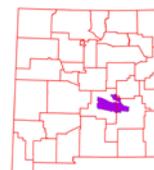
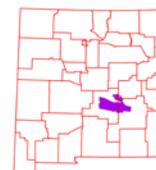


# Rapid Watershed Assessment

## Arroyo del Macho Watershed



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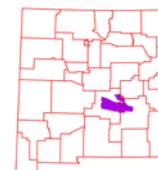
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## Overview

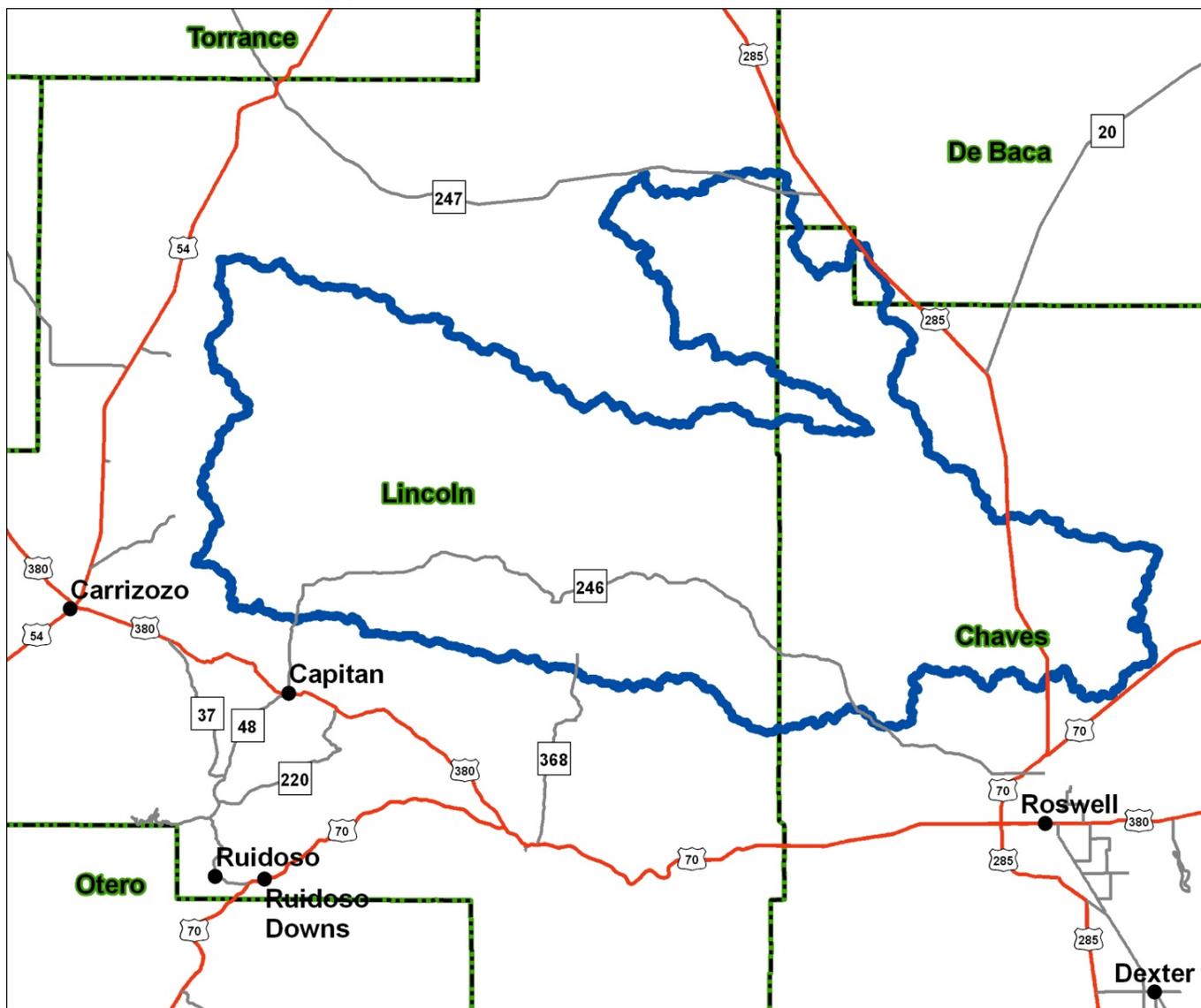
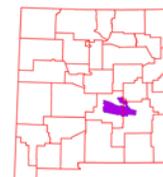


Figure 1. Arroyo del Macho Watershed Overview

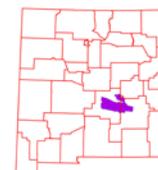


## Overview

The Arroyo del Macho Watershed is located east-central New Mexico. It covers 1,196,967 total acres (4,844 sq. km). Portions of the Arroyo del Macho watershed extend into Chavez, DeBaca, and Lincoln counties. Table 1 summarizes the distribution of the Arroyo del Macho watershed.

**Table 1. Arroyo del Macho watershed acreage distribution.**

	County Acres Total	Acres in HUC	% of HUC in County	% of County in HUC
Chavez	3,885,365	392,877	10	33
DeBaca	1,492,600	8,654	1	1
Lincoln	3,089,795	795,436	26	66
Sum ( $\Sigma$ )		1,196,967		100



## **Physical Setting**

### **Geology:**

The HUC has a northwestern boundary at Tecolote Peak. The southern boundary passes through Jicarilla Peak, Ancho Peak; along the spine of the Sacramento Mountains to Carrizo Mountain then Read Mesa; along the spine of the Capitan Mountains to Sunset Peak; passes between Arabela and Bluewater to include the headwaters of Archuleta Creek; heads eastward from near Page Ranch; crosses State Highway 246 at the intersection with Larkspur Road; turns northward at Haystack Mountain; crosses State Highway 285 south of One Horse Road; and proceeds to the confluence of Salt Creek and the Pecos River. The northern boundary passes between Pipeline Road and Hasperos Canyon; crosses Pipeline Road just SE of the County Road B026 and Pipeline Road intersection; goes to the confluence of Gallo Arroyo with Arroyo del Macho; continues northwestward along the divide between Gallo Arroyo and Fifteenmile Arroyo; turns eastward near Hays Ranch on County Road B020; crosses State Highway 247 near Corona Well; turns southeastward just south of the intersection of State Highway 247 and U.S. Highway 285; follows the divide between Middle Fork Draw and Fifteenmile Arroyo; crosses U.S. Highway 285 between Stargrass Road and Pipeline Road; just south of the Red Bluff Road and Cottonwood Road intersection; and southward to the confluence.

The bedrock is predominantly Permian Period limestone, dolomite and sandstone. The limestone is porous and has many sinkholes. Caliche also forms on the ground surface. These slope eastward down into the Pecos River Valley. The valleys contain Quaternary Period alluvium deposits and older alluvial deposits of the piedmont and upland plains. The Capitan Mountains and Sacramento Mountains also contain Tertiary Period intrusive rocks.

Resource concerns are high sediment erosion. In addition the lowering of valleys by river incision is a continuing process. 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.

Groundwater quality and quantity is a concern. 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 limestone is usually along fracture zones which are hard to intercept with water wells. Groundwater quality ranges from good to fair 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 del Macho 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.



