WETLANDS ACTION PLAN
FOR PLAYA LAKES
CURRY COUNTY, NEW MEXICO

photo by Tish McDaniel

Prepared by Robert Martin
The Nature Conservancy

New Mexico Environment Department
Surface Water Quality Bureau

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Credits

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For more information, please contact:

Robert Martin
The Nature Conservancy
3250 La Paz Lane
Santa Fe, New Mexico 87507
Telephone: 505-474-6689
E-mail: Robert_martin@tnc.org

Shelly Barnes
Surface Water Quality Bureau
New Mexico Environment Department
PO Box 5469
Santa Fe, New Mexico 87502
Telephone: 505-827-2827
E-mail: michelle.barnes@state.nm.us

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EXECUTIVE SUMMARY

The playa wetlands in the Southern High Plains region of New Mexico are the principal source of surface water in the area, important recharge zones for the freshwater Ogallala aquifer below, and integral for many animal species. Playas are important resting, feeding and nesting habitat for migratory birds along the Central Flyway as well as resident birds. They provide habitat, forage and cover for terrestrial vertebrates and invertebrates adapted to its seasonal and variable wetland conditions.

Playa lakes are included in the definition of Waters of the State. The interests of the state are critically linked both economically, ecologically and culturally to good water quality in all of the state's waters including isolated playa lakes. Non-perennial waters make up over 80% of the state's waters, and are expressly protected by the State's water quality standards. Currently, the SWQB Wetlands Program is developing methods to target vulnerable isolated wetlands such as playas, for restoration and protection.

Unlike other areas of the Southern High Plains, many playa landowners in Curry County cannot take advantage of the Conservation Reserve Program through the NRCS because the county is already capped. The area is under threat of development for industrial uses (such as dairies) and many farmers and ranchers are feeling pressure to sell their land. Without additional economic and incentive programs to help landowners protect and restore playas, landowners have few options for financial support in hard times (such as New Mexico's continuing drought). This plan provides a synopsis of potential support systems and programs to help landowners sustainably use playa resources and at the same time protect their natural functions and ecological integrity.

Playas in Curry County are imperiled from nutrient loadings, excessive stormwater runoff in urban areas, sedimentation from cultivation and overgrazing, invasive species and noxious weeds, hydrologic alteration and various contaminants that filter into the Ogallala Aquifer below. Other significant threats to playas are poorly placed and planned roads. Rural and urban playas face different threats and impairments. Road placement and design, and stormwater planning and management are identified as areas for improvement that will provide significant benefits to restoring playas and protecting them from further degradation.

Integral to the goal of restoration and protection of these vulnerable wetlands is engaging community members, schools and other stakeholders regarding the importance of these wetlands. The Nature Conservancy (TNC), NRCS and the Prairie Partnership have been preparing stakeholders through education and communication efforts about this project and other options for preserving playas. The Ogallala Commons has been teaching our future farmers, school children and their teachers and parents about the significance of playas. This Wetlands Action Plan (WAP) provides guidance to maintaining the momentum that has developed in the area.

Because of surrounding land use and human activities, active playa management is essential for maintaining and improving natural playa functions, critical wetland habitat, and recharge to the Ogallala aquifer. Best Management Practices (BMPs) should include managed grazing, planting and protection of buffers, remediating pits and hydromodifications, restoring and maintaining natural runoff to the playa, removing exotic/invasive plants and promoting naturally occurring

playa plant communities, promoting restorative farming practices, and promoting urban planning that also sustains playa resources. In addition, most impacts cross landowner property boundaries. So to fix an impairment on one property may not fix the problem at its source. Incentives should be developed by NRCS and other agencies and funding entities to entice landowners, counties, conservationists, and others to be required to work together in order to be eligible for restoration programs and funding. Improved management will create habitat, food and cover for dabbling ducks, migrant shorebirds and water-dependent land birds. The protection and restoration of playas will result in sustaining populations of many wildlife species and natural playa plant communities.

INTRODUCTION

Playas are a wetland type found across the shortgrass prairie region of Colorado, Nebraska, Kansas, Oklahoma, Texas and New Mexico (Figure 1). Playas are defined as, "shallow depressional recharge wetlands similar to prairie potholes, characterized by annual or multiyear cycles of drydown and filling" (Smith 2003). According to most estimates, there are between 25,000 and 40,000 playas scattered across the Southern Great Plains (Smith 2003). The greatest density of playas is found in the short grass prairies of the Llano Estacado, a portion of which exists in Eastern New Mexico. The U.S. Fish and Wildlife Service (USFWS) included 506 playas in its National Wetlands Inventory (NWI) for Curry County, New Mexico (Dick and McHale 2007). The average size of these wetlands in Curry County is approximately 16.7 acres (Guthery et al. 1981).

Playa lakes serve multiple functions on the Llano Estacado. Playas store water in an area otherwise devoid of surface water. Because of the lack of surface water, the Llano Estacado is completely dependent on groundwater supplies from the vast Ogallala Aquifer. Water from the Ogallala Aquifer supports agricultural, domestic, municipal, livestock, commercial and industrial water needs. Most of the water used in the Southern High Plains, nearly 95 percent, is used for irrigation (HPWD 2013). Since the development of irrigation, withdrawals have greatly exceeded recharge of the Ogallala, causing large water-level declines (McGuire and Fischer, 1999).

Playas are the chief source of recharge for the Ogallala Aquifer (Grudak and Roe, 2009). Playas are the natural flood control system in the Southern High Plains. Playas act as both a source and sink for nutrients, and playas trap sediment and pollution and can effectively reduce flow velocity. However, chronic and heavy sediment loads can alter the ecological functions of playas and their floral and faunal communities (Smith 2003).

Playas in the Southern High Plains provide habitat to more than 250 species of birds. Playas are the most important regional wetland habitat for wildlife of the Southern High Plains, supporting millions of ducks, shorebirds and other migratory and resident birds (Smith 2003). Curry County is part of Bird Conservation Area 18. Many wildlife species are indelibly tied to playas (Bolen et al. 1979). Playas provide habitat to several threatened and endangered species, and species of concern in New Mexico. Playa lakes in New Mexico and Texas provide winter habitat for sandhill cranes. Whooping cranes, prairie falcons, least terns, brown pelicans, and lesser prairie-chickens all utilize playas as part of their habitat. Playas provide a vital role in the survival of ducks and geese of the central flyway (Steiert 1995).

Playas support a diverse biotic community in the Southern High Plains and provide the primary breeding habitat for 13 species of amphibians (Haukos and Smith 1994; Smith 2003). Amphibians are common on the arid shortgrass prairie, but because of the absence of permanent surface water sources they are completely dependent on ephemeral surface water from large rainfall events. New Mexico spadefoots, plains spadefoots, tiger salamanders, Great Plains toads, green toads, and narrowmouth toads all rely on playas for reproduction. Amphibians are often the most abundant vertebrates in many ecosystems (Blaustein and Wake 1995) and their presence is critical to the functioning of the community.

Playa Lakes exist within their own individual watersheds with the playa situated in the lowest point. Because of their distinct setting, playa protection, restoration and management must consider the affects of land use and management practices within the entire playa watershed. Playa lakes with cropland watersheds have been found to have considerably more sedimentation then those with native grassland watersheds (Smith, 2003).

In 2001, the US Supreme Court in the case, *Solid Waste Agency of Northern Cook County v. U.S. Anny Corps of Engineers*, ruled that non-navigable, isolated waters of the United States are not covered under section 404 of the Clean Water Act. This decision has resulted in uncertainty regarding the protection of playas and other isolated wetlands.

In 2005, the New Mexico Water Quality Control Commission (WQCC) adopted the NMED's proposed amendment to the standard definition of surface water of the State to include wetlands. In an appeal in May 2007, the New Mexico Court of Appeals upheld the decision of the WQCC. This allows the NMED to regulate and protect isolated waters such as playa lakes as Waters of the State. The NMED is working to protect wetlands and plans to develop water quality standards specific to wetlands including playas.

Playa restoration projects in Curry County have the potential to build diverse partnerships that are committed to the goal of restoring and protecting playas. Playas are vital to communities, ranchers, farmers and an array of wildlife. Playas are also critical to the recharge of the Ogallala Aquifer, the region's only water source. The protection of these wetlands is therefore of the utmost importance.

Figure 1. The Southern High Plains and Llano Estacado

GEOGRAPHICAL LOCATION

The High Plains occupy the higher elevation parts of the much larger Great Plains, which is bordered by the Rocky Mountains on the west and the Central Lowlands on the east. This area is a remnant of a vast plain formed by alluvial sediments deposited by streams flowing eastward from the Rocky Mountains. The High Plains is characterized by gently sloping, smooth plains with a dry, temperate climate (Dennehy 2000).

The Llano Estacado, or Staked Plains, is the area of the Southern High Plains that spans the Texas-New Mexico border, bounded on the north by the Canadian River in the Panhandle of Texas, on the east and south by the Caprock Escarpment, and on the west by the Pecos River Valley in New Mexico. The Llano Estacado is characterized by a gradual westward rise in elevation from about 2000 feet to about 4200 feet. The Llano Estacado includes all or part of 33 counties in Texas and 4 counties in New Mexico; Quay, Lea, Roosevelt and Curry (Johnson 1931).

Curry County is located in central eastern New Mexico on the border with Texas and has an area of 1,405 square miles. Curry County includes the towns of Clovis, Texico, Melrose, Grady and

Broadview and had an estimated population of 49,649 in 2011 (U. S. Census Bureau 2012). Nearly all the water in the county is supplied by the Ogallala aquifer.

SOILS

Th**e** dominant soils of the Staked Plains are sandy loams and clay loams that are reddish-brown in color. The clay soils are fine-textured and high in organic material and the sandy soils are course and low in organic matter. These soils are highly susceptible to wind erosion when the native vegetation is removed, especially the sandier soils in the southern and western margins of the South Plains (Tharp 1952).

Playa basins are lined with a layer of hydric clay soil. The soil layer in playa basins is usually classified as Randall Clay, but is often classified as other clay types. The hydric clay layer is prone to sedimentation from poor management of the upland which results in reduced hydrologic function (PLJV 2013).

CLIMATE

The climate of the Llano Estacado is characterized by low rainfall, a high percentage of sunny days, a relatively long growing season, and high winds. Annual rainfall averages range from about 22 inches along the eastern edge of the Caprock to about 14 inches annually along the eastern edge of the Pecos Valley at the western boundary. Rainfall amounts typically are greatest in May and September, with very dry conditions prevailing from October through April, a critical period for enhancing the storage of soil moisture.

