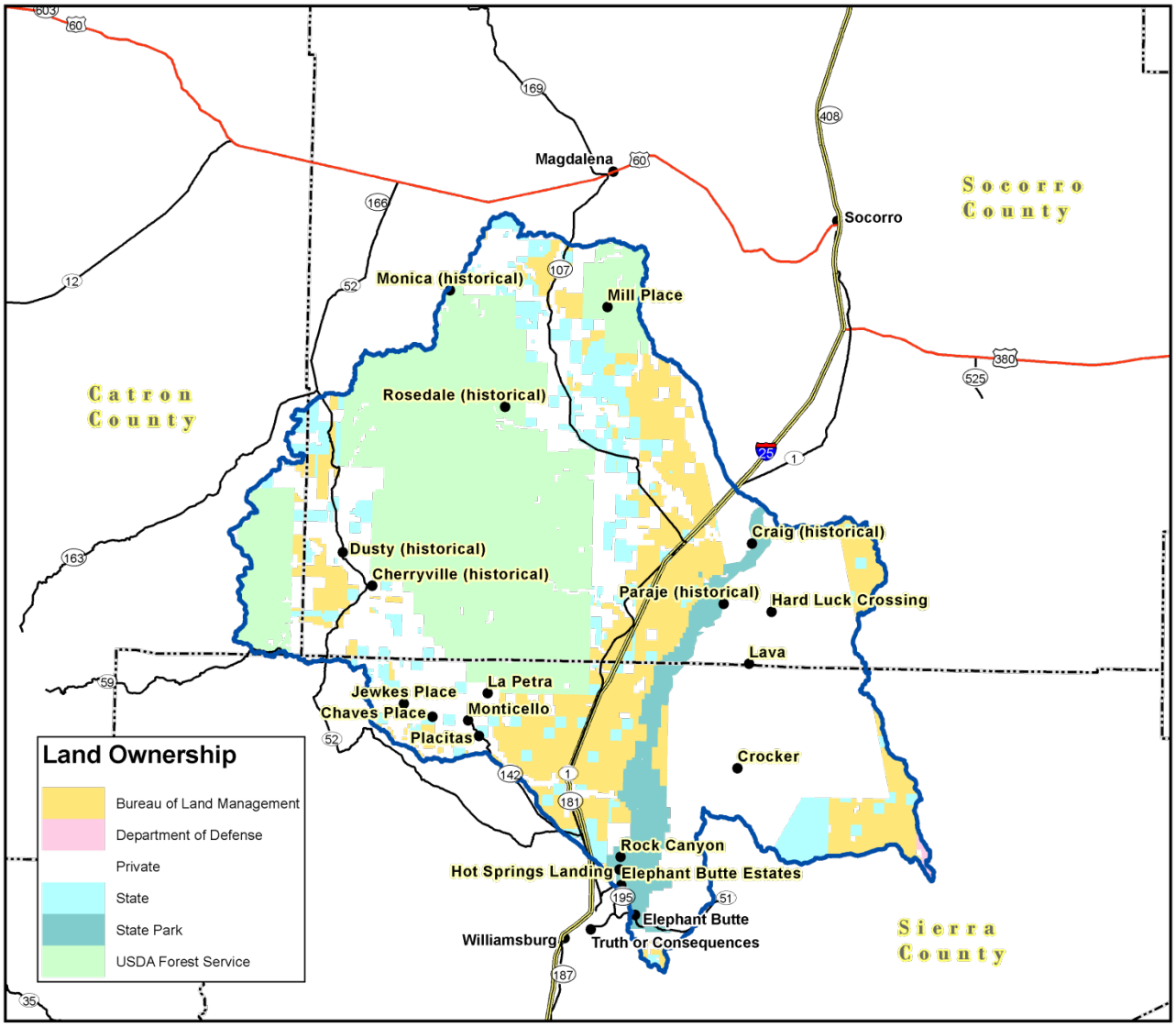
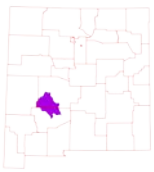


Figure 5. Elephant Butte Reservoir Watershed Land Ownership.

Land Ownership

COUNTY	BLM	Department of Defense	Private	State	State Park	USDA Forest Service
Catron	3,390		12,713	4,383		40,327
Sierra	112,743	1,937	251,224	39,015	43,828	18,987
Socorro	127,449		291,085	73,975	16,218	363,669
Watershed (∑)	243,582	1,937	555,023	117,374	60,046	422,983
% Watershed	17	<1	40	8	4	30

Table 2. Land Ownership in the Elephant Butte Reservoir Watershed.



Land Use / Land Cover [4,5]

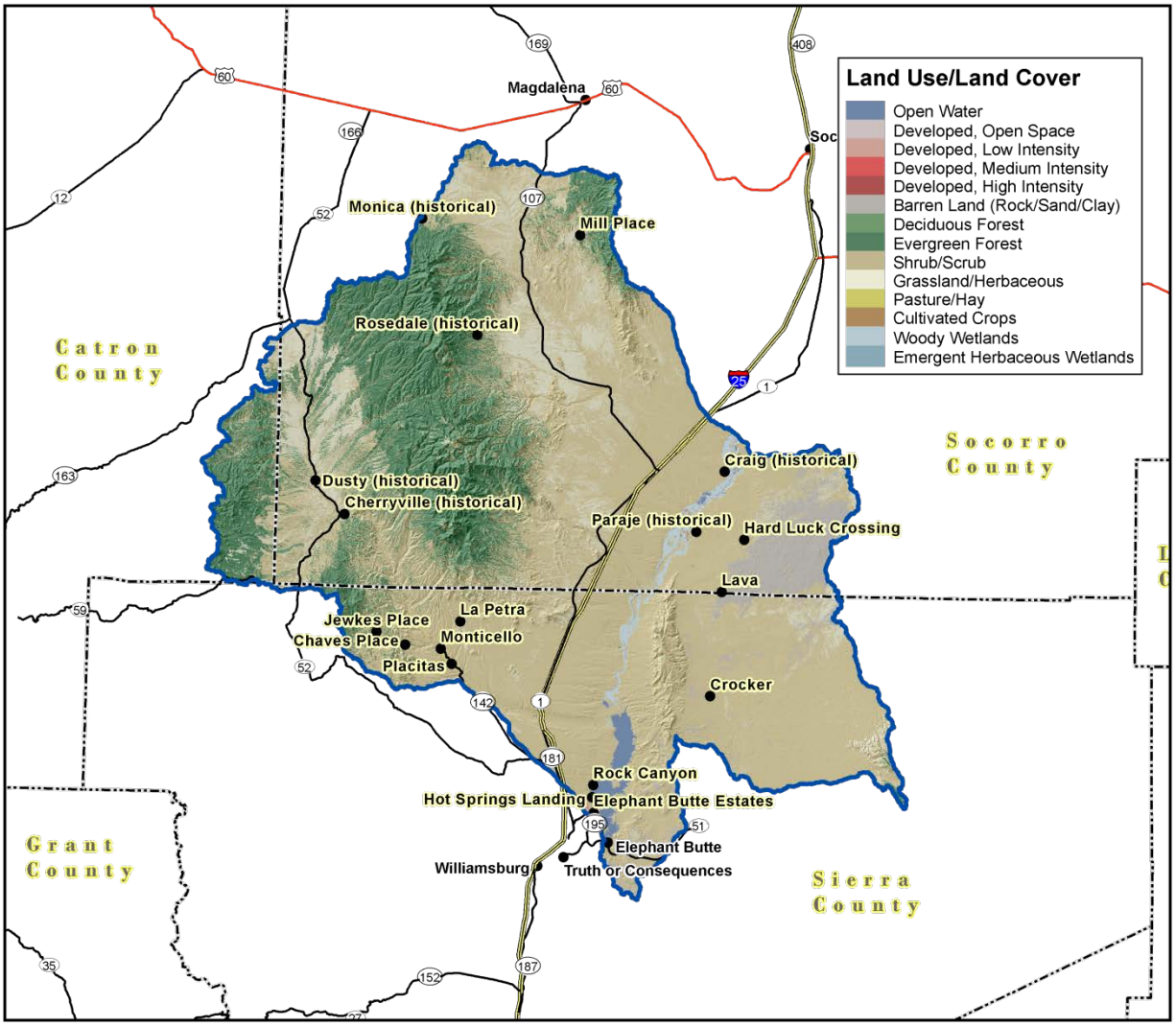
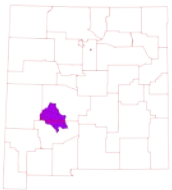