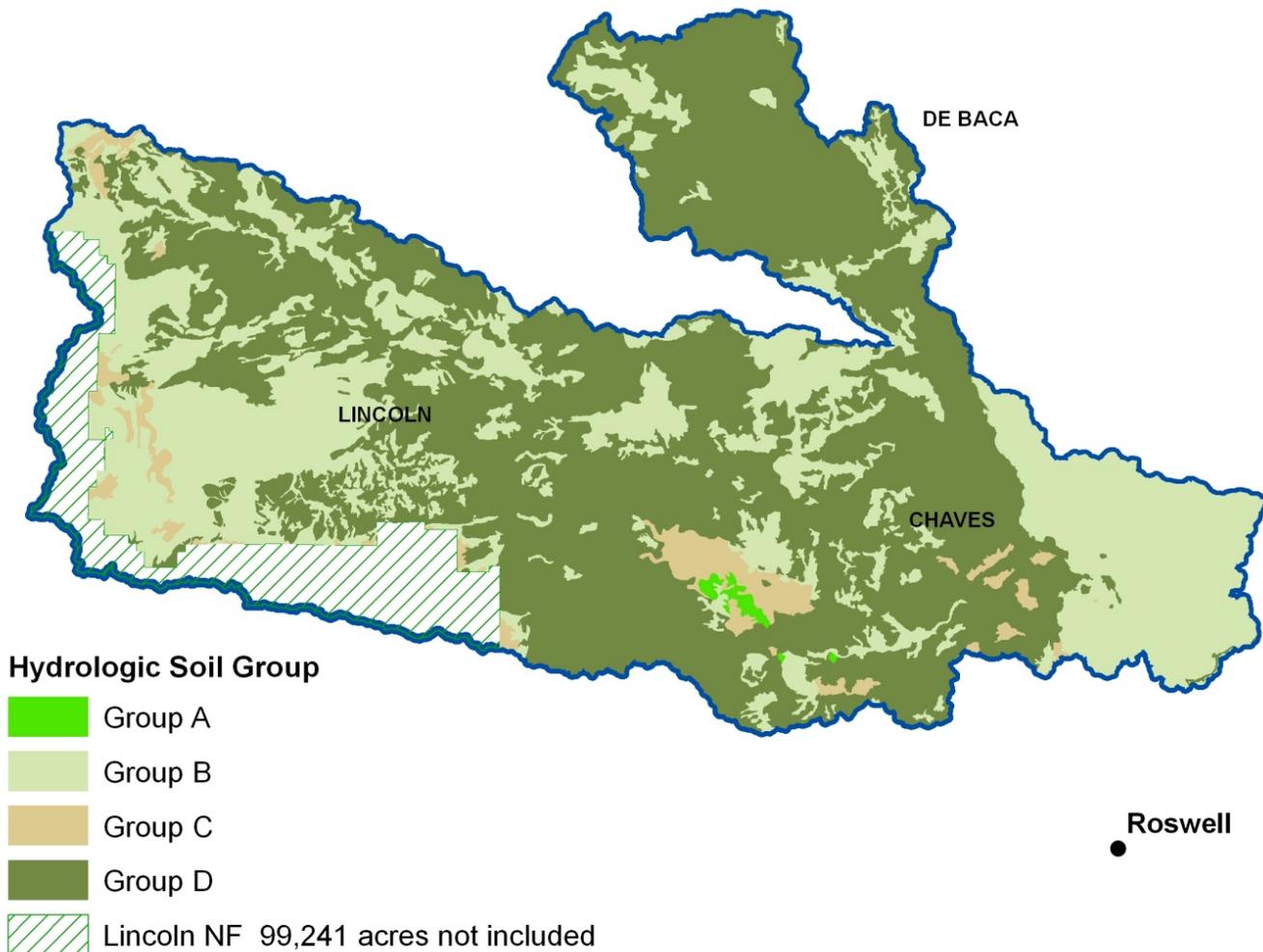
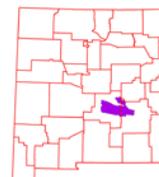


Figure 2 Hydrologic Soil Groups.



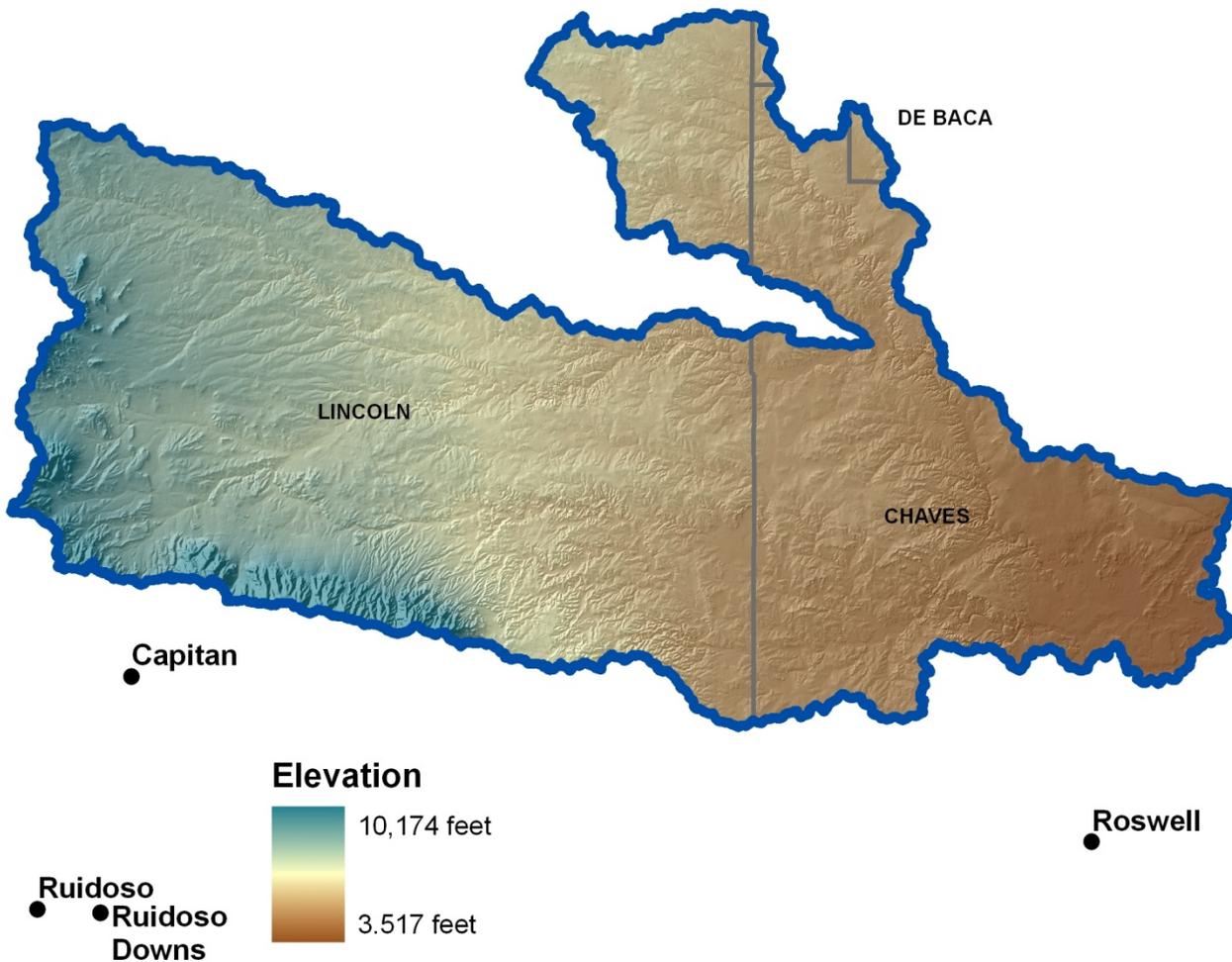
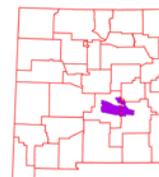