Temperatures are moderate, with the first killing frosts usually occurring by the first of November, and the last by mid-April. This results in an average growing season that ranges from 225 days along the eastern margin to about 185 days along the western edge. Relative humidity levels increase through the spring and peak in midsummer, with average daily pan evaporation rates ranging from 10 to 12 mm (Texas Agricultural Experiment Station 1968).

Ever-present winds are a critical part of the climate on the Llano Estacado, creating a desiccating environment for plants and increasing the potential for soil erosion. Spring is the windiest period, with calm conditions occurring only 1.8 per cent of the time from March to May, and winds blowing at 16 miles per hour or higher 45 percent of the time. In the summer, winds speeds exceed 13 mph nearly 25 percent of the time. The prevailing wind direction is primarily the southwest (Griffiths 1981).

CLOVIS, NEW MEXICO (291939)

Period of Record Monthly Climate Summary

Period of Record : 11/24/1910 to 12/31/2005

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	51.2	56.0	62.8	72.2	80.8	89.4	92.0	90.1	83.7	73.2	60.5	52.0	72.0
Average Min. Temperature (F)	23.5	26.9	32.1	41.1	50.6	59.5	63.5	62.1	55.0	43.9	32.1	25.0	42.9
Average Total Precipitation (in.)	0.45	0.43	0.68	1.04	2.03	2.60	2.62	2.98	2.13	1.74	0.61	0.59	17.92
Average Total SnowFall (in.)	2.4	2.0	1.5	0.3	0.1	0.0	0.0	0.0	0.0	0.2	1.5	3.0	11.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

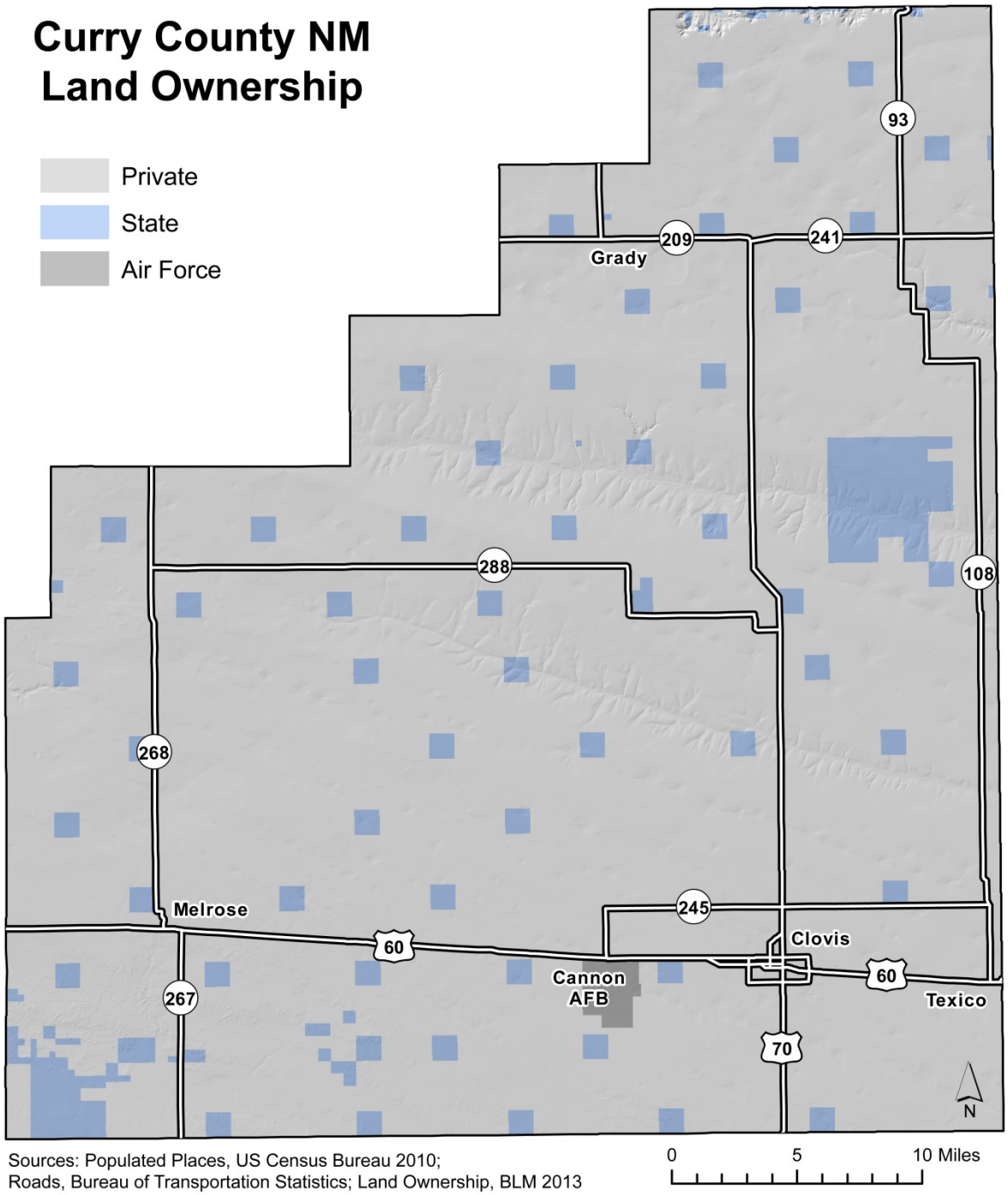
Percent of possible observations for period of record.
Max. Temp.: 96.1% Min. Temp.: 96.9% Precipitation: 98.4% Snowfall: 97.8% Snow Depth: 95.7%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

LAND USE

Curry County is a largely rural county and the economy is predominantly based on agriculture. Another large part of the economy is Cannon Air Force Base which employs approximately 5,000 military and civilian staff. The most common land use is rangeland which comprises 60% of land use. Cultivated farmland makes up 39% of the county. According to the Census of Agriculture, approximately 82% of this farmland is dryland and the remaining 18% is irrigated cropland, although the irrigated farmland acreage has been shrinking recently because of declining Ogallala Aquifer (USDA 2007). Urban development and roads make up 5% of land use. Playas, the only surface water in the county, cover approximately 1.0% of land (Guthery et al. 1981), and contain water only infrequently.

Most of the land in Curry County is privately held, making up approximately 93% of all land in the county. There is also a considerable amount of public land in the county with state lands occupying 7% of the county and federal lands making up less than 1% of the land in the county.


Curry County NM
Land Ownership
Private
State
Air Force
93
209
241
Grady
288
108
268
Melrose
245
60
Clovis
267
Cannon
AFB
60
Texico
70
N
0
5
10 Miles
Sources: Populated Places, US Census Bureau 2010;
Roads, Bureau of Transportation Statistics; Land Ownership, BLM 2013

GROUND WATER

The Ogallala Aquifer, also known as the High Plains Aquifer, is a vast underground water-bearing formation that underlies 174,000 square miles in parts of South Dakota, Wyoming, Nebraska, Kansas, Oklahoma, Colorado, Texas, and New Mexico (Dennehy 2000). The Ogallala Aquifer extends into eastern New Mexico in Quay, Curry, Roosevelt, and Lea Counties. The Ogallala provides almost all the water for domestic, municipal, agricultural, and industrial use in the region.

The Ogallala Formation is an unconfined water-bearing layer composed of poorly sorted clay, silt, sand, and gravel and is the principal geologic unit forming the aquifer, which underlies about 80 percent of the High Plains. The saturated thickness of the Ogallala Aquifer ranges from 0 to over 1,000 feet in Nebraska, with an overall average of about 200 feet. The depth to water surface ranges from 0 to 500 feet, with an average depth of about 100 feet (Dennehy 2000).

Water from the Ogallala Aquifer supports irrigation which has transformed the Llano Estacado into a major agricultural center. Approximately 95 percent of the water pumped from the aquifer is used for irrigation (HPWD 2013). With fertile soils and ideal temperatures, low annual rainfall, especially in the western portion, is the limiting factor for crop production in the region. With the additional input of irrigation, crop yields in the area are among the highest in the nation. According to data obtain from National Agricultural Statistics Service, the farmland of the Great Plains is responsible for approximately 32% of the nation's corn production, 45% of the wheat production, and 88% of the grain sorghum production (Wheeler, 2006). In addition, the region accounts for nearly 18 percent of the cattle in the United States (Dennehy 2000) and is rapidly becoming a center for swine production and the dairy industry. The aquifer system also supplies drinking water to 82 percent of the people who live within the boundaries of the High Plains region.

In Curry County and the rest of the Llano Estacado, groundwater is being pumped out of the aquifer at a much faster rate than it is being recharged. As of May 2006, the New Mexico Office of the State Engineer (OSE) reported 1,125 wells extracting 305,192 acre feet per year in Curry County. Recent studies have estimated an average recharge rate for the entire High Plains region is only 0.5 of an inch per year (HPWD 2013). Declines of a foot or more per year were recorded throughout the 1940s; and during the late 1950s at the peak of irrigation development, some monitoring wells indicated as much as five feet of decline in a single year. (HPWD 2013). Water levels have declined more than 100 feet since irrigation began in the1940's in Kansas, Oklahoma, Texas, and New Mexico (McGuire and Fischer, 1999). The saturated thickness of the Ogallala in west Texas is estimated to have declined by an average of 12% from 1990 to 2004, with several counties including Parmer County undergoing much more drastic reductions (Texas Tech University 2007). In many areas, irrigation has become impossible or cost prohibitive because of water-level declines.

Research from Gurdak and Roe (2009) indicates that playas are the primary source of recharge water for the vast Ogallala Aquifer (Figure 2). Playa basins are composed of hydric clay soils which are critical for the proper hydrologic function of playas (Smith 2003). This clay layer expands and seals when saturated and contracts when dry leaving a network of large cracks on

the playa floor. During a large rainfall event, the cracks and fissures in the clay layer provide a pathway for water to reach the aquifer. Once the soil is saturated, the water fills the playa basin. Once filled with water, playas may remain wet for several months depending on weather conditions and the geomorphology of the playa.

The quality of the water pumped from the aquifer is suitable for irrigating; but in some places, the water does not meet U.S. Environmental Protection Agency (USEPA) drinking water quality standards. For example, some constituents identified above EPA standards include sulfate, chloride, selenium, fluoride, nitrate, and total dissolved solids (HPWD). Maintaining adequate vegetative buffers around playas is critical to protecting the groundwater supply from contamination.