Figure 6. Subset of the National Land Cover Dataset in the Elephant Butte Reservoir Watershed.

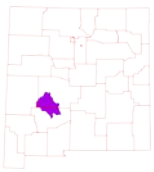


Land Use / Land Cover

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.

Land Use/ Land Cover	Acres	% of Watershed
Shrub/Scrub	854,905	61
Evergreen Forest	305,118	22
Herbaceous	149,297	11
Barren Land	59,373	4
Woody Wetlands	12,578	1
Open Water	11,894	1
Developed, Open Space	4,720	< 1
Developed, Low Intensity	1,333	< 1
Cultivated Crops	663	< 1
Deciduous Forest	559	< 1
Hay/Pasture	458	< 1
Developed, Medium Intensity	86	< 1
Mixed Forest	43	< 1
Emergent Herbaceous Wetlands	18	< 1
Developed, High Intensity	10	< 1

Table 3. Extent of NLCD classes in the Elephant Butte Reservoir Watershed.



Land Use / Land Cover

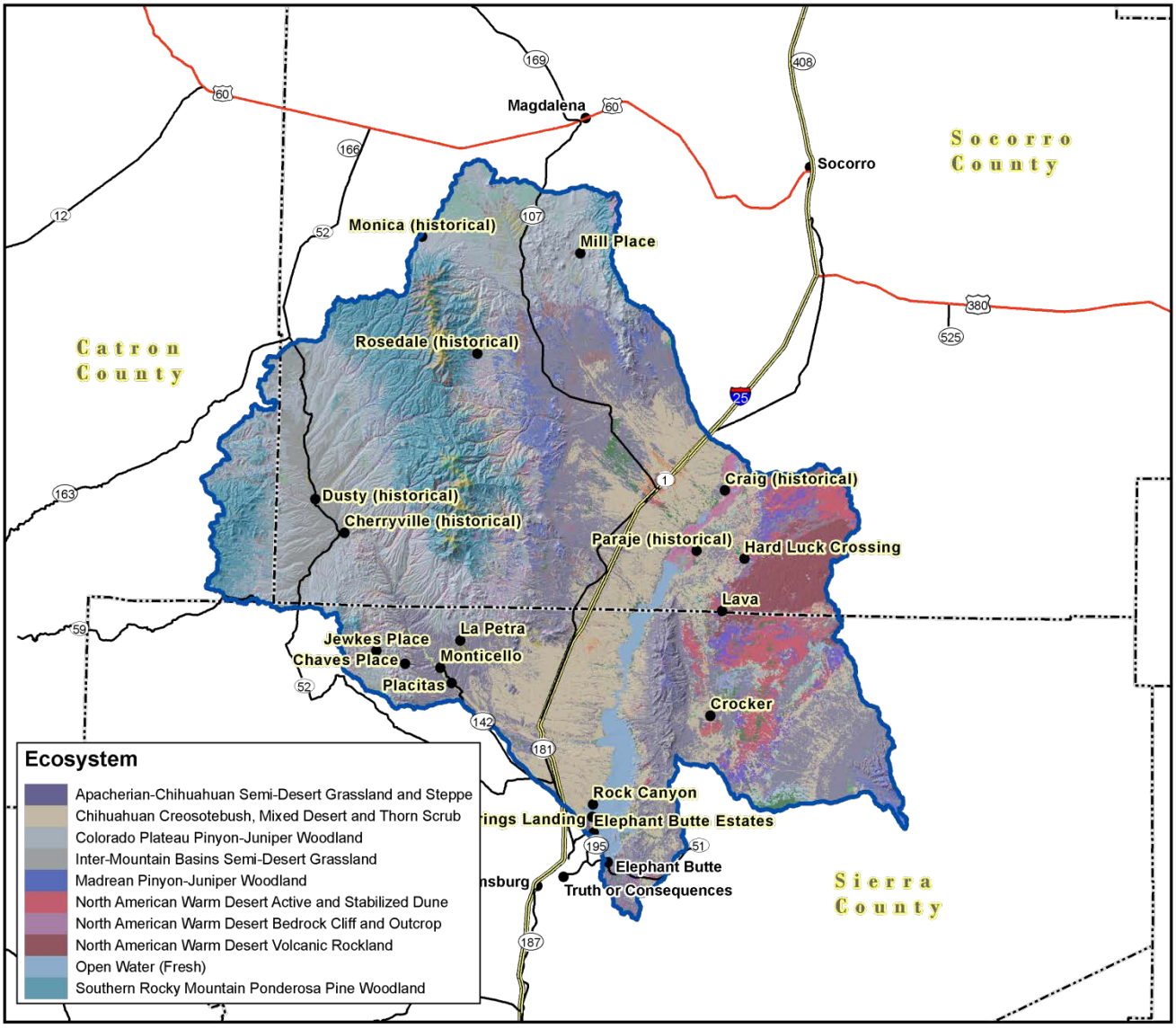


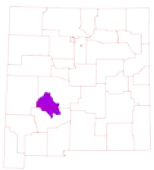
Figure 7. Subset of the SWREGAP over the Elephant Butte Reservoir Watershed. The 10 dominant ecosystems are displayed in the legend.

Land Use / Land Cover

The land cover 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.