Figure 3. Arroyo del Macho Watershed Shaded Relief



**Precipitation**

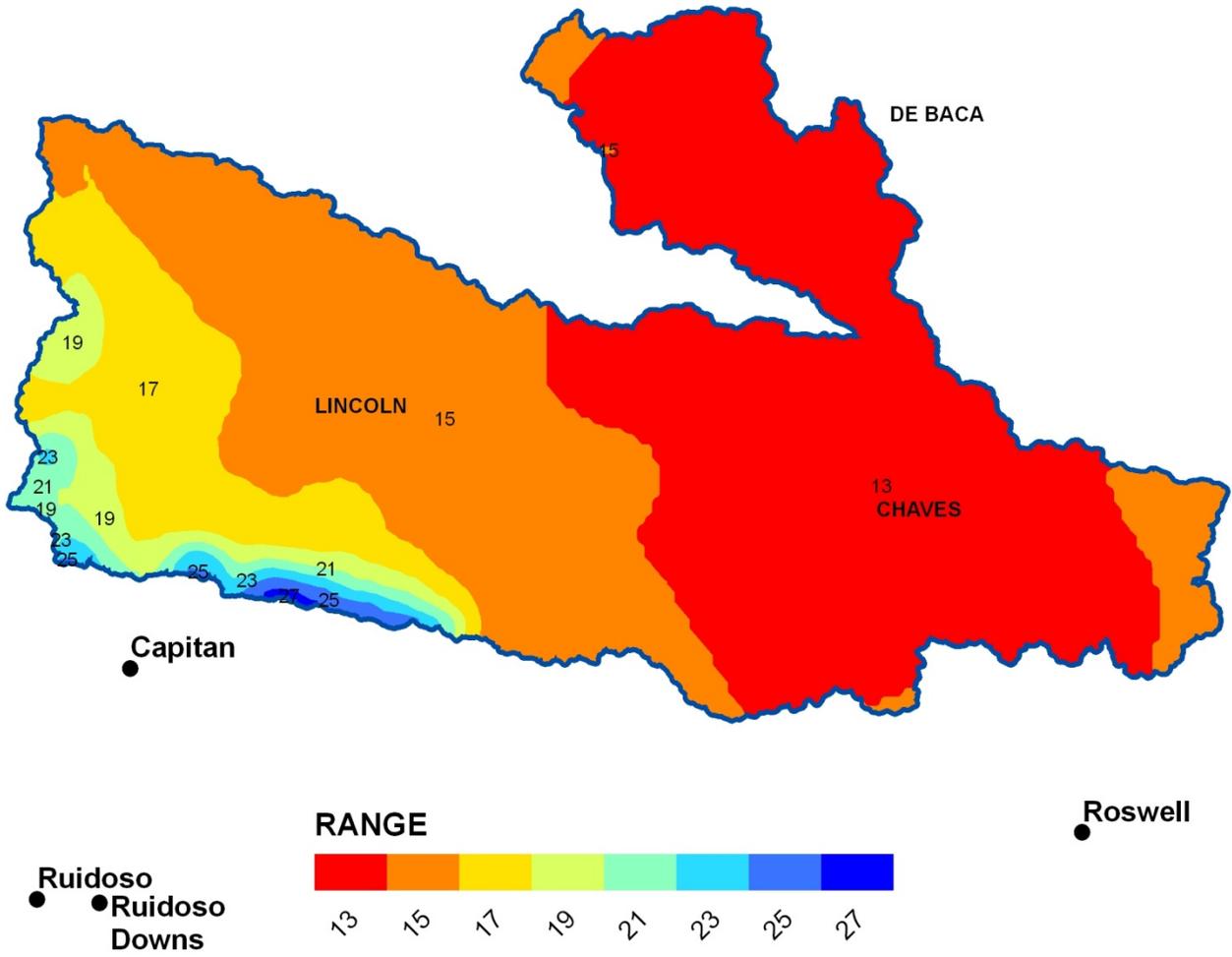


Figure 4. Arroyo del Macho Watershed Annual Precipitation.



## Land Ownership <sup>2</sup>

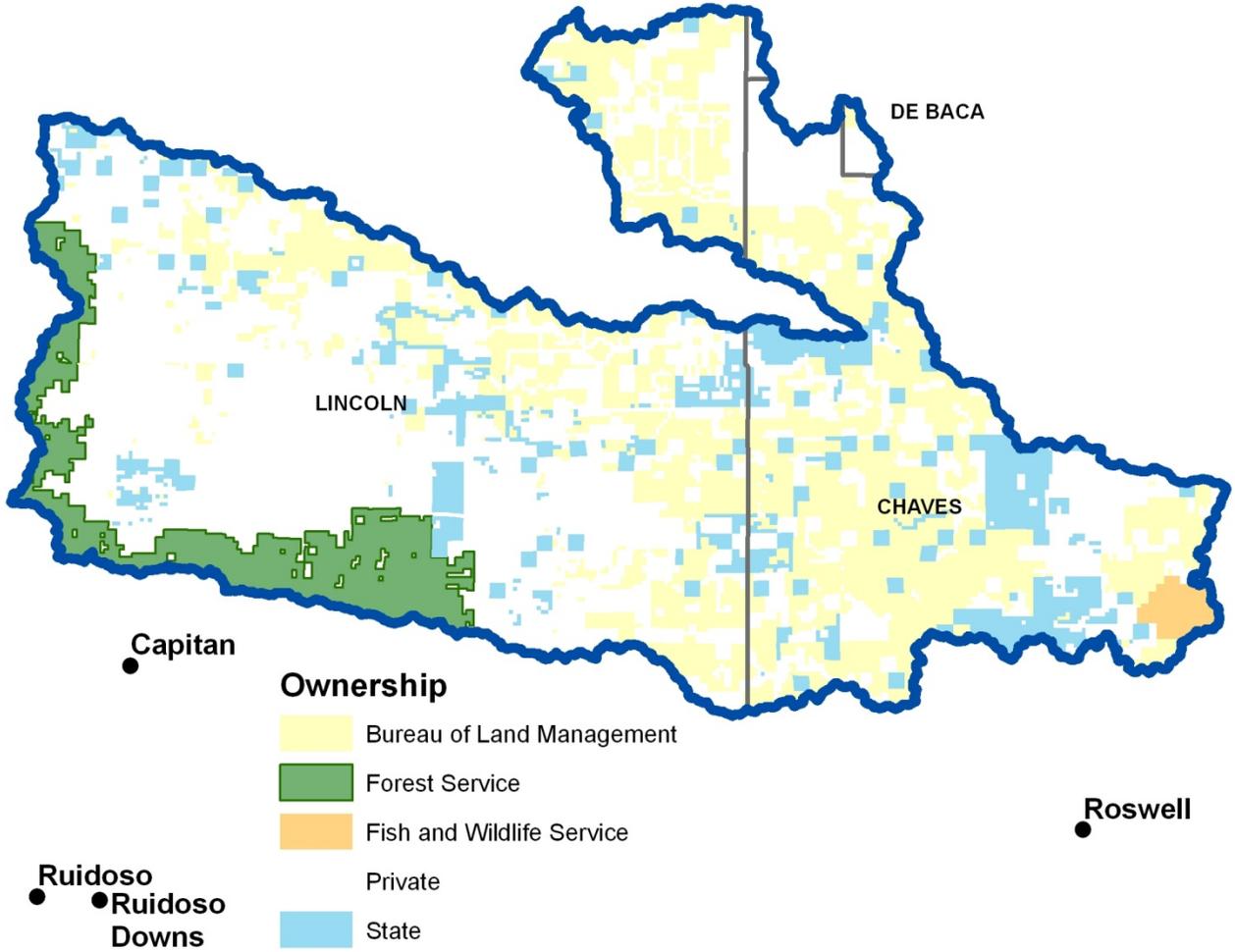


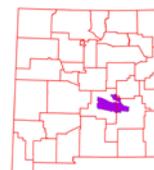
Figure 5. Arroyo del Macho Watershed Land Ownership.