Playas are the chief source of natural flood control on the shortgrass prairie (Luo et al. 1997). Because of the extremely flat topography and the potential for large rainfall events, flooding can be a real threat on the Southern High Plains. Playas are often utilized as a major part of the flood control in municipal systems in towns in west Texas and eastern New Mexico.

Many landowners in the Southern High Plains are realizing the value of playas through revenues associated with hunting, wildlife viewing, and restricted use rental agreements. In fact, revenue from wildlife associated activities can exceed those derived from agriculture and grazing in the playa lakes region (Bergstrom and Stoll 1993). Today, there is extensive recognition of the ecological services provided by playas. Playas help to improve the overall health of our environment. Playas provide critical habitat for migratory waterfowl and native amphibians. Playas can effectively recharge and purify ground water, moderate floods, reduce soil erosion and contribute to the overall diversity of the Southern High Plains.

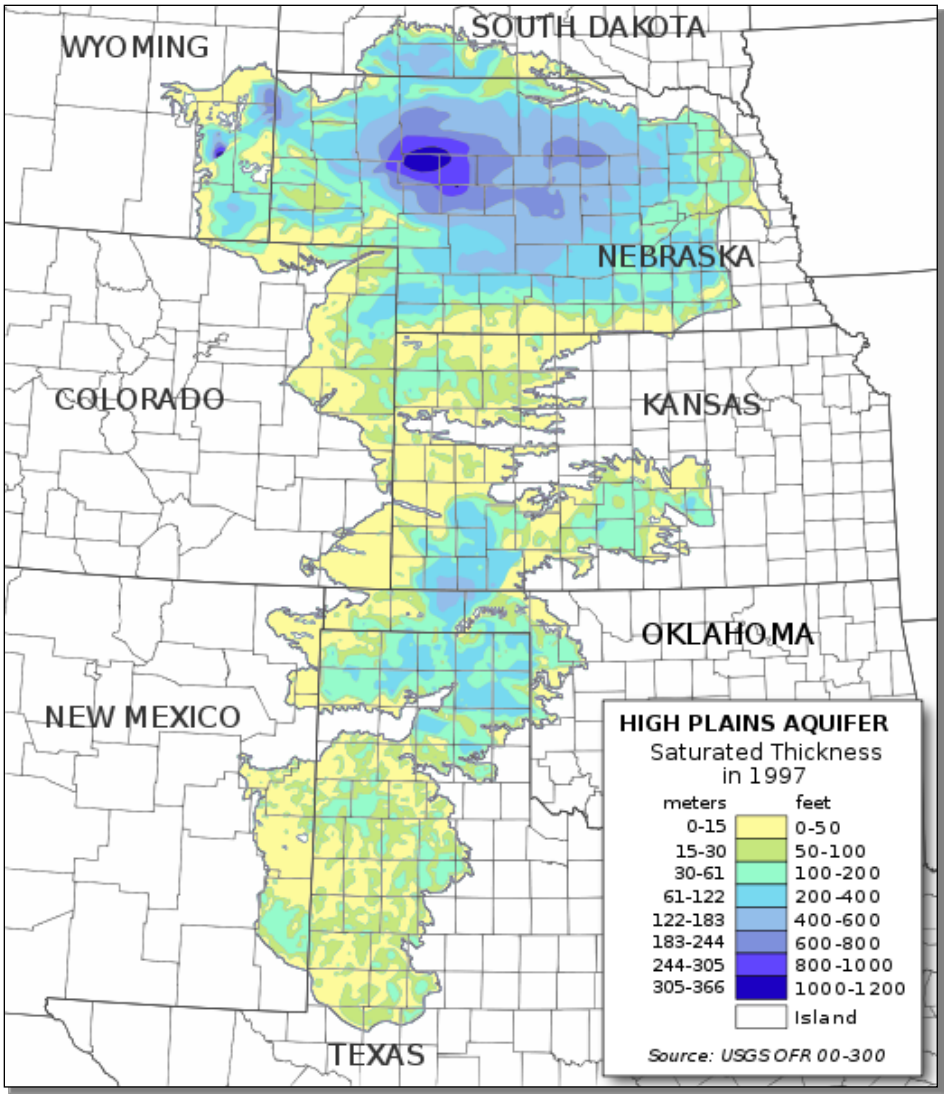


Figure 2. Ogallala Aquifer

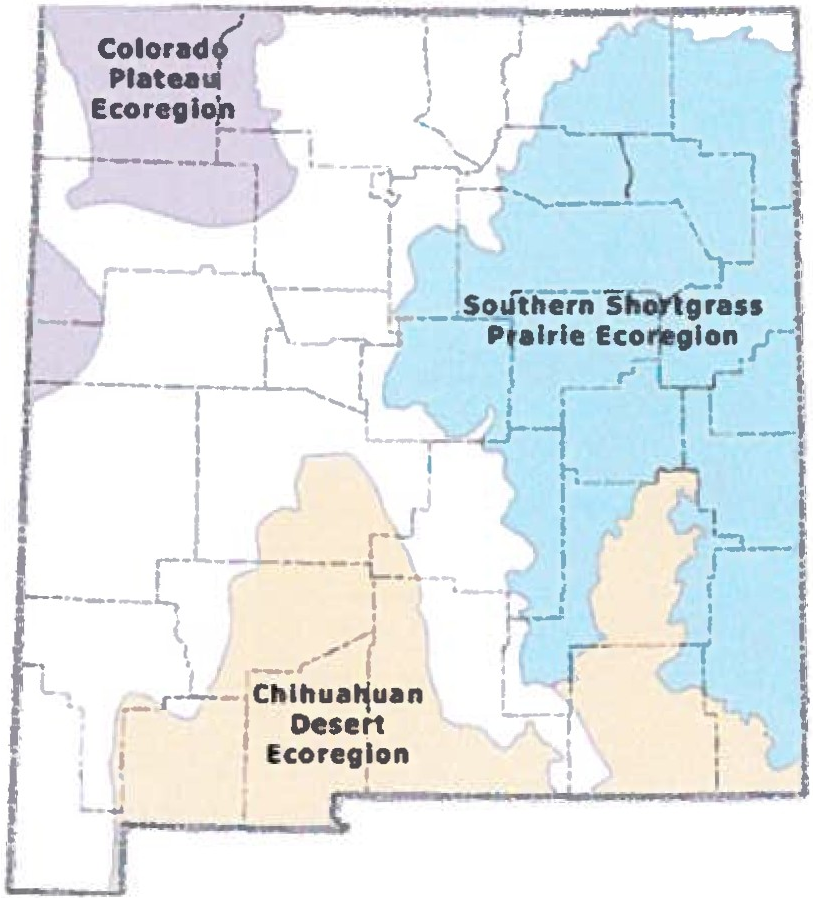


Figure 3. New Mexico Ecoregions

FORMATION OF PLAYAS

Although there is currently no universally accepted explanation for the origin and development of playas, several hypotheses have been proposed. Local historians have long proposed that large mammal activity may be responsible for the origin of playas, hence the common term "buffalo wallows." Small depressions on the plains would attract large numbers of bison, and the trampling effect would compact soil and leave the basin open to wind erosion. Sabin and Holiday (1995) have suggested that wind erosion is the main causative agent in the development of playas. In this model, the wet periods or animal activity would prevent the growth of native vegetation, leaving the playa basin unprotected. Wind erosion from the powerful High Plains winds would deepen the playa basin and cause deposition of lunettes on the leeward side. Anyone who has lived in the high plains realizes that wind erosion of playa basins is a rather common event. A good percentage of playas show evidence of wind erosion with the presence of lunettes (Sabin and Holliday 1995), although this evidence would seem contrary to the general circular shape of most playas.

Dissolution of carbonates may be the most widely accepted explanation for the development of playas (Osterkamp and Wood 1987). In this theory, water in the playa basin percolates through

the calcium carbonate or "caliche" layer that underlies most soils on the High Plains. The calcium carbonate reacts with the water producing carbon dioxide and carbonic acid. This reaction results in dissolution of the calcium carbonate and a gradual deepening of the playa basin. It's most likely that several of these models may explain the origin and development of playas working in concert with one another.

HISTORICAL SIGNIFICANCE

The first discoveries of human occupation of North America, from the Pleistocene times (10,000-12,000 B.P.) were in the Southern High Plains of eastern New Mexico at Folsom and Clovis (Smith 2003). In addition, the northwestern area of the Llano Estacado contains numerous Paleo-Indian artifacts and remains of prehistoric bison. A study of this period shows the vital importance of wetlands to early human occupation. These prehistoric bison populations as well as the Paleo-Indians these herds supported were completely dependent on playas and springs for their water source.

The introduction of horses to Native American societies by Spanish explorers in the 1500s brought about a cultural shift in Plains Indians. The principal population of the Llano Estacado was Apache and the economy was based on bison hunting. Bison were the primary source of food and the principal building material used to make tents. Playas were essential in the development of the economy of this society (Smith 2003).

Since Anglo-European colonization of the Great Plains in the 1800s, the western plains had a crucial value for grazing cattle. Wet playas allowed the ranchers to sustain their cattle and settle new lands. Until the use of underground water became available through the widespread use of windmills in the late 1800s, playas and springs were the only source of water for livestock (Smith 2003).

IMPORTANCE OF PLAYAS

The biological and hydrological functions of playas are very important to maintain the grassland ecosystem of the Southern High Plains. Some of these ecosystem services that playas provide are well known to residents, while other important services have just recently been uncovered.

Even though the widespread use of windmills and wells tapped into the Ogallala Aquifer has reduced reliance on playas, they are still an important source of livestock water and may be the only water available on some grazing lands. The variety and abundance of plants growing in playa basins are also important grazing forage for livestock. Because of increased forage and water availability, rangeland containing playas is often highly valued by landowners.

Playas are the natural flood control system of the High Plains. Although, the region is relatively arid, thunderstorm events are often strong and severe, with the capacity to dump large amounts of rainfall in short periods of time. Urban centers in the High Plains such as Lubbock, Amarillo, and Clovis have long recognized the economic advantage of utilizing playas as the backbone of their stormwater management systems. Without these independent

localized watersheds, flooding of crops and structures would be much harder to predict and losses would likely be much higher.

Playas attract large numbers of wildlife at certain times of the year. Pronghorn and mule deer are often attracted to dry playas because of the variety of edible plants that are uncommon on rangeland. Waterfowl are often present in large number at wet playas. Playa plants provide a critical part of the diet of migratory ducks and geese that allow them to travel the central flyway of North America. Playas provide huge biological benefits for wildlife as well as economic benefits for landowners and communities seeking to provide hunting and bird watching opportunities for wildlife enthusiasts.