ECOSYSTEM	Acres	% of Watershed
Apacherian-Chihuahuan Semi-Desert Grassland and Steppe	311,925	22%
Colorado Plateau Pinyon-Juniper Woodland	280,502	20%
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	248,526	18%
Southern Rocky Mountain Ponderosa Pine Woodland	152,410	11%
Inter-Mountain Basins Semi-Desert Grassland	82,096	6%
North American Warm Desert Active and Stabilized Dune	49,523	4%
North American Warm Desert Volcanic Rockland	37,675	3%
Open Water (Fresh)	30,716	2%
Madrean Pinyon-Juniper Woodland	30,638	2%
North American Warm Desert Bedrock Cliff and Outcrop	22,946	2%

Table 4. SW Region Gap analysis ecosystem acreages.



Hydrology [6, 7, 8,9,10]

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 7,029 miles (11,313 km) of water courses in the Elephant Butte Reservoir Watershed. The majority of these courses typically flow intermittently in summer months during periods associated with high intensity convective thunderstorms.

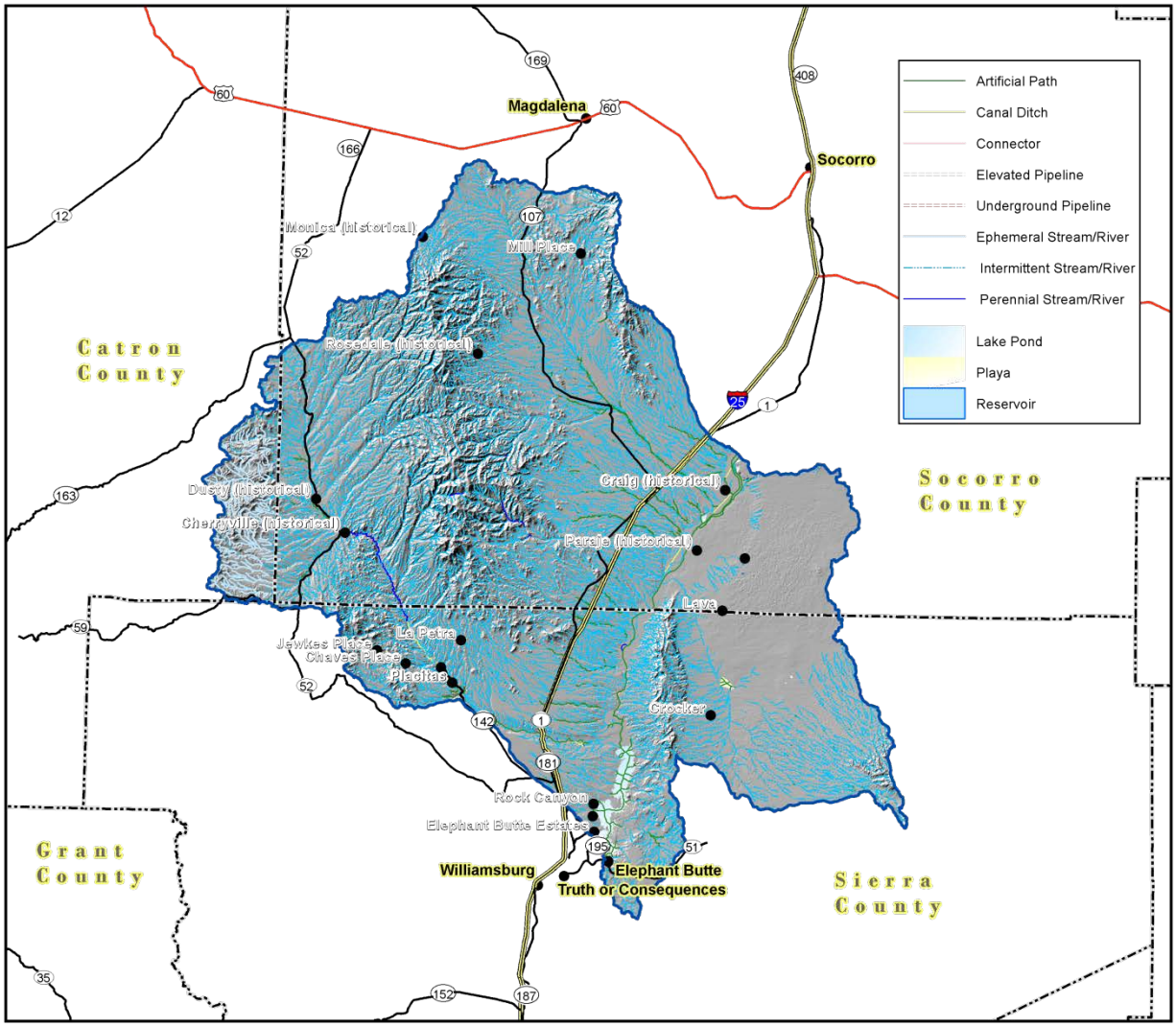
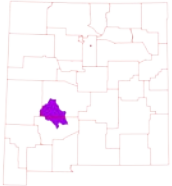


Figure 8 National Hydrologic Dataset (NHD) of the Elephant Butte Reservoir Watershed.

Water Course Type	Miles
Artificial Path	266
Canal / Ditch	16
Connector	2
Ephemeral Stream/ River	190
Intermittent Stream / River	6,529
Perennial Stream / River	27
Sum (∑)	7,029

Table 5 NHD Water Course Type and Extents



Gauging Stations:

There are 5 dams and water gauging stations in the watershed. USGS Site 08358400 is located in the northeast section of the watershed near the Rio Grande Floodway at San Marcial, NM. During the period 1964 – 2011, this site has had mean annual discharge of 730 cubic feet per second ranging from 1.18 (1971) to 2086 (11987) cubic feet per second.