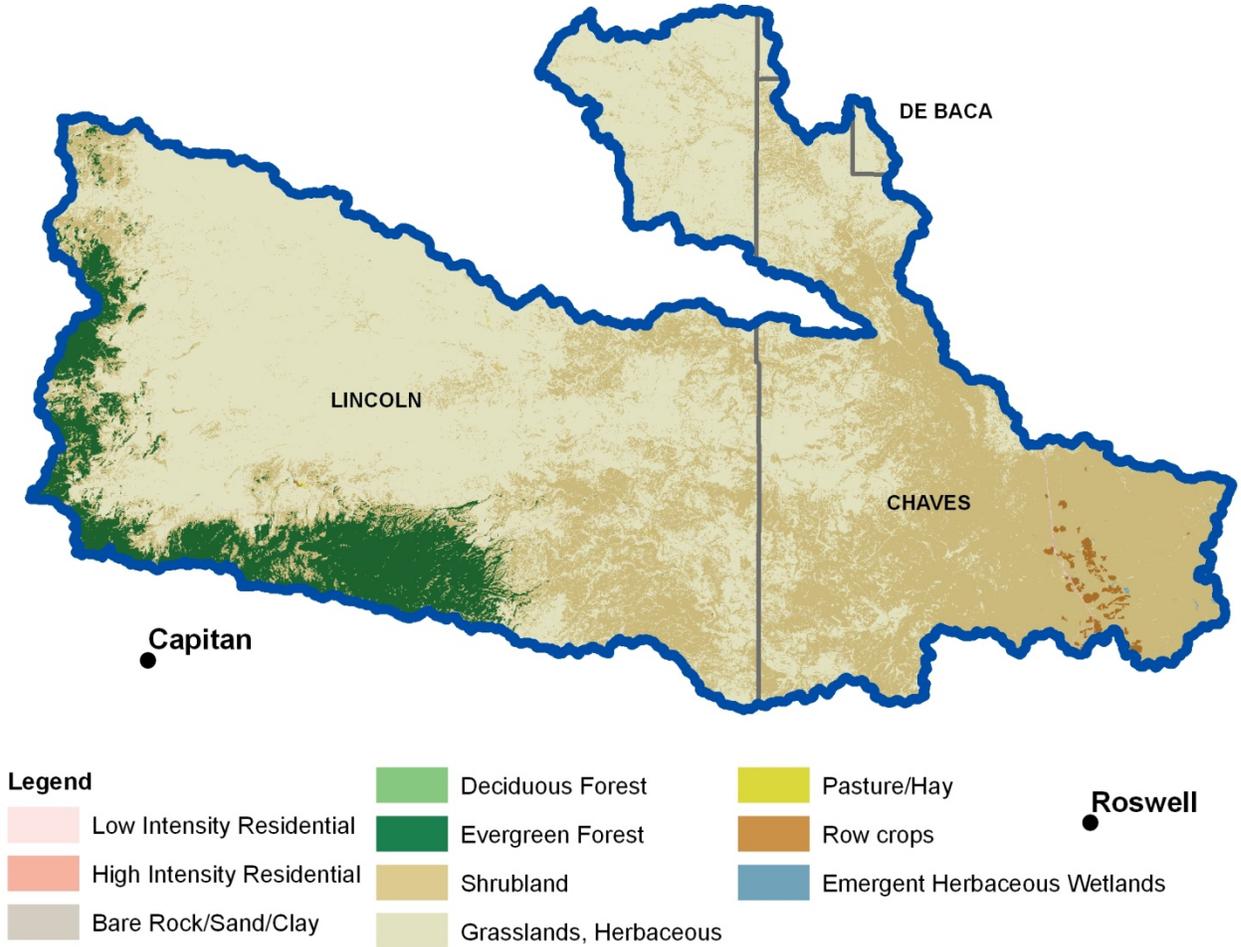
### Land Ownership

<u>COUNTY</u>	<u>BLM</u>	<u>FS</u>	<u>FWS</u>	<u>Private</u>	<u>State</u>
Chavez	182,007		9,322	130,891	70,657
DeBaca	1,021			7,633	
Lincoln	183,322	86,146		459,069	66,899
Watershed ( $\Sigma$ )	366,350	86,146	9,322	597,593	137,556
% Watershed	31	7	1	50	11

Table 2. Land ownership in the Arroyo del Macho watershed.



**Land Use / Land Cover** <sup>3.4</sup>



**Figure 6. Subset of the National Land Cover Dataset over the Arroyo del Macho Watershed.**

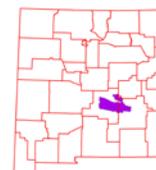


## Land Use / Land Cover

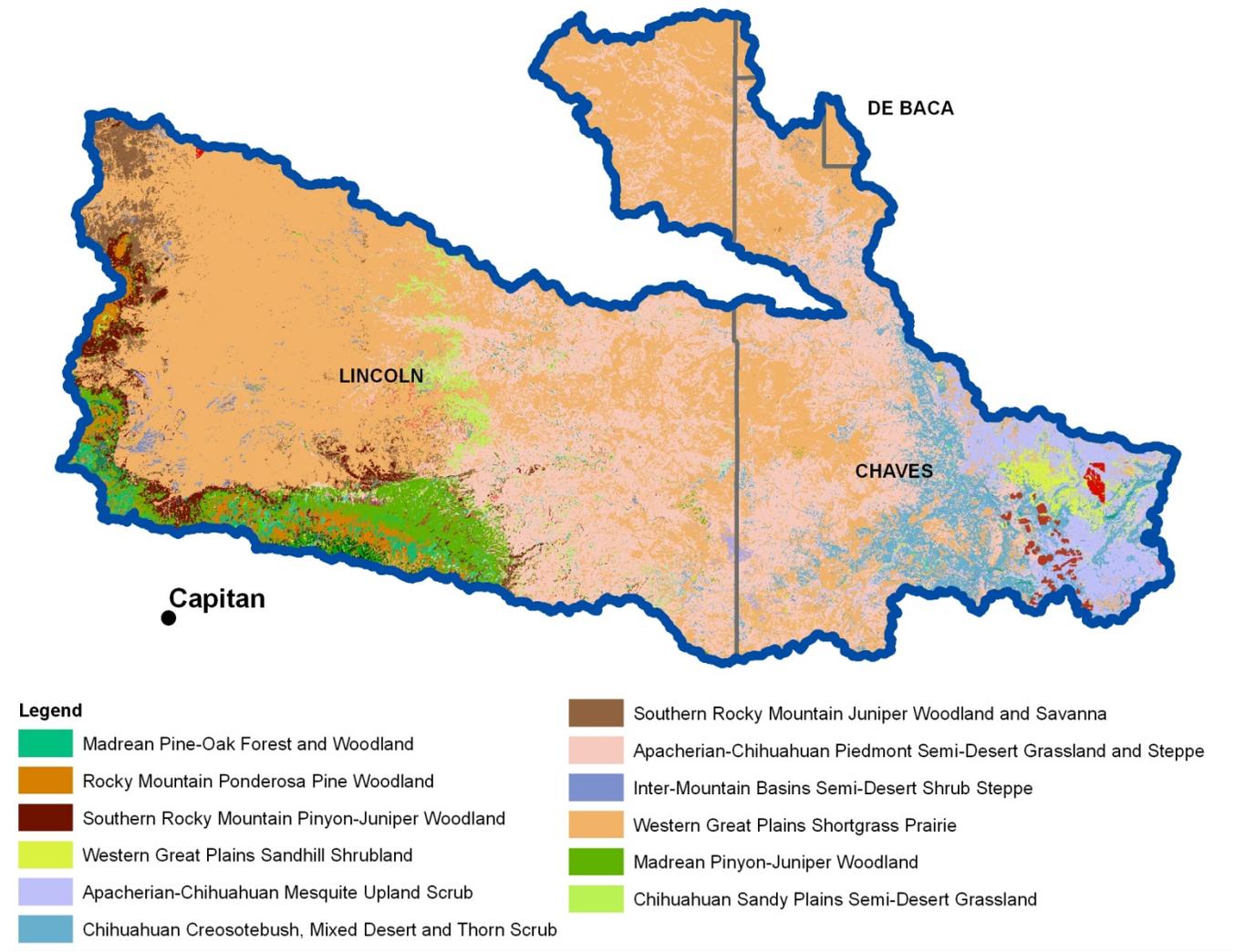
The U.S. Geological Survey (USGS) produced the National Land Cover Dataset (NLCD) as part of a cooperative project between the USGS and the U.S. Environmental Protection Agency (USEPA). The goal of this project was to produce a consistent land cover data layer for the conterminous United States. The 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>
<b>Grasslands, Herbaceous</b>	<b>674,016</b>	<b>56%</b>
<b>Shrubland</b>	<b>423,908</b>	<b>35%</b>
<b>Evergreen Forest</b>	<b>91,377</b>	<b>8%</b>
<b>Row crops</b>	<b>4,342</b>	<b>&lt; 1%</b>
<b>Low Intensity Residential</b>	<b>2,215</b>	<b>&lt; 1%</b>
<b>Emergent Herbaceous Wetlands</b>	<b>295</b>	<b>&lt; 1%</b>
<b>Bare Rock/Sand/Clay</b>	<b>258</b>	<b>&lt; 1%</b>
<b>High Intensity Residential</b>	<b>179</b>	<b>&lt; 1%</b>
<b>Deciduous Forest</b>	<b>177</b>	<b>&lt; 1%</b>
<b>Pasture/Hay</b>	<b>172</b>	<b>&lt; 1%</b>