The single most important value of playas to the communities of the High Plains may well be groundwater recharge. The Southern High Plains is almost completely dependent on the Ogallala Aquifer for its water needs. The decline of the aquifer and the dramatic impacts this could have on the economy is one of the greatest threats facing the region. Recent research has shown that playas are the primary source of recharge for the aquifer and are also are responsible for filtering out contaminants before they reach the aquifer. The sustenance of the Ogallala Aquifer and therefore the future of the Southern High Plains region depends on the long-term hydrologic functionality of the playa ecosystem.

WILDLIFE HABITAT

The biodiversity of animals and plants in Curry County playas is rich and plentiful. Playas provide habitat for many species of unique plants including pink smartweed and curly dock. These playa plants are essential for the survival of the migrating waterfowl that travel the Central Flyway of North America. Playas are also home to many invertebrates such as fairy shrimp, tadpole shrimp, and leeches that provide a source of food for waterfowl, shorebirds, reptiles, and amphibians. The numerous amphibians provide a food source for reptiles such as checkered garter snakes and western hognose snakes and mammals such as raccoons, skunks, and badgers (Steiert 1995).

Although the high plains climate is characterized by low and inconsistent rainfall, amphibians are quite abundant. The amphibians of the Llano Estacado have adapted to the dry conditions by estivating in underground burrows except in periods of rainfall, but surface water is still needed for reproduction. Many high plains amphibians are completely dependent on playas for breeding habitat in an area otherwise devoid of surface water. Spadefoots (family Pelobatidae), true toads (family Bufonidae), and mole salamanders (family Ambystomatidae) are among the common amphibian species of the playa lake region.

New Mexico Department of Game and Fish has compiled a list of the Species of Greatest Conservation Need for the Shortgrass Prairie Ecoregion as part of the Comprehensive Wildlife Conservation Strategy for New Mexico. The following table is a combination of species that have either state or federal protection and keystone species that are vital to the function of the ecosystem (NMDGF 2006).

Table 1. Species of Greatest Conservation Need in the Southern Shortgrass Prairie Ecoregion in New Mexico

Federal Status	**State Status**
C – Candidate Species	T – Threatened Species
T – Threatened Species	E – Endangered Species
E – Endangered Species	S – Sensitive Species
SC – Species of Concern	

Common Name	**Federal Status**	**State Status**
Birds		
Bald Eagle	T	T
Golden Eagle		
Scaled Quail		
Sandhill Crane		
Mountain Plover	SC	S
Long-Billed Curlew		
Wilson's Phalarope		
Sprague's Pipit		
Baird's Sparrow	SC	T
Grasshopper Sparrow		
Ferruginous Hawk		
Lesser Prairie-Chicken	C	S
Mourning Dove		
Burrowing Owl		
Loggerhead Shrike		S
Mammals		
Least Shrew		T
Arizona Myotis Bat		S
Prairie Vole		S
Black-Tailed Prairie Dog	C	S
Swift Fox		S
Mule Deer		
Amphibians		
Western Chorus Frog		
Plains Leopard Frog		
Tiger Salamander		
Reptiles		
Ornate Box Turtle		
Collared Lizard		
Sand Dune Lizard	C	E
Milk Snake		
Western Diamondback Rattlesnake		
Desert Massasauga		

THREATS AND IMPAIRMENTS

The positive effects of playas on the ecosystem and the important role they play in the regeneration of the Ogallala Aquifer are generally poorly understood and often unappreciated. Unlike other wetland systems, there have been very few adequate regulations to protect playas. Although playa lakes are named specifically in section 404 of the Clean Water Act (1972), the SWANCC Decision of (2001) removed playas from federal jurisdiction because they are isolated wetlands. Playas currently receive no federal surface water protection or regulation. In addition, at least 90% of the playas in the Southern High Plains had already been negatively affected by anthropogenic impacts by the 1980s (Haukos and Smith 2003).

Sedimentation is one of the biggest threats to playas on the Southern High Plains (Luo et al. 1997, Smith 2003). Excessive sedimentation is almost always a result of anthropomorphic causes. Sedimentation can be caused by runoff from surrounding irrigated or dryland farm fields, excessive runoff from roadways, erosion from poorly managed grazing lands, and erosion from ditches and arroyos. Sedimentation decreases playa depth and volume and increases evaporation, damaging the role these systems play in the ecosystem by reducing water filtration and biodiversity (EPA 2006). In a properly functioning playa system, there may be small amounts of sediment deposited in the playa basin. This small sediment load can normally be maintained through removal by wind erosion from the relentless winds of the Southern High Plains on the exposed soil of the playa basin during dry periods.

Poorly sited roadways throughout the county have greatly contributed to the degradation of playas in Curry County. Roadways have generally been placed in an even grid formation throughout the county, with no consideration of playas or their watersheds. Many playas have been completely bisected by roadways, as the example image here. In other examples, roadway drainage ditches capture all water and discharge the runoff in one spot, causing erosional features in the watershed, reducing the buffering capacity of normal sheet flow, and altering the hydroperiod of the playa.

Urban Playas and common impairments.

Santa Fe Lake, pictured here, is a playa lake owned by Burlington Northern Santa Fe Railroad (BNSF) located approximately one mile south of Clovis, New Mexico. This 40 acre playa was used for wastewater discharge from the Atchison, Topeka and Santa Fe Railway (ATSF) rail yard beginning in the early 1900's when the yard was first constructed. ATSF ceased to exist when it merged with the Burlington Northern Railway to form BNSF in 1996.

In the late 1970's, the Environmental Protection Agency (EPA) conducted an environmental site investigation of the site. Preliminary reports from that investigation indicated that high concentrations of hydrocarbons, heavy metals, and cyanide were present on the site. Santa Fe Lake was consequently added to the National Priority List in 1983 and identified as a Superfund Site by the EPA as a result of these findings of contamination.

Cleanup of the site began in 1988 with the construction of a dike, moat, and beach area around the lake to prevent rainfall runoff from entering the lake. This allowed the lake water to evaporate, therefore exposing the lake basin sediments for treatment. Contaminated soil was treated by enhanced bioremediation until hydrocarbons were reduced to cleanup standards. Once treatment was completed, BNSF began the restoration process, which included planting native grasses within the lake basin and other areas disturbed through the remediation. On March 17th, 2003 the Santa Fe Lake site was removed from the National Priorities List. BNSF continues to maintain the site by routinely sampling the groundwater beneath it and ensuring that the native grasses are the primary vegetation at the site (US Army Corps of Engineers 2008).

Creating pits within playas is a common practice by producers to provide a longer lasting source of water for livestock and to provide a source of irrigation water pumped to nearby cropland. The practice of pitting was so widespread that it was often funded by the Natural Resource Conservation Service (known at that time as the Soil Conservation Service) as recently as the 1960s. The practice of "pitting" can cause changes in the native vegetation and can disturb the expansive clay layer that is critical to proper playa function. Pits also provide reproductive habitat for amphibians that require long metamorphic times and can drastically change the normal species composition of native amphibians. In the Southern High Plains, more than 70% of playas larger than 10 acres have pits (Guthery et al. 1981).

Urban playas pose a major threat of introducing contaminants into playas within urban watersheds, leading to contamination of the aquifer. Common contaminants from urban runoff include heavy metals, hydrocarbons, pesticides, fertilizers, and automotive chemicals. As urban playas rarely have adequate vegetative buffers, these contaminants are swept from the streets and concentrated in the playa. The City of Clovis has a long history of utilizing playas for stormwater storage. The following playas are currently impacted by this utilization.

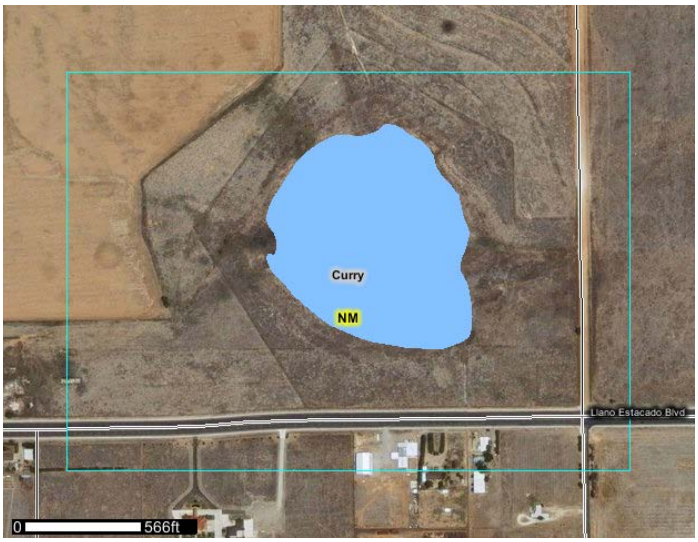
Goodwin Playa. Goodwin Playa is in the heart of Clovis, New Mexico and is owned by the city. The area of the playa is 11.5 acres and the property is also home to a prairie dog town. The city installed a walking trail system around the property in 2011. Since the addition of the trail system, the area is often used by local residents and has been the site for numerous Playa Festival field trips from Clovis elementary schools.

Goodwin Playa currently has a large pit created to increase stormwater capacity to offset increased runoff from residential development within the watershed. The pit can be clearly seen in the photo. The site is ideally suited for an outdoor classroom and wildlife viewing center, but federal funding for these projects has been withheld because of lack of assurances by the city to prohibit further clay removal from the playa.

Although, Goodwin Playa has been highly modified by excavation and increased runoff, it still retains many of the characteristics of a natural playa. Restoration needs include dirt work to address the pit, erosion control structures for arroyos, and non-native plant control. Much of this restoration could likely be funded from federal sources if the city would agree to support restoration efforts.

Sorgen Playa. Sorgen Playa is situated near the intersection of Llano Estacado and Prince on the north side of Clovis. The area of the playa is 13.9 acres. The playa receives inflow of storm water runoff from the adjacent highly-developed area including the huge Wal-Mart parking lot. The property is owned by the city of Clovis. There is a large arroyo feeding the playa on the northwest. The playa was extensively excavated to increase storage capacity,

but according to recent soil surveys, the Randall Clay layer may still be intact. Financial support from Wal-Mart for restoration projects is a real possibility, although restoration of this playa may be financially impractical.



Priebe Playa. This playa is city owned primarily for the purpose of possible future storm water protection. The frontage along Llano Estacado may be sold by the city for commercial development. Priebe playa is in very good condition for an urban playa. The area of the playa basin is 23.5 acres. There is an old barbed-wire fence running through south end of playa. The south portion of the playa buffer was retained by previous owner for commercial development. Threats include modification for development, inadequate buffer protection, contamination from urban runoff, and erosion/sedimentation from nearby roads. Priebe Playa is a good candidate for conservation and has excellent outreach and education potential.