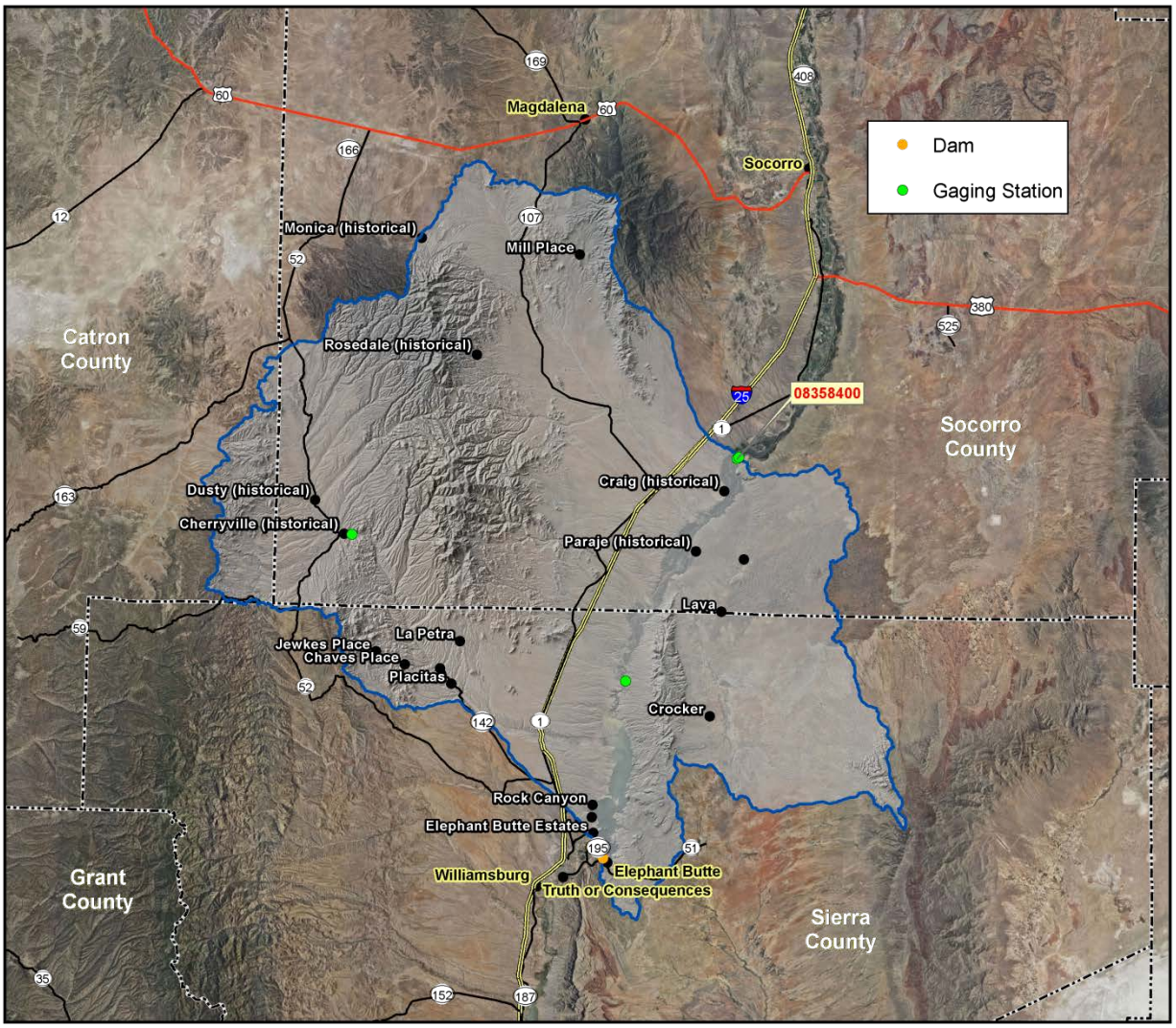


Figure 9. Gauging Stations in the Elephant Butte Reservoir Watershed.

Hydrology

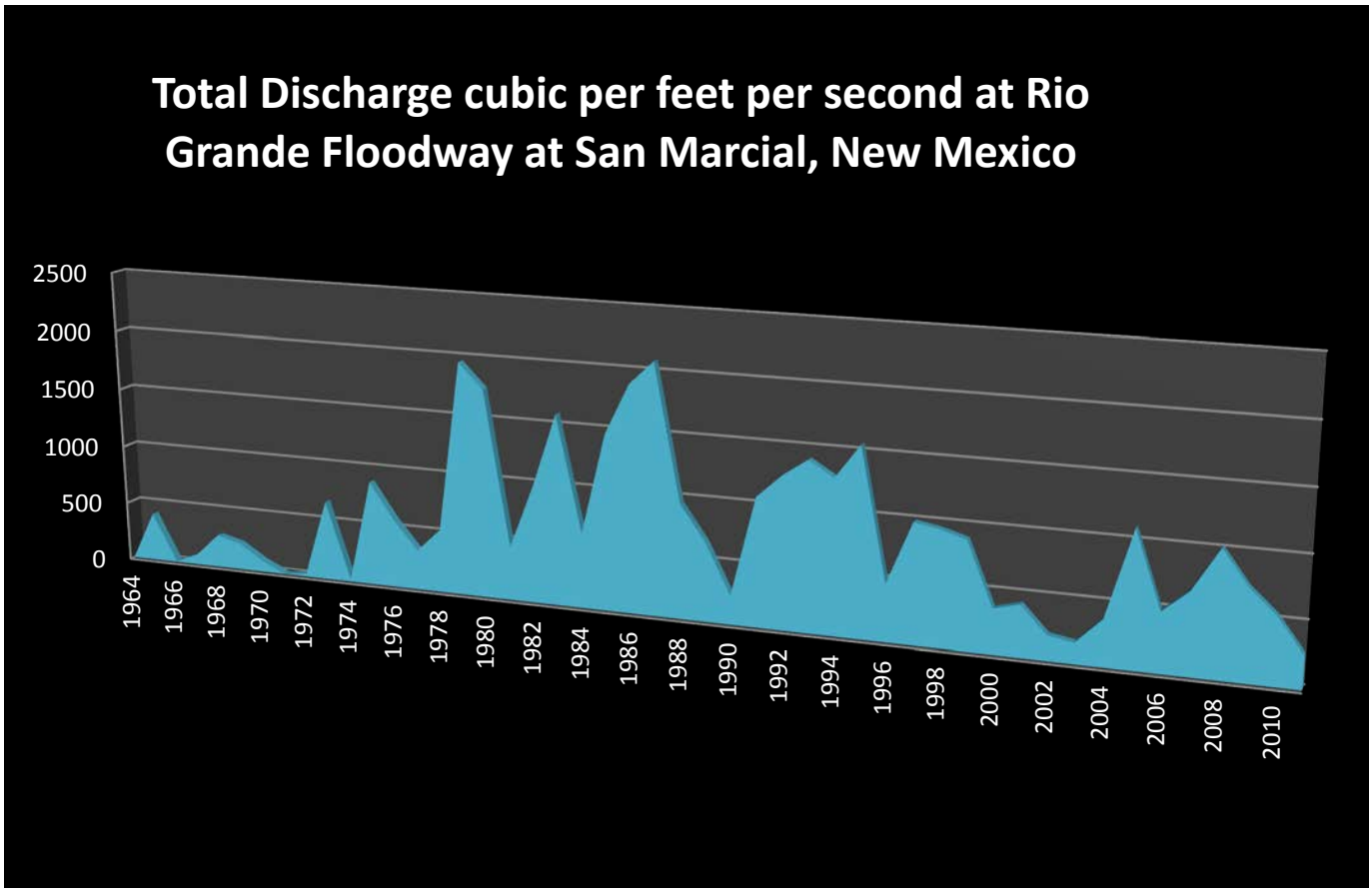
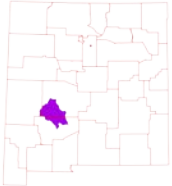


Figure 10. Monthly average of Mean Daily Flow on the Elephant Butte Reservoir Watershed at Rio Grande Floodway at San Marical, NM. Period of observation: 1964-2011.



New Mexico Water Quality Control Commission (NMWQCC):

The New Mexico Water Quality Control Commission (NMWQCC) is the issuing agency of water quality standards for interstate and intrastate waters in New Mexico.

There are no impaired river and stream reaches. There is one waterbody listed as 303(d) Impaired Surface Waters:

1. Elephant Butte Reservoir

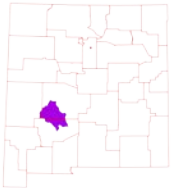
Use	Elephant Butte Reservoir
Irrigation Storage	x
Livestock Watering	x
Primary Contact	x
Warmwater Aquatic Life	NS
Wildlife Habitat	x

Table 6. Listed Uses. NS = Not Supporting, NA = Not Assessed, x = Fully Supporting.