Table 3. Extent of NLCD classes in the Arroyo del Macho watershed.



**Land Use / Land Cover**



**Figure 7. Subset of the SWREGAP over the Arroyo del Macho Watershed. The 12 dominant ecosystems are displayed in the legend.**

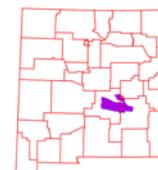


## Land Use / Land Cover

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.

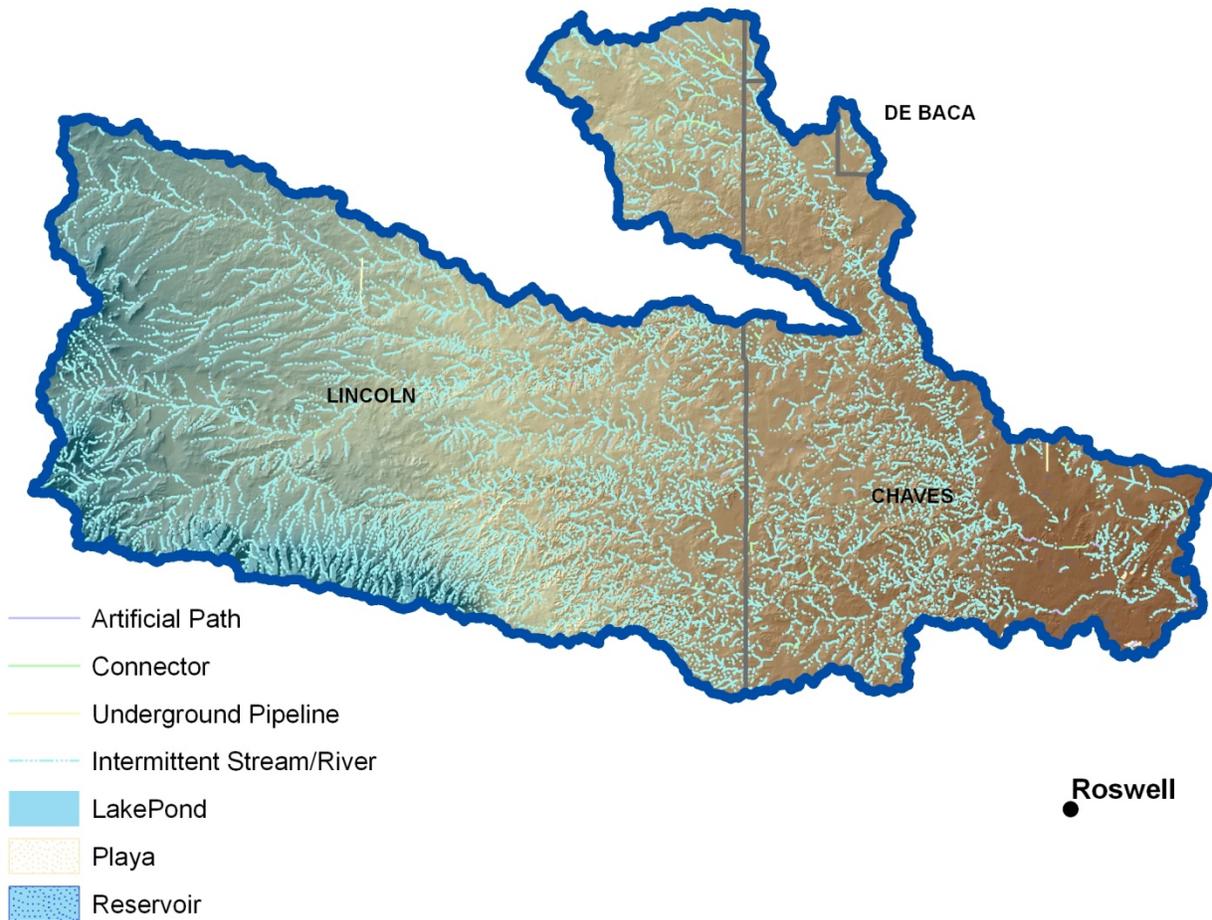
<u>Ecosystem</u>	<u>Acres</u>	<u>% of Watershed</u>
Western Great Plains Shortgrass Prairie	563,941	47
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	332,474	28
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	59,711	5
Apacherian-Chihuahuan Mesquite Upland Scrub	55,198	5
Madrean Pinyon-Juniper Woodland	35,616	3
Southern Rocky Mountain Juniper Woodland and Savanna	28,082	2
Rocky Mountain Ponderosa Pine Woodland	21,928	2
Southern Rocky Mountain Pinyon-Juniper Woodland	20,766	2
Chihuahuan Sandy Plains Semi-Desert Grassland	10,716	1
Western Great Plains Sandhill Shrubland	9,137	1
Inter-Mountain Basins Semi-Desert Shrub Steppe	8,852	1
Madrean Pine-Oak Forest and Woodland	7,366	1

**Table 4. SW Region Gap analysis ecosystem acreages.**



**Hydrology** 5,6, 7, 8

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 3,360 miles (5,407 km) of water courses in the Arroyo del Macho 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 del Macho.**



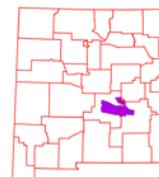
<b>Water Course Type</b>	<b>Miles</b>
Artificial path	29
Connector	27
Canal / Ditch	5
Intermittent Stream / River	3,294
Underground Pipeline	5
Sum ( $\Sigma$ )	3,360

**Table 5. NHD Water Course Type and Extents**

There are no water gauging stations or dams in the watershed.