New Pond Playa. This property is owned by city of Clovis for storm water drainage. The playa is bisected by an asphalt road. The original playa size was 12.3 acres, but the basin has been extensively modified by excavation and a large berm constructed to direct stormwater flow and to increase capacity. The original playa may be seen on left and the excavation area may be seen on right. The playa is in poor condition and not a good candidate for restoration.

Dennis Chavez Park. Dennis Chavez Park is utilized for stormwater catchment and has also been improved as a recreational park. The lake was extensively excavated in 2000 in order to increase stormwater capacity. Trees and park benches have also been added recently. The lake contains fish and aquatic turtles, although the history of the stocking is unknown. There was a fish kill event around 2010, and low oxygen levels due to eutrophication are a likely cause. Recreational fishing is not allowed at the park.

Water is diverted directly from city streets through concrete channels that can be seen in the image. Contamination from urban pollutants and eutrophication from excess nutrients are problems at the lake. Dennis Chavez Park would be an excellent site for the addition of vegetative buffers or constructed wetlands to increase water quality and decrease the likelihood of groundwater contamination.

Ingram Lake. Ingram Lake is owned by the city and serves as stormwater retention for the city. Ingram Lake is located in southeast Clovis and is adjacent to the city landfill. The playa commonly retains water because of the excess water diverted from Clovis. In 2012, however, after an extended drought, the playa dried up exposing many catfish and carp. The playa provides habitat to numerous waterfowl and shorebirds. In the past, Ingram Lake received effluent from the city wastewater plant. Because of its past and present uses, testing would be necessary to determine if Ingram Lake contains significant levels of contaminants. Ingram Lake would be an excellent site for the constructed wetlands and/or vegetated buffers.

Because of the additional nutrients from stormwater runoff, urban playas often suffer from the problem of eutrophication. Eutrophication is the process by which excess nutrients, especially nitrogen and phosphorous, cause a rapid increase in the algae population, known as an algal bloom. The photosynthesis of the algae results in dissolved oxygen levels that fluctuate widely from daytime highs to nighttime low. In urban playas used for recreational fishing, such as Greene Acres Lake in Clovis, the nightly drop in dissolved oxygen levels can sometimes cause massive fish deaths.

Greene Acres Lake. Greene Acres Lake is situated in the downtown Clovis and is a popular recreational destination for fishing, picnics, and is even the location for the city's Fourth of July celebration. The lake is encircle by an improved walking trail and also contains improved park benches and tennis courts.

Greene Acres Lake is still relatively shallow and retains some characteristics of a playa. Several excavation projects were attempted in the past, but the excavation does not appear to be extensive. Large rain events in the past sometimes resulted in flooding to adjacent streets and significant damage to homes and businesses. The lake is stocked with fish and is highly utilized by local fishermen.

The lake receives stormwater through several, unfiltered channels and erosion is evident at the channel on the northwest side of the lake. Eutrophication is a common occurrence at Greene Acres and the impact of urban pollutants to the fishery and the local residents consuming the fish is a concern. The problems of groundwater contamination from urban pollutants, eutrophication, and impacts to the fishery may however be mitigated with the use of vegetated buffers or constructed wetlands and their installation is highly recommended.

<u>Rural Playas and common impairments.</u>

Contamination from agricultural runoff is a major threat to the playa water quality and of the aquifer. Playas in farmed areas are at high risk from contamination from fertilizers, herbicides, and pesticides from surrounding fields. Cropland playas often have minimal or no vegetative buffer in place that would serve as a natural filter for many of the contaminants.

Concentrated Animal Feeding Operations (CAFOs) are commonly sited in order to use playa basins for wastewater drainage. Until 1993, there were virtually no regulations prohibiting CAFOs from discharging wastewater into playa basins. CAFOs in operation before this time are exempt from any discharge restrictions and are not subject to modern regulations requiring liners to prevent pollutants from entering groundwater and monitoring wells to check for early signs of contamination. As playas are the main source of recharge for the Ogallala Aquifer, this practice would seem to be at high risk of introducing nitrates and other contaminants into the aquifer.

State Line Playa. This playa is located on the New Mexico – Texas state line about 3 miles south of Texico, NM. Most of the playa is in Texas, although a portion lies in NM. There are two feedlots adjacent to the playa, one in NM and one in TX. The construction of feedlots near playas was a common practice historically; presumably it saved the landowners the cost of building modern lagoons to capture waste and reduce the spread of disease. Modern regulations require lining of lagoons and the installation of monitoring wells to check for groundwater contamination. Many of the concentrated animal feeding operations (CAFOs) were constructed before the implementation of modern regulations. The risk of groundwater contamination would seem to be extremely high with playas directly adjacent to CAFOs.

Harrington Playa West. The area of Harrington Playa is 20.8 acres. A large catfish /retention pond was built to catch sediment runoff from the adjacent road and cultivated field. The pond dam was blown out several years ago. There is an extremely deep arroyo (10 ft) leading to the playa across from the culverts in the road. Restoration of arroyo would likely require re-routing of storm water by the NM State Highway Department. The restoration of this playa

would likely be expensive and would require cooperation with the Highway Department as well as with the adjoining landowner. This playa is an excellent example of a playa where the impacts cannot effectively be mitigated by the landowner without the cooperation of others.

A handful of farmers and ranchers in the Southern High Plains have adopted techniques which help avoid contaminating playas with sediment and nutrients. Techniques such as planting native vegetation as buffers around playas can help to filter fertilizer, sediment, and pesticides from runoff. These buffer zones also provide habitat, forage, and nesting locations to a myriad of bird species.

Poorly managed livestock grazing can be a serious problem for playas. Overgrazing by domestic livestock is one of the main contributing factors to the loss of native grasses in the Great Plains. Uncontrolled grazing activities have destroyed playas and extinguished native woody plants (Smith 2003). Fencing playas, crop rotation, and grazing management, can improve the quality of playas and help to maintain these diverse ecosystems.

This playa displays a number of common impairments to rural playas including: a ditch entering the playa (in the foreground) carrying road runoff; a central pit and associated mound of side cast material altering the playa hydrology, subjecting the perimeter of the playa to premature and prolonged periods of drying; along the far side, the playa watershed is cultivated with no buffer between the field and playa to prevent sediment and nutrient-contaminated runoff entering the playa.

The attitudes people have toward wetlands have shifted enormously over time. Historically, wetlands were regarded as nuisances, vectors for disease and havens for dangerous predators. The 1849 Swamp Lands Act was the zenith of this attitude, promoting the "reclamation" of wetlands via their conversion to agricultural lands, through draining, diking and filling (Leschine et al. 1997). Although nearly 22,000 playas exist in the SHP, their ecological composition and function as wetland ecosystems have until recently been overlooked and are still mis-understood.

CURRENT REGULATIONS FOR PROTECTION

Until 2001, playa lakes were considered jurisdictional Waters of the U.S. under the Clean Water Act. In 2001, the U.S. Supreme Court in the case, Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers ruled that non-navigable, isolated waters of the United States are not covered under section 404 of the Clean Water Act. This decision has resulted in uncertainty regarding the protection of playas and other isolated wetlands.

In 2005, the New Mexico Water Quality Control Commission (WQCC) adopted the NMED's proposed amendment to the standard definition of Surface Waters of the State to recognize that the state has plenary power within its borders and is not constrained by interstate commerce considerations. This ensured that isolated waters such as playas were still under the jurisdiction of the State. In an appeal in May 2007, the New Mexico Court of Appeals upheld the decision of the WQCC. This allows the NMED to continue to regulate and protect isolated waters such as playa lakes as Waters of the State.

Currently, the water quality standards applicable to playas are regulated in the New Mexico Administrative Code (NMAC) Title 20, Chapter 6, and Part 4 "Water Quality Standards for Interstate and Intrastate Surface Waters". According to the standards for Ephemeral Waters, including playas, the Designated Uses of these water bodies are livestock watering, wildlife habitat, limited aquatic life, and secondary contact (NMAC 20.6.4.97). The criteria applicable to establish these Designated Uses are established in NMAC 20.6.4.900 F, G, H and J. These criteria do not establish limits for playa-specific pollutants which have been the cause of the degradation of some playas and the death of hundreds of birds. Specific criteria for playa lakes are needed to avoid pollution and guarantee the beneficial functions of playas. The NMED is working to protect and restore these vulnerable isolated wetlands and plans to develop water quality standards specific to wetland types including playas.

Playas are also included in indirect regulations by the Oil and Gas Conservation District (OCD) and NMED under NMAC Title 19, Chapter 15. Contamination from Oil and Gas activities is to be avoided in playa lakes and is regulated through the following:

- No pit shall be located within 200 feet of any lakebed, sinkhole or playa lake (measured from the ordinary high-water mark (NMAC 19.15.17.10);
- No surface waste management facility shall be located within 200 feet of a watercourse, lakebed, sinkhole or playa lake (NMAC 19.15.36.13).

National Pollutant Discharge Elimination System (NPDES) regulations require that communities meeting the definition of MS4 (40 CFR Part 122.26) obtain permit coverage for stormwater

discharges from their jurisdictions. Communities that meet the Phase I requirements (population above 100,000) or Phase II requirements (within an Urbanized Area as defined by the U.S. Census Bureau/population density of 1000 people per square mile) must submit a permit application to EPA. Communities that do not meet these population requirements can still be designated to require an NPDES permit. Clean Water Act regulations at Section 402(p)(2)(E) and (6) and NPDES regulations at 122.26(a)(9)(i)(D) provide for designation of stormwater discharges as a point source under the MS4 program which "contribute to a violation of a water quality standard, or is a significant contributor of pollutants to waters."

New Mexico is one of four states that do not have primacy of the NPDES program; thence, EPA writes all NPDES permits in New Mexico using federal Clean Water Act jurisdiction. This means waterbodies meeting the definition of Waters of the United States are the only waters that would trigger permitting requirements for sources proposing to discharge to them. Playas are included in the definition of Waters of the State, but not the definition of Waters of the United States. The current Waters of the United States rulemaking process will clarify which discharges in New Mexico will be covered by the NPDES program, and which will be exempt.

Regardless of the regulatory requirements, NMED encourages proactive approaches to looking at the impacts of stormwater runoff and also encourages the development of a Stormwater Management Plan (SWMP) to address source control and Best Management Practices to resolve pollution issues and to protect receiving waters.