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.

Probable Causes of Impairment	Elephant Butte Reservoir
Mercury in Fish Tissue	x
PCBs in Fish Tissue	x

Table 7. Possible Causes of Impairment



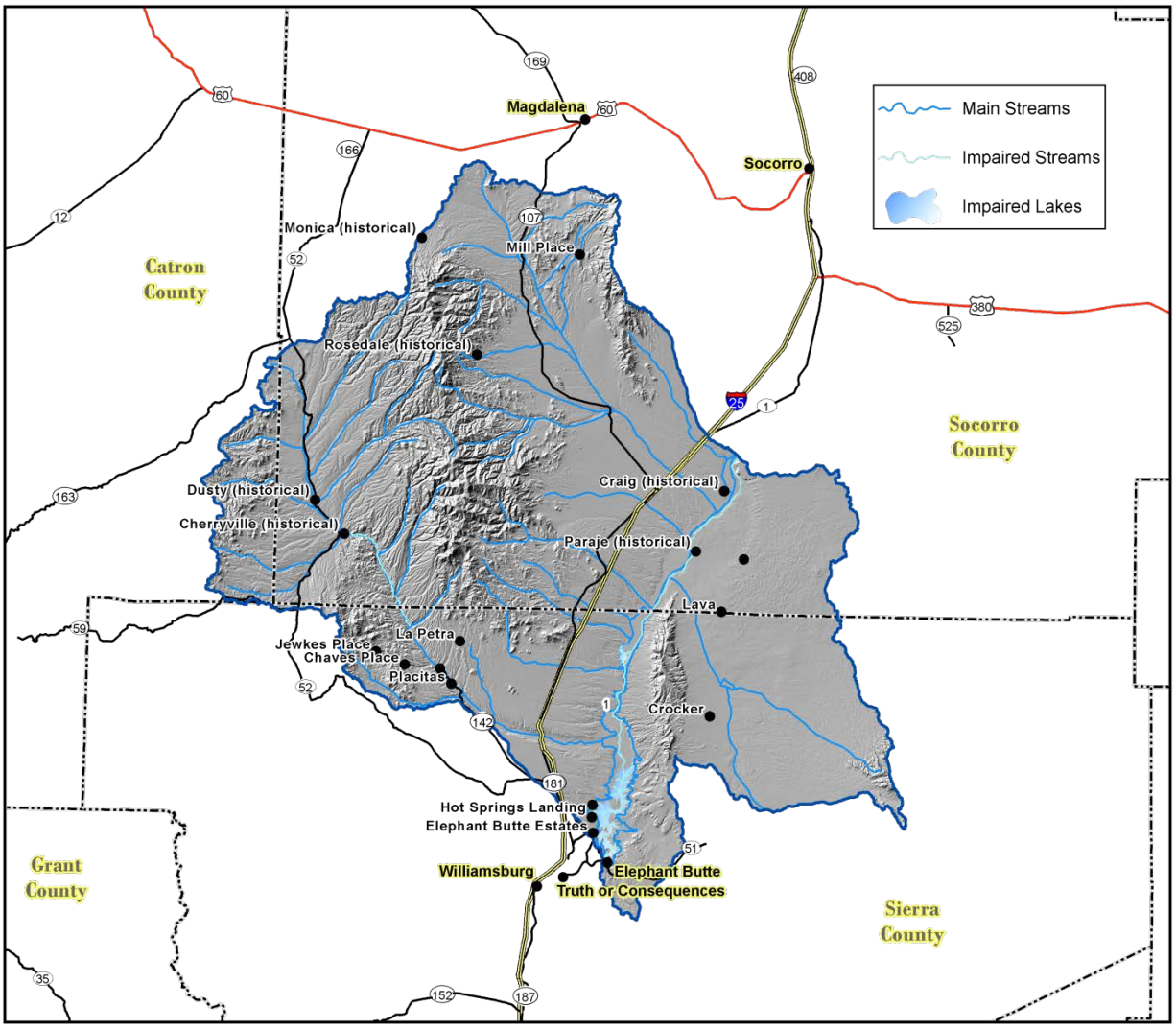
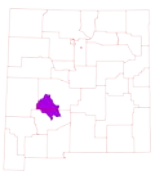


Figure 11. 303(d) Impaired Waters.



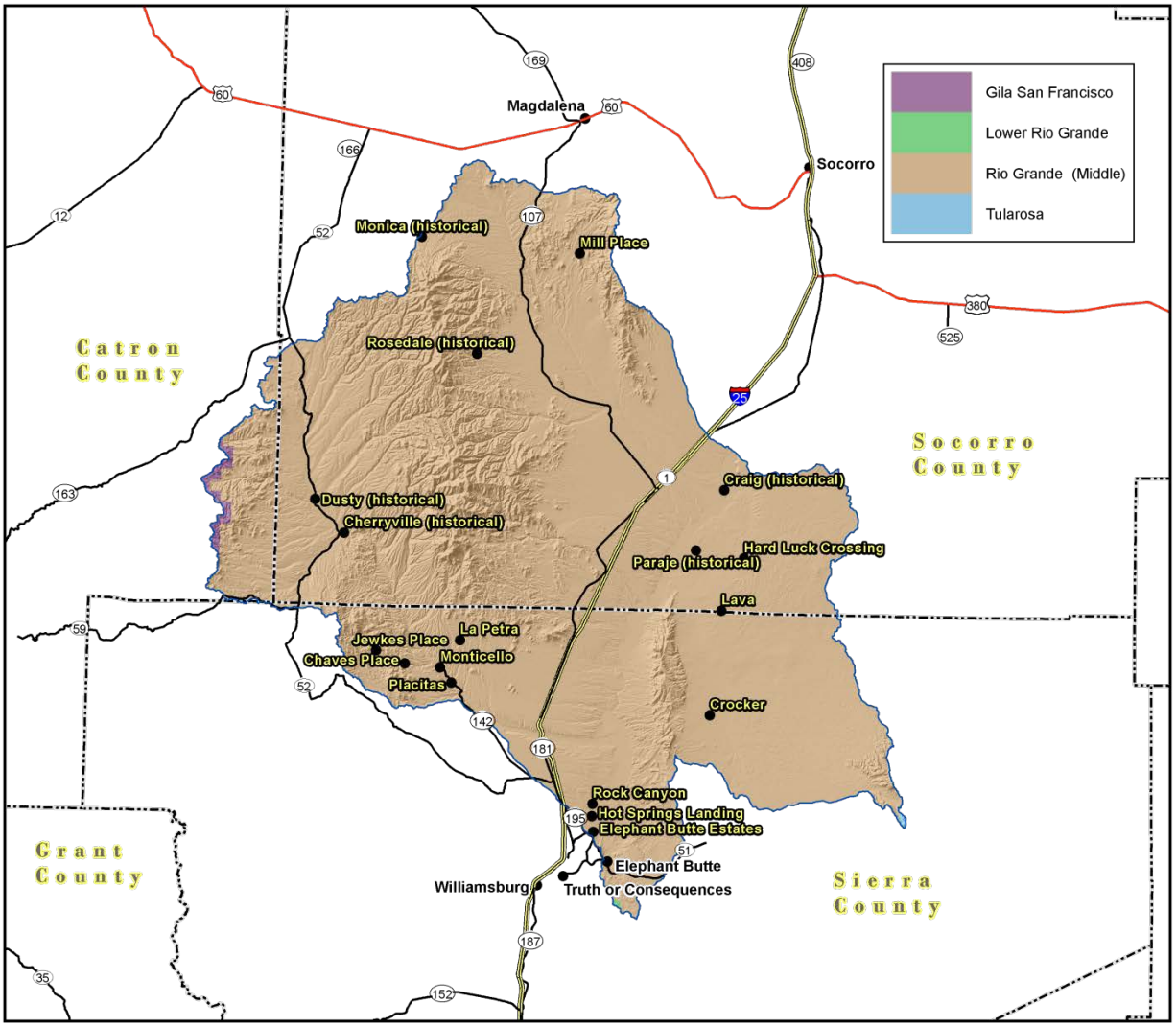
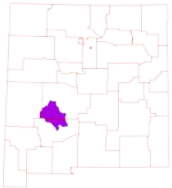