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 del Macho watershed as part of the Rio Grande River Basin.

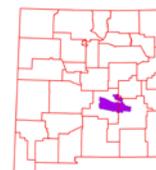
The Arroyo del Macho watershed has no lakes designated as impaired, and no reaches listed as 303 (d) Impaired Surface Waters.



## Hydrology - Declared Groundwater Basins

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 Arroyo del Macho watershed is within one Underground Water Basins: the Roswell Artesian.

<b>Groundwater Basin</b>	<b>Acres in Basin</b>	<b>Watershed Acres</b>	<b>% of Declared Basin</b>
Roswell Artesian	6,920,505	1,196,967	17



## Threatened and Endangered Species <sup>9</sup>

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 del Macho 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>
<a href="#"><u>Pecos Pupfish</u></a>	<a href="#"><u><i>Cyprinodon pecosensis</i></u></a>	Actinopterygii	Cyprinodontidae		T
Greenthroat Darter	<a href="#"><u><i>Etheostoma lepidum</i></u></a>	Actinopterygii	Percidae		T
<a href="#"><u>Pecos Gambusia</u></a>	<a href="#"><u><i>Gambusia nobilis</i></u></a>	Actinopterygii	Poeciliidae	LE	E
<a href="#"><u>Sacramento Mountain Salamander</u></a>	<a href="#"><u><i>Aneides hardii</i></u></a>	Amphibia	Plethodontidae		T

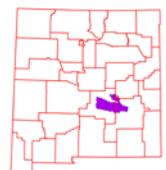
Table 6. Threatened and Endangered Plant and Animal Species.

## Invasive Species <sup>10</sup>

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 del Macho watershed, the SWEMP has identified 6 species of invasive plants (Table 8). Each of these species is defined as non-native by the USDA PLANTS database.

<u>Scientific Name</u>	<u>Common Name</u>
<b><i>Zygophyllaceae</i> (Caltrop Family)</b>	<b>African Rue</b>
<b><i>Scrophylariaceae</i> (Figwort Family)</b>	<b>Dalmatian Toadflax</b>
<b><i>Brassicaceae</i> (Mustard Family)</b>	<b>Hoary Cress (Whitetop)</b>
<b><i>Asteraceae</i> (Sunflower Family)</b>	<b>Musk Thistle</b>
<b><i>Asteraceae</i> (Sunflower Family)</b>	<b>Russian Knapweed</b>

Table 6. Invasive Species Recognized by the SWEMP.



**Common Resource Areas** <sup>11</sup>

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.

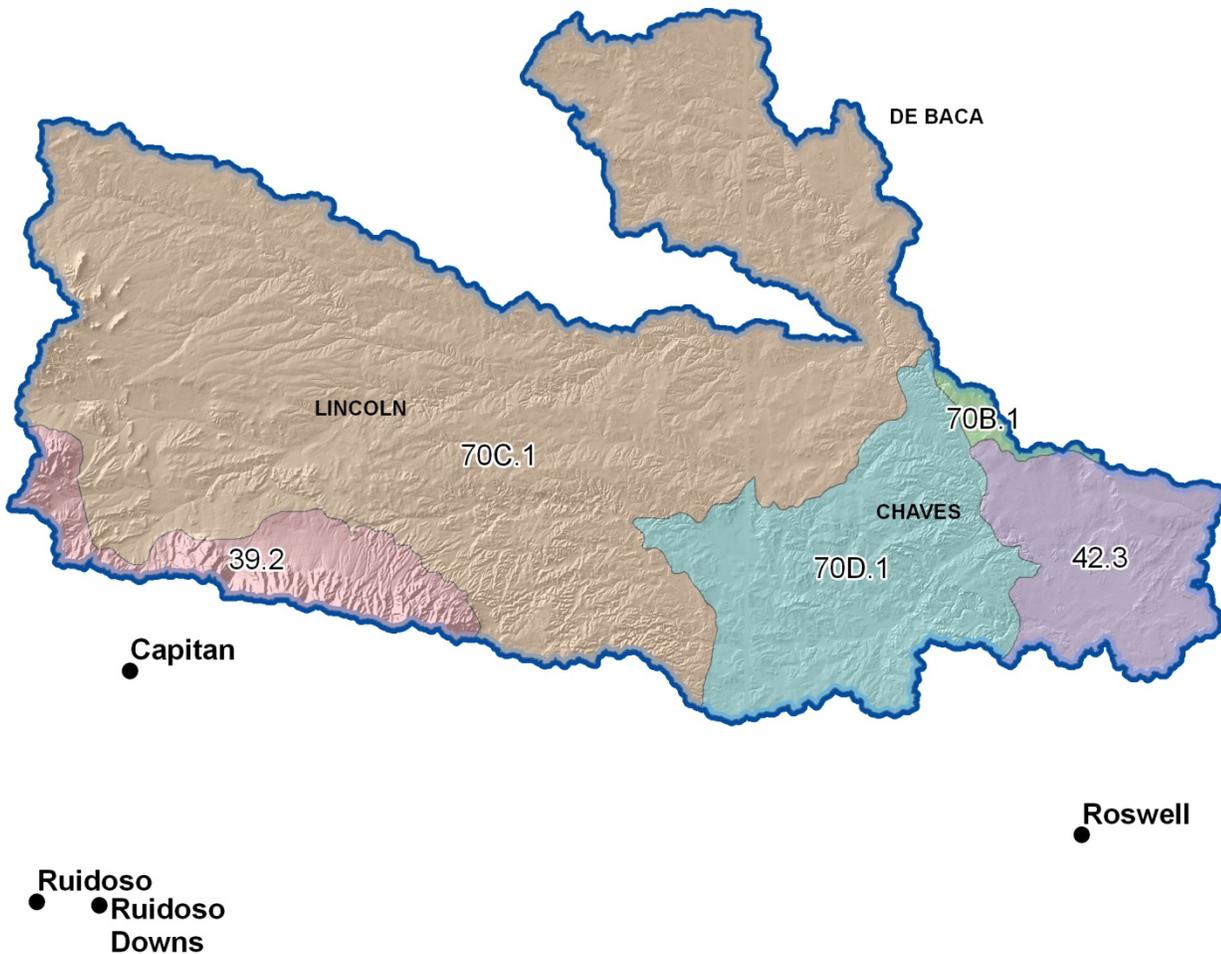
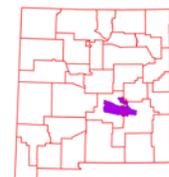


Figure 9. Common Resource Areas of the Arroyo del Macho Watershed



### 39.2– Central New Mexico Mountains

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 12000 feet. Precipitation ranges 17 to 25 inches per year. The soil temperature regime ranges from mesic to frigid. Vegetation includes corkbark, Douglas and white fir, Englemann spruce, pinyon and southwestern white pine, and aspen. Grasslands include tufted hairgrass, sedges, and Arizona and Thurber fescue.

### 42.3– Chihuahuan Desert Grassland

This unit occurs within the Basin and Range Physiographic Province and is characterized by valley plains and alluvial fans broken by the Pecos River. Drainage divides are low and inconspicuous forming one great plain. Elevations range from 2800 to 5000 feet. Precipitation ranges from 8 to 13 inches per year. The soil temperature regime is thermic. The soil moisture regime is aridic. Vegetation includes tobosa, alkali sacaton, black grama, burrograss, creosote bush, tarbush, soaptree yucca, catclaw, fourwing saltbush, winterfat, mesquite and desert willow.