TOOLS FOR CONSERVATION

Playa Education and Outreach

Playa Field Trips

In the early 1990s, Tish McDaniel, The Nature Conservancy, organized playa field trips in Curry County for public school students using Title II funding from the Department of Education. Staff from the NRCS service center in Clovis assisted with the field trips. These field trips focused on hands-on playa education for students of all ages, teaching playa ecology and the wildlife benefits of playas. The playa field trips ended in 2000, although some playa education was continued by a few interested teachers.

Playa Festivals

In 2010, Ogallala Commons, a small Texas-based non-profit, received funding from the New Mexico Environment Department's Curry County Playas Project to organize Playa Festivals for 5th graders in eastern New Mexico. Ogallala Commons has been holding Playa Festivals for elementary students and Playa Field Days for landowners in west Texas since the year 2000, but this is the first time these educational programs have been offered in eastern New Mexico. Playa festivals are normally a two-day event with a conservation education day targeted at landowners and teachers with students scheduled for future playa festivals. The conservation education programs educate landowners on the function and ecology of playas and the relationship to the Ogallala Aquifer. They also prepare teachers so that they can take an active

role in the upcoming playa festivals. The Playa Festivals bring in experts to do presentations covering subjects such as water conservation, the Ogallala Aquifer, playa plants, playa wildlife including invertebrates, waterfowl, and amphibians and reptiles. The festival concludes with a field trip to a local playa where the students can experience many of the playa ecology principles taught earlier in the day.

With support from NMED, Ogallala Commons held Playa Festivals at Clovis Mesa, Clovis Arts Academy, Grady, Portales, and Dora public schools in 2010 and 2011. Playa Festivals covered subjects including playa ecology, water conservation, aquifer recharge, and playa wildlife, in a combination of classroom and field settings. Although the Playa Festivals in eastern New Mexico were highly successful and greatly appreciated, finding alternative funding sources remains a challenge, and only a few of New Mexico schools were able to continue with the program. Dora Consolidated Schools was able to receive funding from Grasslans Charitable Foundation, a local non-profit, to continue Playa Festivals with Ogallala Commons. Ogallala Commons was recently awarded a Share with Wildlife Grant to fund six playa festivals in Curry, Roosevelt, and Harding counties in 2014. (http://ogallalacommons.org/).

Playa Decision Support System

The Playa Lakes Joint Venture (PLJV) and its partners have recently developed the Playa Decision Support System (Playa DSS), a GIS-based tool designed to maximize the conservation

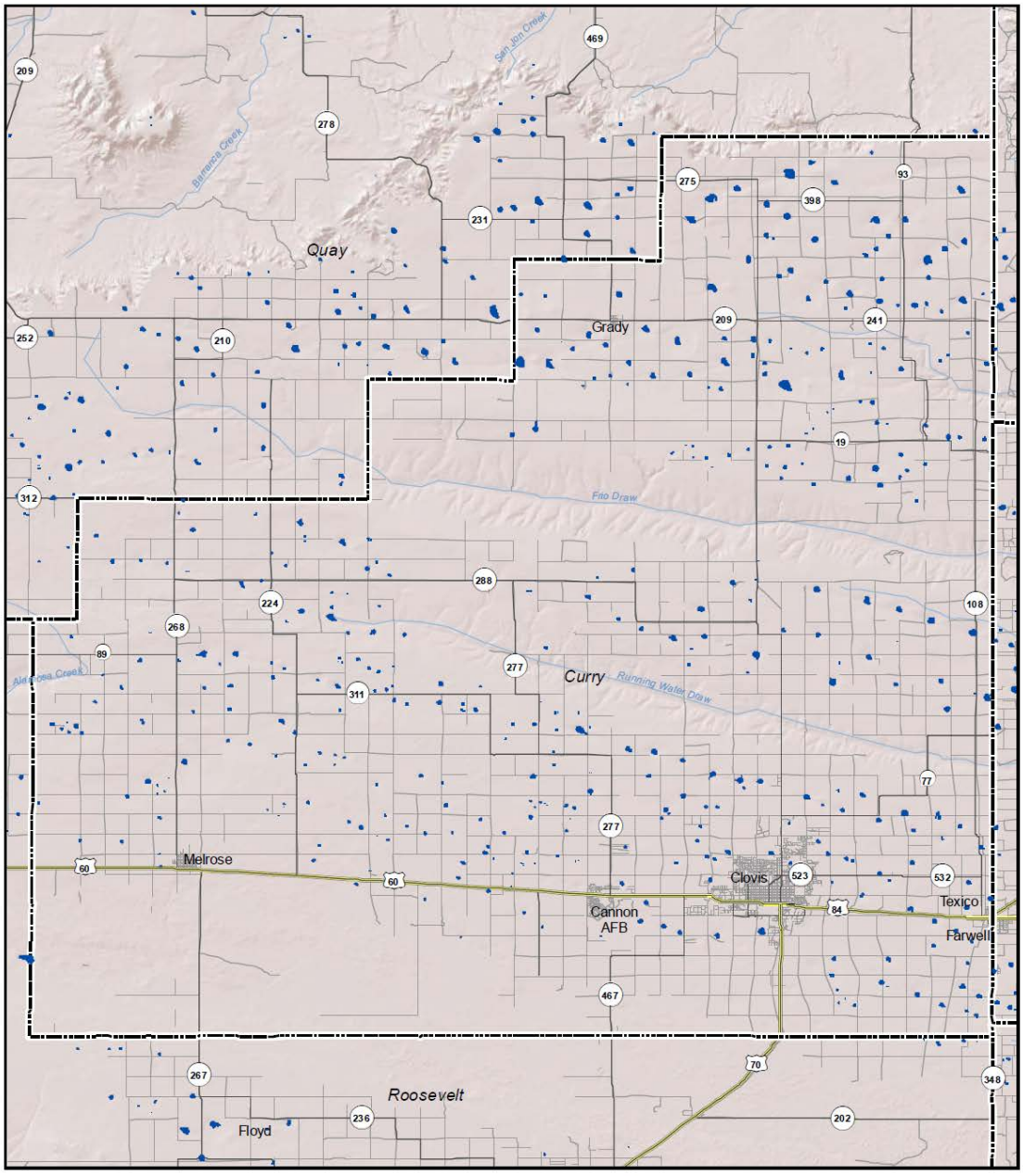
of playas by guiding land-use activities. The Playa DSS is designed to provide information to land managers and natural resource professionals in order to assist with decisions that may impact playa function and ecology within the playa lakes region of Oklahoma, Kansas, Nebraska, Colorado, New Mexico, and Texas.

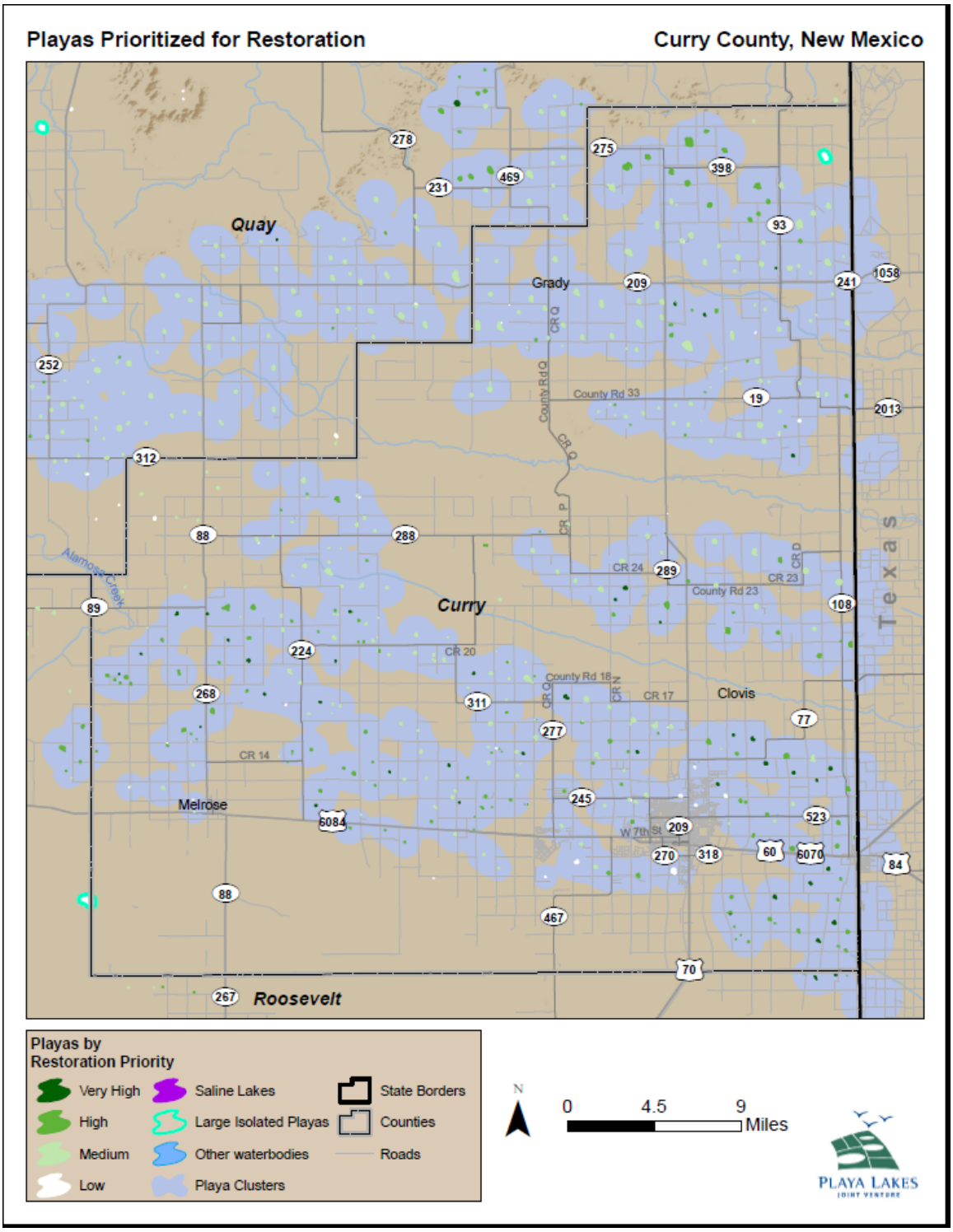
One of the goals of the Playa DSS is to prioritize individual playas based on ecological significance to serve as a guide for both conservation efforts and to predict ecological impacts from prospective land use. This information is designed to help conservationists target the most important playas for restoration and conservation and to assist developers in minimizing negative impacts to playas by avoiding critical playas for specific land use activities.