Figure 12. Declared Groundwater Basins of the Elephant Butte Reservoir.

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 Elephant Butte Reservoir Watershed is completely within Gila San Francisco, Mimbres and Rio Grande (Middle) Underground Water Basin. The surface watershed in New Mexico covers 140,945 of the approximately 29,764,917 million acres of the underground water basin in New Mexico.

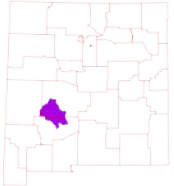


Threatened and Endangered Species [11]

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 8 lists those species which are currently listed and tracked in the Elephant Butte Reservoir Watershed.

Common Name	Scientific Name	Tax Class	Family	Federal Status	State Status
Bell's Vireo	*Vireo bellii*	Aves	Vireonidae		T
Caliente Tryonia	*Pseudotryonia alamosae*			LE	E
Chiricahua Leopard Frog	*Rana chiricahuensis*	Amphibia	Ranidae	LT	
Mexican Spotted Owl	*Strix occidentalis lucida*	Aves	Strigidae	LT	
Mexican Wolf	*Canis lupus baileyi*	Mammalia	Canidae		E
Neotropic Cormorant	*Phalacrocorax brasilianus*	Aves	Phalacrocoracidae		T
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Aves	Tyrannidae	LE	E
Spotted Bat	*Euderma maculatum*	Mammalia	Vespertilionidae		T

Table 8. Threatened and Endangered Plant and Animal Species.

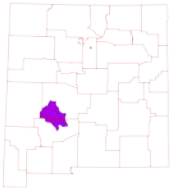


Invasive Species [12]

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 Elephant Butte Reservoir Watershed, the SWEMP has identified 6 species of invasive plants (Table 9). Each of these species is defined as non-native by the USDA PLANTS database.

Scientific Name	Common Name
Zygophyllaceae (Caltrop Family)	**African Rue**
Fabaceae (Pea Family)	**Camelthorn**
Brassicaceae (Mustard Family)	**Hoary Cress**
Asteraceae (Sunflower Family)	**Musk Thistle**
Brassicaceae (Mustard Family)	**Perennial Pepperweed (Tall Whitetop)**
Asteraceae (Sunflower Family)	***Russian Knapweed***

Table 9. Invasive Species Recognized by the SWEMP.



Common Resource Areas [13]

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.

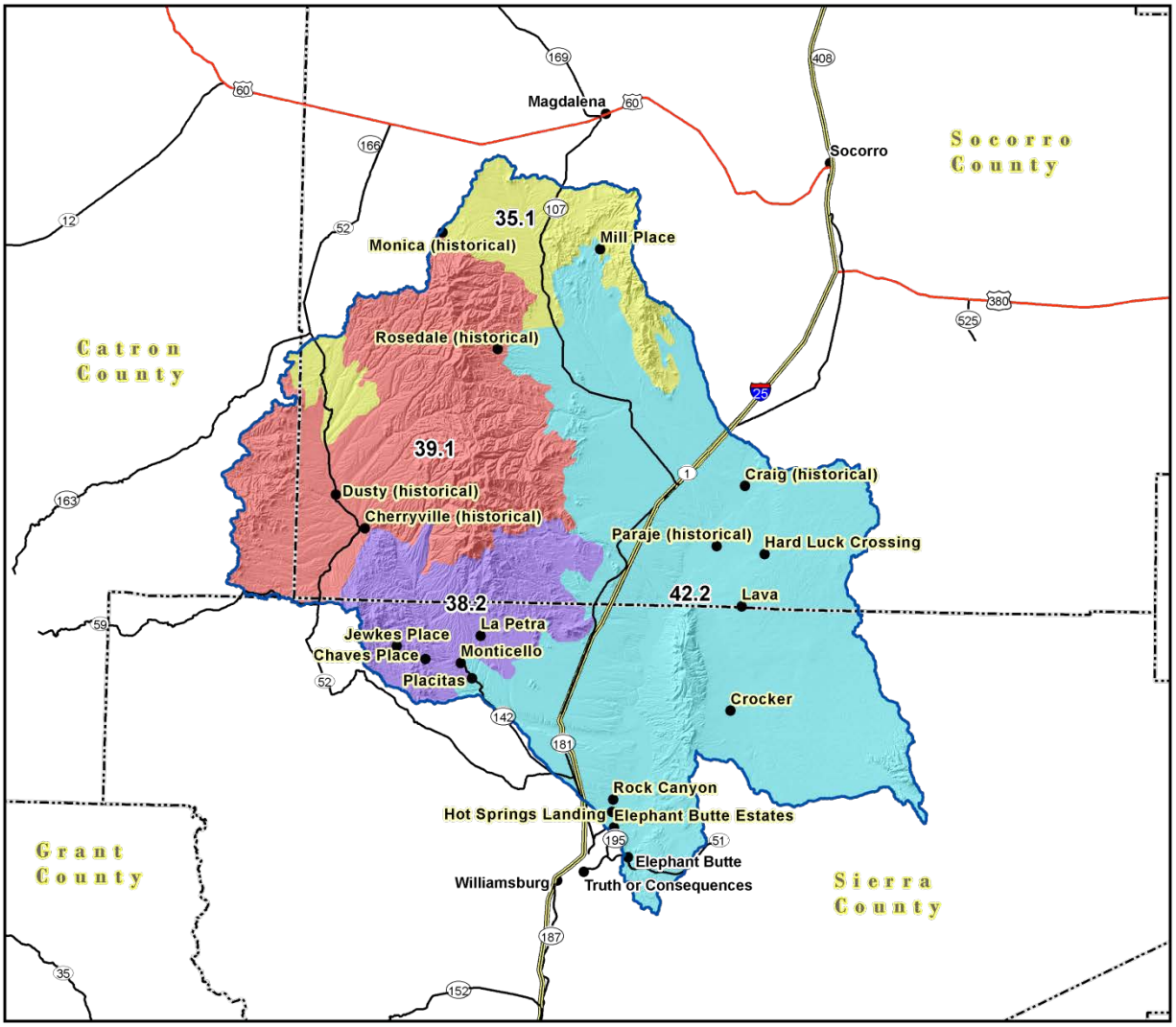


Figure 13. Common Resource Areas of the Elephant Butte Reservoir Watershed.