### 70B.1 - Central Pecos Valleys and Plains

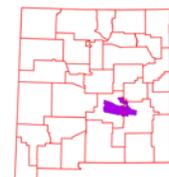
This unit is characterized by broad, rolling piedmonts, plains, and tablelands broken by drainageways and tributaries of the Pecos River. Native vegetation is mid- to short-grass prairie species in the lowlands, with pinyon and juniper in the higher elevations and on steeper north-facing slopes. Current land use is predominantly livestock grazing. The soils formed in material weathered from sedimentary rocks of Cretaceous age.

### 70C.1 - Central New Mexico Highlands

Tablelands and mesas separated by broad plains and small terraces characterize this area. Elevation is 5,000 to 7,200 feet and precipitation is 12 to 17 inches. The soil moisture regime is aridic to ustic and the soil temperature regime is mesic. Pinyon-juniper savannah and pinyon juniper woodlands at higher elevations, and broad mid- to short-grass prairies and basins at lower elevations dominate the area. Current land use is livestock grazing. The soils formed in Quaternary alluvium, eolian sands, and sedimentary rocks of Permian age. (Old CP-3)

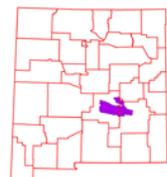
### 70D.1 - Southern New Mexico Foothills

This unit is characterized by nearly level to steep limestone hills with steep, narrow drainageways. Elevation ranges from 4,000 to 7,000 feet and average annual precipitation is 13 to 18 inches. Native vegetation is sparse and consists of pinyon, juniper, algerita, agave, yucca and cacti. Grasses include blue and black grama, little bluestem, and muhly species. Shrubs include catclaw, ocotillo, sotol and fourwing saltbush. Much of the area is federally owned. Federal and private lands are used for grazing, wildlife habitat, and military training.



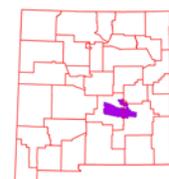
## Conservation <sup>12</sup>

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.



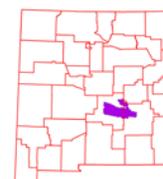
Conservation Practice	2007		2008		2009		2010		2011		TOTAL	
	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres	#	Acres
Brush Management	2	299	18	2007	13	754	31	3898	3	146	67	7104
Conservation Crop Rotation			1	89	1	192			2	274	4	555
Enhancement – Grazing Mgmt							1	13592			1	13592
Enhancement – Habitat Mgmt							1	13592			1	13592
Forest Stand Improvement							2	57	3	54	5	111
Integrated Pest Management			1	89	1	192			2	274	4	555
Irrigation System, Sprinkler			1	89	1	192	1	57	2	274	5	612
Irrigation Water Mgmt			1	89	1	192			2	274	4	555
Monitor key grazing areas to improve grazing management									1	2180	1	2180
Nutrient Management			1	89	1	192			2	274	4	555
Patch-burning to enhance wildlife habitat									1	60	1	60
Prescribed Burning					2	680					2	680
Prescribed Grazing	38	60687	71	88183	7	71853	51	151144	45	51581	212	423448
Residue Management			1	89	1	192			2	274	4	555
Rotation of supplement and feeding areas									1	2180	1	2180
Upland Wildlife Habitat Management	38	60687	71	88183	8	72642	51	151144	45	51581	213	424237
<b>SUM (Σ)</b>	<b>78</b>	<b>121673</b>	<b>166</b>	<b>178907</b>	<b>36</b>	<b>147081</b>	<b>138</b>	<b>333484</b>	<b>111</b>	<b>109426</b>	<b>529</b>	<b>890571</b>

Table 7. 5 year Trends in Applied Conservation Practices. Reported in Acres.



Conservation Practice	2007		2008		2009		2010		2011		TOTAL	
	#	Feet	#	Feet	#	Feet	#	Feet	#	Feet	#	Feet
Dam							18				18	
Fence			4	36003			6	45456			10	81459
Irrigation Pipeline									1	1176	1	1176
Irrigation Water Conveyance, Pipeline, High-Pressure, Underground, Plastic							1	5000	1	630	2	5630
Irrigation Water Conveyance, Pipeline, Low-Pressure, Underground, Plastic			1	4782	1	3000					2	7782
Pipeline	6	64565	14	125046	1	3	6	18827			27	208441
Pond									2		2	
Pumping Plant	1		3		5		2				11	
Recycle 100% of farm lubricants									1		1	
Retrofit watering facility for wildlife escape									1		1	
Structure for Water Control			1				1		2		4	
Water Well			2		6		1				9	
Watering Facility	12		78		5		8				103	
<b>SUM (Σ)</b>	19	64565	103	165831	18	3003	43	69283	8	1806	191	304488

Table 8. 5 Year Trends in Location Specific Applied Conservation Practices. Reported in Feet if Linear (i.e. Fence)



## Soil Resource Inventory <sup>13</sup>

The Arroyo del Macho 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.

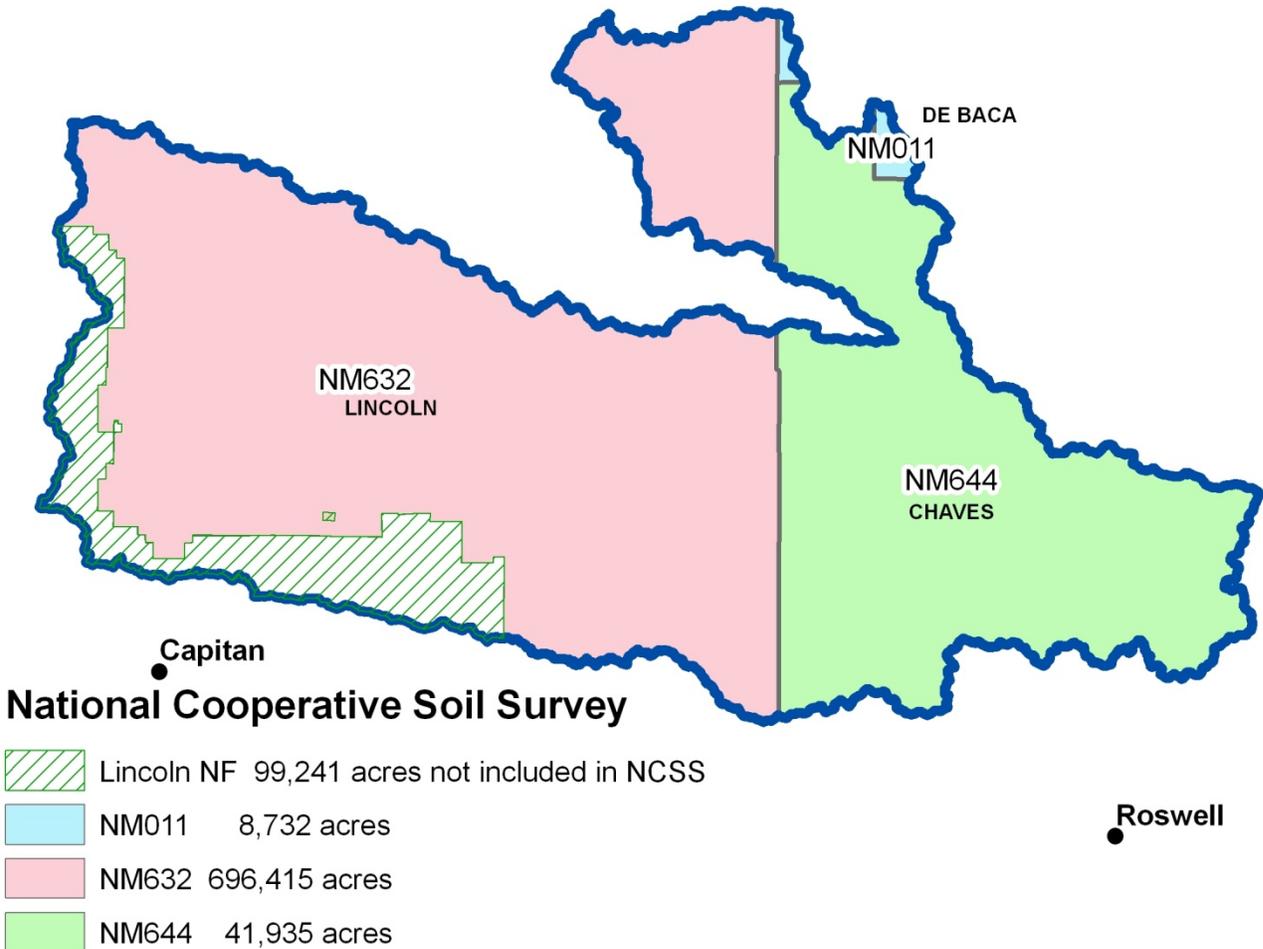
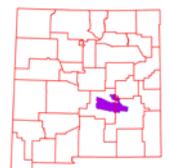