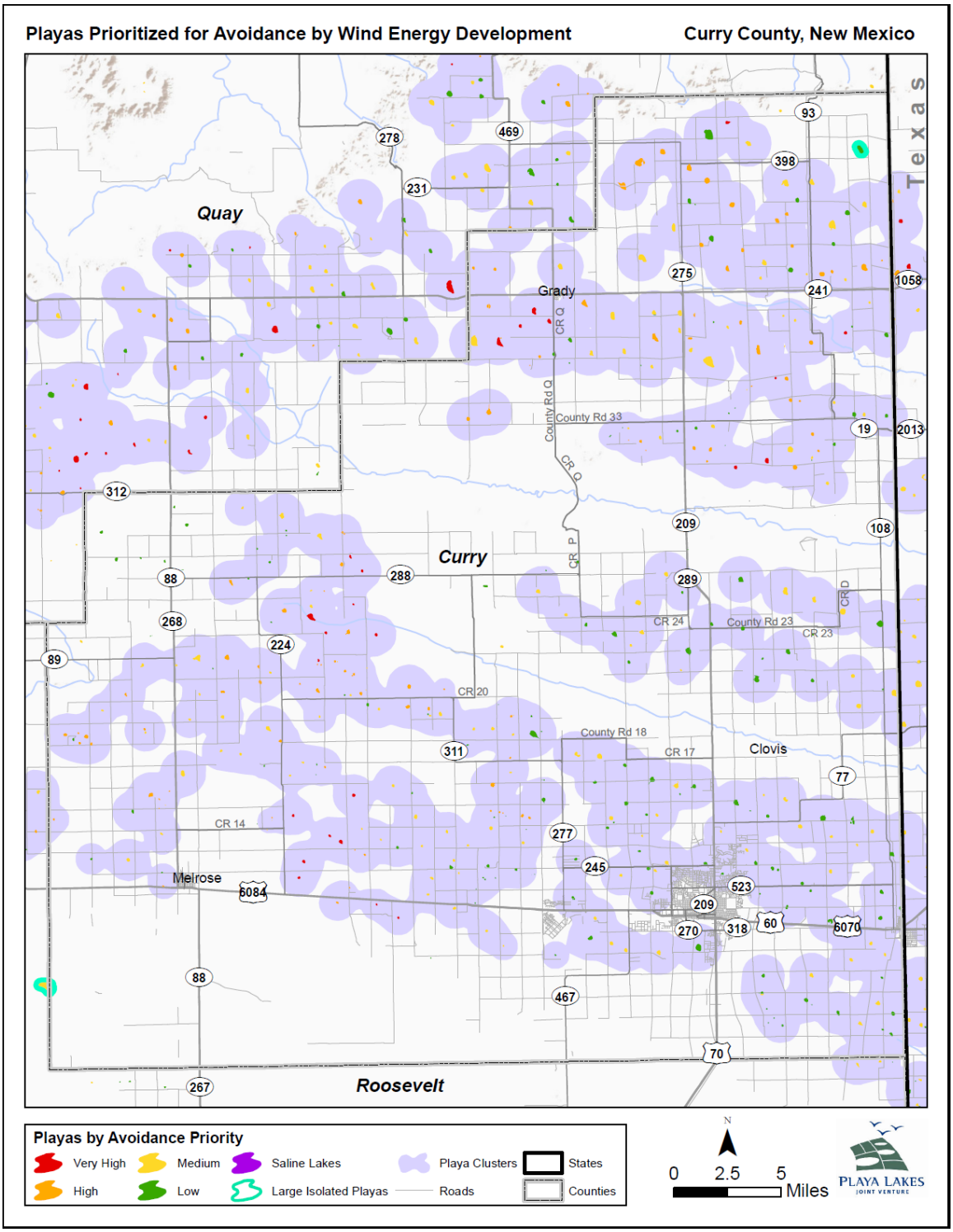
In addition to restoration priority, the Playa DSS also identifies large isolated playas, playa clusters, and saline lakes. Please see the following pdf copies of maps for probable playas, playa restoration priority, and playa avoidance priority for Curry County as examples of data provided by PLJV's Playa DSS. (http://www.pljv.org/playa-dss).

Probable Playas in **Curry County, New Mexico**

PLAYA LAKES JOINT VENTURE




Playas Prioritized for Restoration
Curry County, New Mexico
Quay
Grady
Curry
Roosevelt
Melrose
Clovis
Texas
Alamosa Creek
County Rd 33
County Rd 23
County Rd 18
CR 24
CR 20
CR 17
CR 14
CR Q
CR P
CR D
278
275
398
231
469
93
241
1058
209
252
19
2013
312
88
288
289
89
108
224
268
311
277
77
245
523
6084
270
318
60
6070
84
467
70
267
Playas by
Restoration Priority
Very High
High
Medium
Low
Saline Lakes
Large Isolated Playas
Other waterbodies
Playa Clusters
State Borders
Counties
Roads
N
0
4.5
9
Miles
PLAYA LAKES
JOINT VENTURE


Playas Prioritized for Avoidance by Wind Energy Development
Curry County, New Mexico
Quay
Curry
Roosevelt
Grady
Clovis
Melrose
Texas
County Rd 33
CR 20
CR 24
County Rd 23
CR 23
County Rd 18
CR 17
CR 14
CR Q
County Rd Q
CR P
CR D
278
469
231
93
398
275
241
1058
19
2013
312
209
108
88
288
289
268
224
89
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270
318
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6070
6084
467
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267
Playas by Avoidance Priority
Very High
High
Medium
Low
Saline Lakes
Large Isolated Playas
Playa Clusters
Roads
States
Counties
N
0
2.5
5
Miles
PLAYA LAKES
JOINT VENTURE

New Mexico Rapid Assessment Method (NMRAM) for Playa Wetlands

The Surface Water Quality Bureau of the New Mexico Environment Department is developing methods for condition assessment of wetlands in New Mexico. The SWQB is currently modifying and adapting their rapid assessment method (NMRAM) to accurately measure the condition of precipitation-driven playas of the Southern High Plains in eastern New Mexico. The NMRAM methodology will be validated through the collection of data from playa sites in 2015 and 2016. The resulting NMRAM Manual and Field Guide for Playas of the Southern High Plains will be available on line at http://www.nmenv.state.nm.us/swqb/Wetlands/NMRAM/index.html in late 2016.

This methodology will be transferred to agencies, stakeholders and other States through a two and ½ day "Texas/New Mexico Wetlands Across Borders" workshop, meetings of the New Mexico Wetlands Roundtables, two training sessions, and presentations at other venues. The New Mexico Environment Department Wetlands Rapid Assessment Web-Based Database (NMWRAD), will be updated to accept new data for playa wetlands.

Developing an assessment methodology to determine the condition of playas will assist NMED in prioritizing wetlands in need of restoration, help identify stressors that are causing degradation of wetlands, and will help development of methods for protecting playas including refining water quality standards that apply to playas.

PLAYA RESTORATION AND CONSERVATION PROGRAMS

National Resource Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides technical and financial assistance to agricultural producers and forest land owners who want to improve and protect the condition of soil, water, air, plants and animals. The EQIP program is a highly successful program that provides financial and technical assistance to implement structural and conservation practices that address natural resource concerns. The costs for these practices are typically shared by landowner and NRCS often with the landowner supplying for 25% and the federal government supplying 75%. Landowner requests are awarded based on a ranking process and availability of funds.

In 2007, Tish McDaniel of The Nature Conservancy (TNC) worked with local NRCS staff and the Central Curry Soil and Water Conservation District (CCSWD) to create EQIP practices to specifically address the conservation concerns of playas. These programs include funding for 3-year grazing deferral plans and other conservation practices. Playa EQIP programs are now in place at the NRCS local service centers in Clovis, Clayton, Tucumcari, Portales, and Lovington. Playa EQIP in Curry County has been well received and enrollment has been consistent.

Central Curry Soil and Water Conservation District's Curry County Playa Restoration Program

A substantial settlement was awarded as compensation for damages to natural resources that occurred at the Santa Fe Lake Superfund Site. As a result of the settlement, approximately $310,000 was awarded to the Central Curry Soil and Water Conservation District (CCSWCD) to be administered to protect and restore playa lakes within the boundaries of Curry County. The CCSWCD's Curry County Playa Restoration Program was designed to improve wildlife habitat and improve water quality at playa lakes and has protected a total of 17 playas in eastern New Mexico. Grazing deferral contracts for the playas run through the year 2017.

United States Fish and Wildlife Agency (USFWS) Private Stewardship Grant

In 2004, Tish McDaniel received a $150,000 Private Stewardship Grant from the USFWS for pit removal and invasive plant control on two playas. NRCS offered advice and assistance on the project.

United States Fish and Wildlife Service (USFWS) North American Wetlands Conservation Act (NAWCA)

In 2005, TNC was awarded a small NAWCA grant for $75,000 focused on playa restoration in eastern New Mexico. The project funded several erosion control structures and pit removal to address sedimentation issues and 10 years of deferred grazing for three playas in Curry County. The projects will continue until 2015.

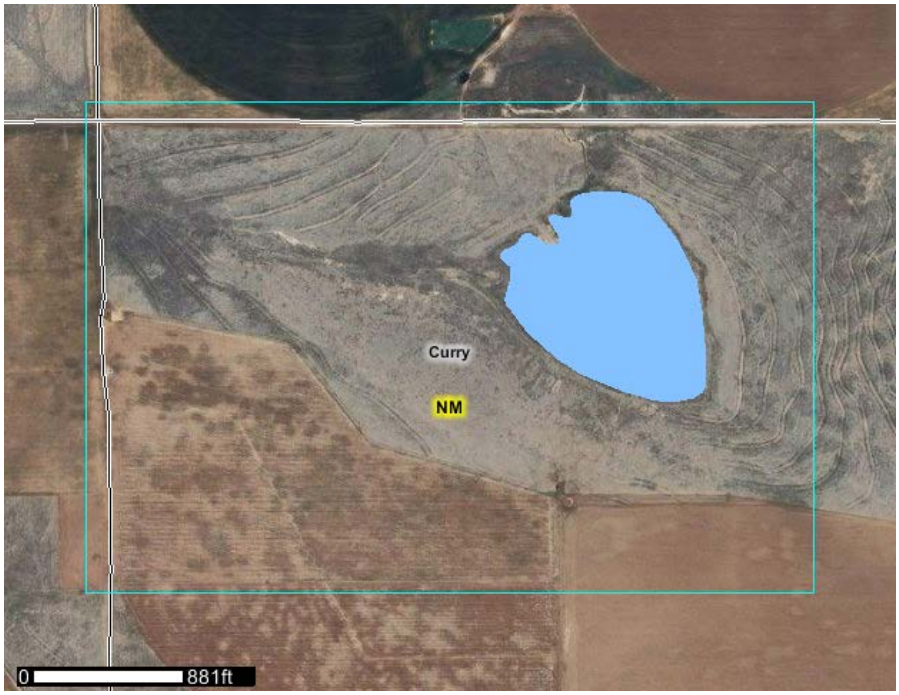
Jim Starbuck Playa
UTM 13S 0656314 3830388

This10.9 acre playa is located in central Curry County and is in good condition. There is CRP on North and South sides. Shorebirds were present at the site. It was enrolled into a 10 year NAWCA contract in 2009. The grant is paying for grazing deferment and restoration. Two arroyos were restored using rock and brush weirs to address erosion concerns and reduce sedimentation in the playa.