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.

38.2 - Interior Chaparral - Woodlands

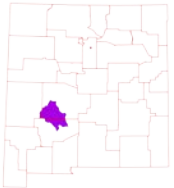
This unit occurs within the Transition Zone Physiographic Province and is characterized by canyons and structural troughs or valleys. Igneous, metamorphic and sedimentary rock occurs on rough mountainous terrain. Elevations range from 4000 to 5500 feet. Precipitation averages 16 to 20 inches per year. The soil temperature regime ranges from thermic to mesic. The soil moisture regime is aridic ustic. Vegetation includes turbinella oak, silktassel, juniper, pinyon, sugar sumac, and bullgrass.

39.1 - Mogollon Plateau Coniferous Forests

This unit occurs within the Colorado Plateau Physiographic Province and is characterized by volcanic fields and gently dipping sedimentary rocks eroded into plateaus, valleys and deep canyons. Elevations range from 7000 to 12500 feet. Precipitation averages 20 to 35 inches per year. The soil temperature regime ranges from mesic to frigid. The soil moisture regime ranges from typic ustic to udic ustic. Vegetation includes ponderosa pine, Gambel oak, Arizona walnut, sycamore, and Douglas fir.

42.2 - Chihuahuan Desert Shrubs

This unit occurs within the Basin and Range Physiographic Province and is characterized by valley plains, alluvial fans, and mountains. Sediments are from fluvial, lacustrine, colluvial and alluvial deposits. Igneous and metamorphic rock dominate the mountain ranges. Elevations range from 3800 to 5200 feet. Precipitation ranges from 8 to 10 inches per year. The soil temperature regime is thermic. The soil moisture regime is typic aridic. Vegetation includes Creosote, tarbush, soaptree yucca, torrey yucca, tobosa, and alkali sacaton.

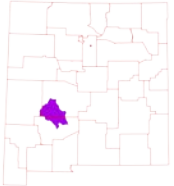


Conservation [14]

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.

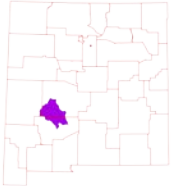
Conservation Practice	2007		2008		2009		2010		2011		TOTAL	
	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres
Brush Management	1	15,216					1	9,775	3	44,369	5	69,361
Forest Stand Improvement									2	21,944	2	21,944
Irrigation Land Leveling			2	29			1	8	2	121	5	158
Irrigation Water Management									1	21	1	21
Prescribed Grazing									1	12,918	1	12,918
Upland Wildlife Habitat Management	1	10,036			2	33,451	2	23,522	1	20,432	6	87,441
SUM (∑)	2	25,253	2	29	2	33,451	4	33,304	10	99,805	20	191,843

Table 10. 5 year Trends in Applied Conservation Practices. Reported in Acres.



Conservation Practice	2007		2008		2009		2010		2011		TOTAL	
	#	Feet	#	Feet	#	Feet	#	Feet	#	Feet	#	Feet
Diversion									1	7,165	1	7,165
Fence	1	734	1	48,514					1	7,298	3	56,545
Irrigation Field Ditch									1	1	1	1
Irrigation Water Conveyance, Ditch and Canal Lining, Plain Concrete							1	25			1	25
Irrigation Water Conveyance, Pipeline, Low-Pressure, Underground, Plastic			1	25							1	25
Pipeline			1	36,562	1	30,137	1	12,974	3	79,673	1	36,562
SUM (∑)	1	734	3	85,101	2	30,161	4	27,439	10	143,434	3	85,101

Table 11. 5 Year Trends in Location Specific Applied Conservation Practices. Reported in Feet if Linear (i.e. Fence)



Soil Resource Inventory[15]

The Elephant Butte Reservoir Watershed has a number of certified National Cooperative Soil Survey (NCSS) inventories. The National Forests in New Mexico are not covered, but have soils information available through their Terrestrial Ecosystem Unit Inventories. These will be integrated with the National Cooperative Soil Survey (NCSS) Inventories in the next few years. 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 Cooperative Soil Survey:

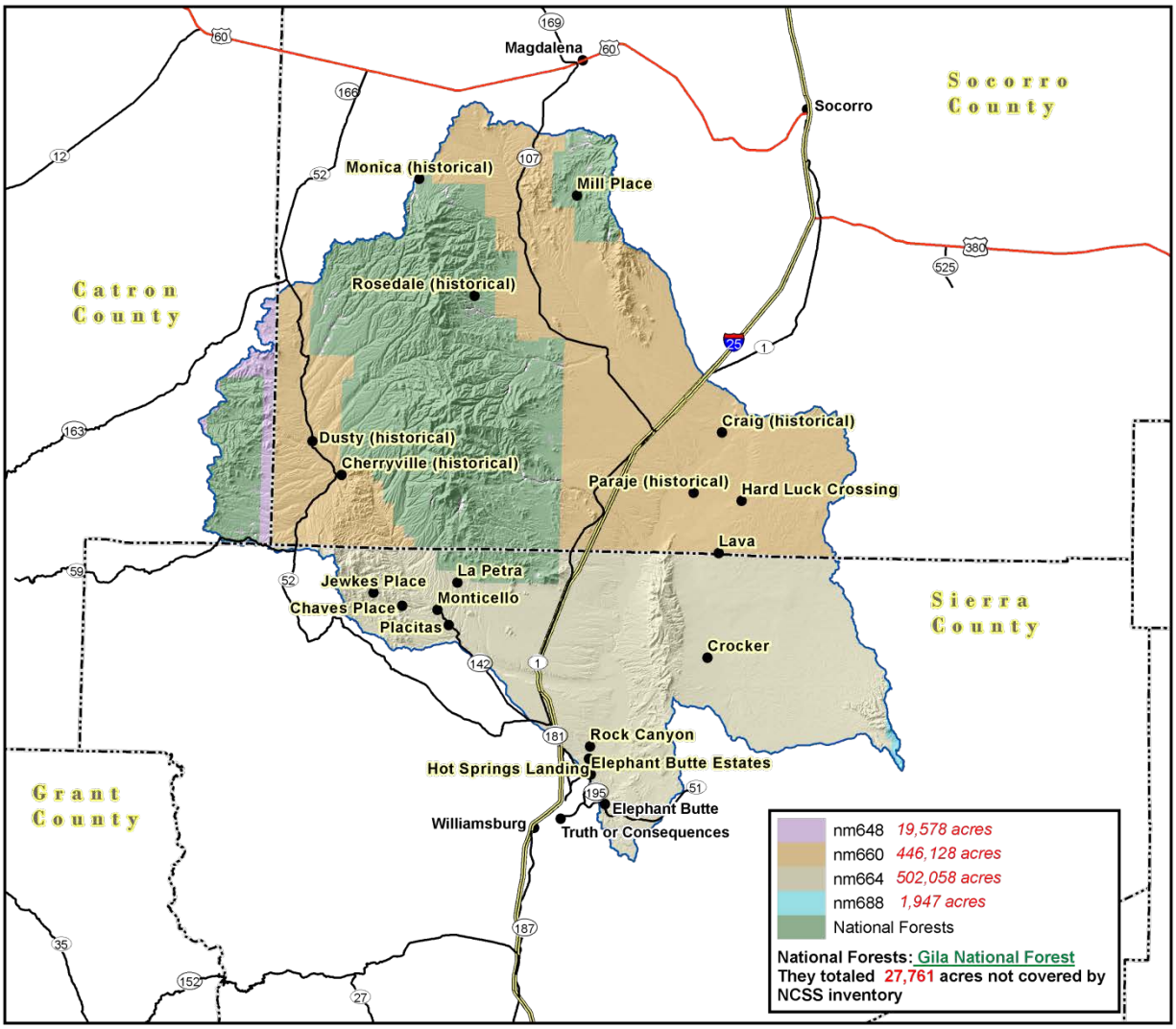


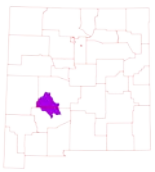
Figure 14. National Cooperative Soil Survey coverage of the Elephant Butte Reservoir Watershed.

Soil Resource Inventory

In order to evaluate the susceptibility of erosion within the Elephant Butte 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 map unit 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 -

SSURGO Value	Nominal Description	Model Rank
Saturated Hydraulic Conductivity		
µm / s		
705.0 - 100.0	Very High	0
99.9 - 10.0	High	1
9.9 - 1.0	Moderately High	2
0.9 - 0.1	Moderately Low	3
0.09 - 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 12. 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 included in the model at his time.

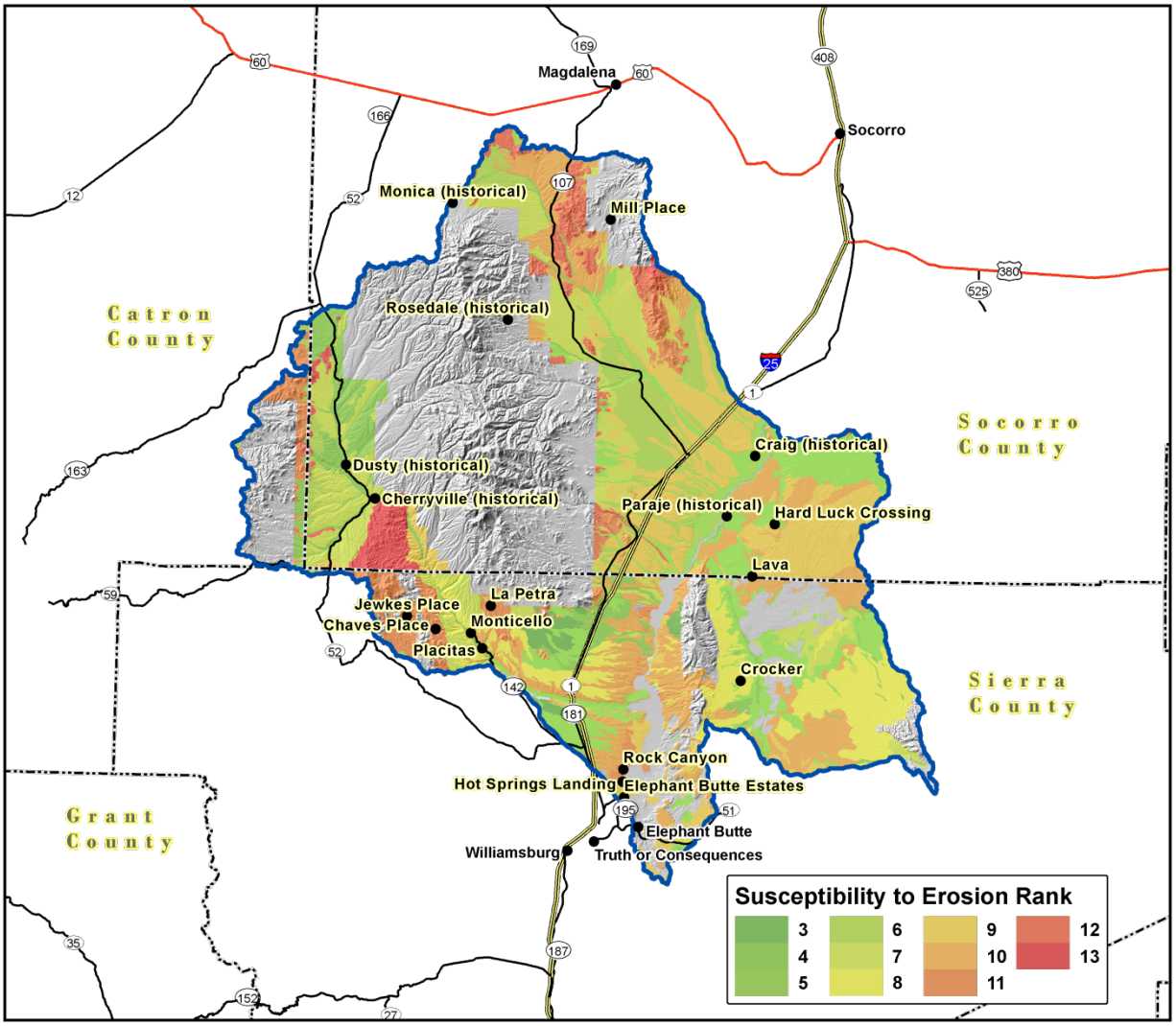
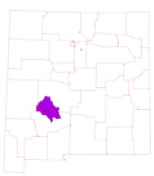


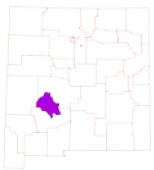
Figure 15. Elephant Butte Reservoir Watershed Erosion Potential.



Soil Resource Inventory

Rank	Acres
3	11,221
4	62,211
5	124,169
6	67,087
7	119,106
8	83,809
9	141,460
10	147,736
11	59,692
12	30,475
13	21,312
Sum(∑)	868,278

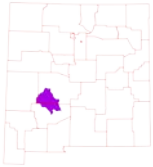
Table 13. Soil Erosion Potential Model Results. A greater rank indicates greater potential for erosion.



Socioeconomic Data 2010 [18]

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 adj. 2010
Catron	3,725	709	3,344	16	99	7	0	142	117	40,906
Sierra	11,988	3,352	10,265	49	199	49	3	1,032	391	38,641
Socorro	17,866	8,664	13,424	188	2,082	219	8	1,442	503	41,964

Table 14. Socioeconomic Data of the Counties in the Watershed (2010).



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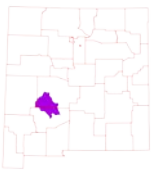

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