Figure 10. National Cooperative Soil Survey of Arroyo del Macho

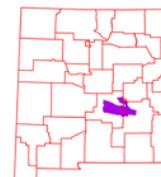


## Soil Resource Inventory

In order to evaluate the susceptibility of erosion within the Arroyo del Macho 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>
<b>Saturated Hydraulic Conductivity</b>		
µm / 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
<b>Slope %</b>		
0 - 5		0
6 - 10		1
11 - 15		2
16 - 25		3
> 25		4
<b>Soil Loss Tolerance</b>		
5	High Tolerance For loss	0
4	↓	1
3	↓	2
2	↓	3
1	Low Tolerance For Loss	4
<b>Wind Erodibility Group</b>		
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 9. 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.

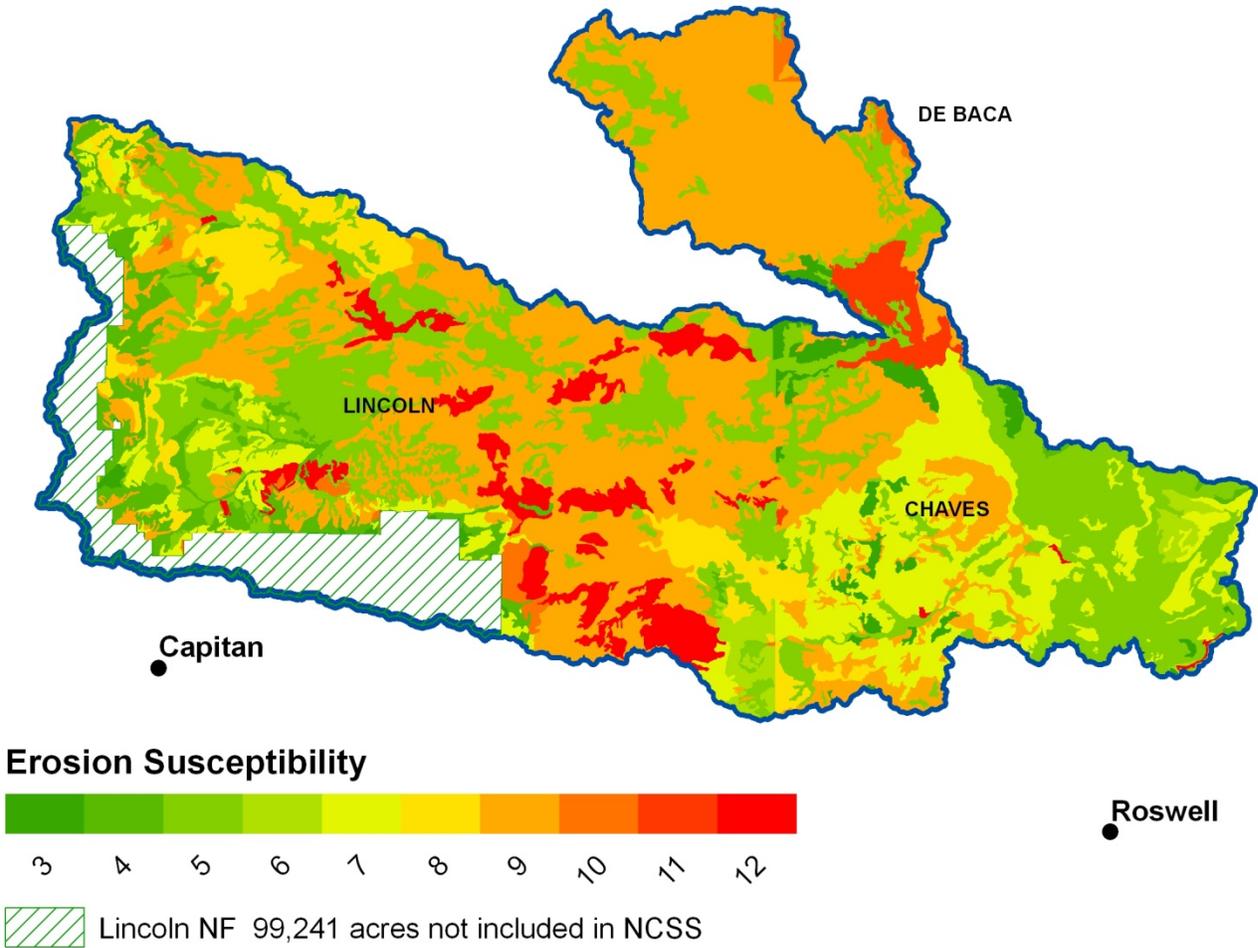
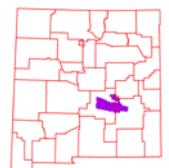


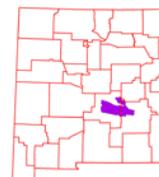
Figure 11. Erosion Potential of the Arroyo del Macho Watershed



## **Soil Resource Inventory**

<b>Rank</b>	<b>Acres</b>
3	22,742
4	48,085
5	299,336
6	14,991
7	141,123
8	60,107
9	424,322
10	11,249
11	18,837
12	57,207
<b>Sum( <math>\Sigma</math> )</b>	<b>1,097,999</b>

**Table 10. Soil Erosion Potential Model Results. A greater rank indicates greater potential for erosion.**



**Socioeconomic Data** <sup>14</sup>

COUNTY	Total population: Total	Total population: Urban	Total population: Rural	Total Pop.: Rural Farm	Total Pop.: Rural Nonfarm	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 (estimate)
Chavez	65,645	47,158	14,224	1,044	13,180	34,139	46,518	1,323	814	414	52	14,399	2,125	\$34,325
De Baca	2,022	0	2,240	306	1,934	779	1,766	3	13	1	0	160	79	NA
Lincoln	20,497	9,251	10,160	309	9,851	6,110	17,439	96	489	75	10	1,880	508	NA

**Table 11. Socioeconomic Data of the Counties in the Watershed (2010) except for green cells, not available yet from 2010 census so are 2000.**



## References

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9. New Mexico Natural Heritage Program - <http://nhnm.unm.edu/>
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14. United States Census Bureau - <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>