Construction of brush and rock weir structures at an arroyo feeding Jim Starbuck Playa in June 2009. The volunteers shown are area NRCS staff and TNC staff. The volunteers were organized as part of an NRCS staff training workshop.

Gary Starbuck Playa
UTM 13S 0658179 3829393

This playa is located in central Curry County and is in good condition. The playa bottom is 25.4 acres. Two arroyos were caused by road runoff and a misplaced culvert. The playa has a relatively small pit. It has provided for large numbers of waterfowl in the past. It is surrounded by cropland. There is a sediment plume entering playa. The playa is enrolled into a NAWCA program with 10-year grazing deferral contract and restoration. Brush and rock weirs were constructed in gullies to reduce erosion and sediment deposition in playa.



Construction of brush and rock weir structures at an arroyo on Gary Starbuck Playa in June 2009. The volunteers shown are area NRCS staff and TNC staff. The volunteers were organized as part of an NRCS staff training workshop.

Water flowing down arroyo on its way to Sours Playa after a large rain event on August 2010.

Construction of brush and rock weir structures at the arroyo just south of Sours Playa in September 2011. The volunteers shown are area NRCS staff and TNC staff. The volunteers were organized as part of an NRCS staff training workshop.

New Mexico Environment Department (NMED) Curry County Playas Restoration and Protection Project

This project utilized funding from the U.S. Environmental Protection Agency's (EPA) Clean Water Act Section 104(b)(3) Wetlands Program Development Grant. The NMED's Surface Water Quality Bureau (SWQB) and TNC have cooperated in this project focused on demonstration restoration techniques and conservation of playas in eastern New Mexico. The SWQB and TNC worked with private landowners to protect five playas in Curry, Quay, and Roosevelt counties. The project protected over 1,200 acres of playa wetlands and watershed upland by reducing sedimentation, improving water quality, and restoring playa function.

Restoration included implementation of Best Management Practices (BMPs) such as one-year grazing deferral, development of alternative upland livestock watering facilities, solar panel and pump installation for the upland water facilities, development of upland wildlife watering systems, invasive species treatment, and fencing to manage livestock around the playa. Other restoration techniques included pit restoration with appropriate soils in playa bottoms. A demonstration structure was designed for the Wood's Playa to spread concentrated flow back to sheet flow and reduce the development of an alluvial fan that was filling the playa from a poorly-sited road.

Landowners were also required to develop 10-year conservation plans with rangeland specialists from local NRCS service centers focusing on playa protection. Best management practices and conservation practices outlined in these plans include the following:

- **Prescribed Grazing** – grazing will be managed according to a schedule that meets the needs of the soil, water, air, plant and animal resources and the objectives of the resource manager. Grazing will be implemented in a manner which maintains a vegetative buffer to protect and improve playa water quality, reduce sediment load, and provide cover for wildlife. During years when water is present in the playa, grazing cattle in an alternate location is recommended. Maintaining and improving the ecosystem can be achieved by implementing a rest/rotation grazing schedule during the growing season with no more than 50% of the current year's growth removed by livestock or wildlife.
- **Wetland Wildlife Habitat Management** – Retain, create, or manage wetland habitat for water fowl, fur bearers, or other wildlife. Resource manager will use alternative water facilities for livestock watering to reduce impacts to playa water quality.
- **Herbaceous Weed Control** – Remove or control of herbaceous weeds including invasive, noxious or prohibited plants.
- **R and M of Rare or Declining Habitats** - Restore and conserve rare or declining native vegetated communities and associated wildlife species.
- **Upland Wildlife Habitat Management** - Create, maintain, or enhance area(s) to provide upland wildlife food and cover.

The five participating project sites highlight examples of each of these BMPs as noted in the following pages. A demonstration restoration technique and design was developed to restore impacts from a County Road on the Woods playa. The goal of this restoration technique was to restore a more natural hydrologic connection to the playa watershed and buffer without impacting the current road placement. This technique is discussed in further detail below.

Funding also went to support Playa Festivals for eastern New Mexico 5th graders organized by Ogallala Commons in 2010. These festivals were described in a previous section.

Mackechnie Horse Pasture, Quay County (UTM 13S 0648300 3862400). This 16.1 acre playa was in relatively good condition. A small pit on the southern end was filled with the excavated spoils after an NRCS Engineer deemed the soils appropriate. The landowner installed an upland livestock watering facility, a wildlife watering facility and the pipeline from current well to supply both of these sites. This entire pasture was fenced to exclude livestock from playa and playa buffer during appropriate times. The pasture was rested (deferred from grazing) for one entire year and placed into a 10-year Conservation Plan focusing on playa protection with the NRCS.

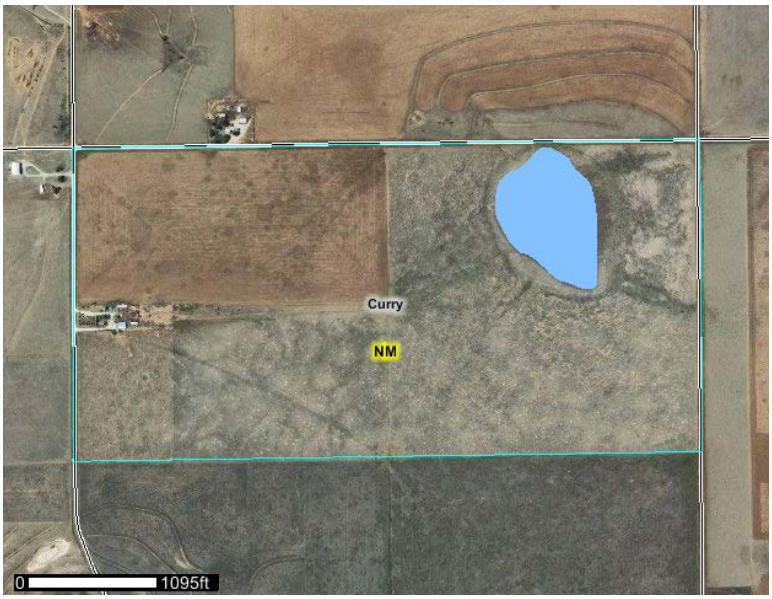
A wildlife watering facility upland of MacKechnie playa.

Miller Playa, Curry County (UTM 13S 0636000 3824900). This 9.5 acre playa is impacted by an erosional feature from the road to the east. The landowner developed an upland livestock watering facility including the addition of electrical lines to power the pump at a well. This entire pasture was fenced to exclude livestock from playa and playa buffer during appropriate times. The pasture was rested (deferred from grazing) for one entire year and placed into a 10-year Conservation Plan focusing on playa protection with the NRCS.

The erosional feature leading to this playa is an excellent candidate for future road impact restoration consideration.

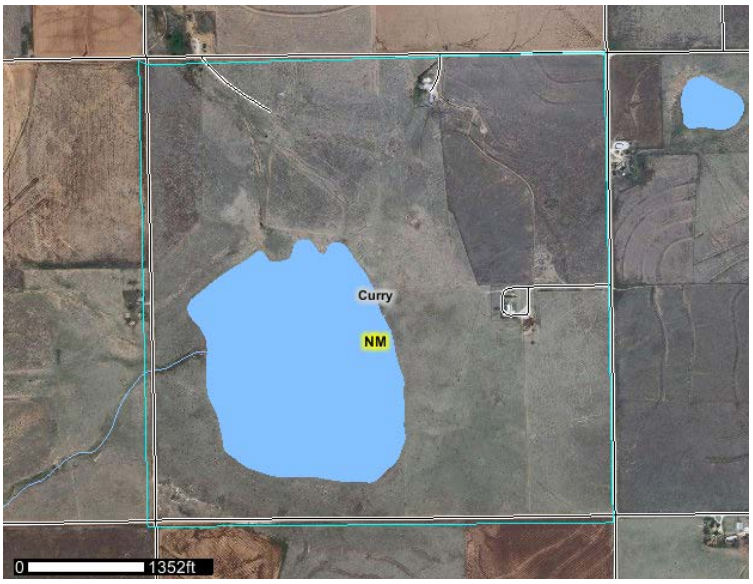
Tarver Playa, Roosevelt County (UTM 13S 0654150 3749525). This 13.0 acre playa near Dora, NM is in good condition and has served as a past site for local Playa Festivals. The landowner developed an upland livestock watering facility and installed solar panels and a pump to replace an existing wind mill at the well. Catclaw Acacia, *Senegalia greggii*, an invasive species, was treated in the playa upland. The pasture was rested (deferred from grazing) for one entire year and placed into a 10-year Conservation Plan focusing on playa protection with the NRCS.

Upland livestock watering facility and solar panels at Tarver property.



White Playa, Curry County (UTM 13S 0655000 3851200). This 16.1 acre playa contained a small pit that was filled with the excavated spoils after an NRCS Engineer deemed the soils appropriate. The surrounding upland including the playa buffer lacked vegetative cover from grazing impacts. The landowner installed fencing to exclude livestock from the entire pasture and deferred grazing for one year. An upland livestock watering facility was developed including pipeline installation from current well. The landowner placed the pasture into a 10-year Conservation Plan focusing on playa protection with the NRCS.

Playa pit restoration and livestock exclusion fencing at White playa.



Wood Playa, Curry County (UTM 13S 0665200 3866500). This very large 124.4 acre playa was impacted by a road crossing to the west. An erosional feature and sediment plume altered the natural hydrologic condition. An upland livestock watering facility with solar panels and well pump were developed. Cholla cactus were treated in the upland watershed. This entire pasture was fenced to exclude livestock from playa and playa buffer during appropriate times. The pasture was rested (deferred from grazing) for one entire year and placed into a 10-year Conservation Plan focusing on playa protection with the NRCS.
A demonstration design and treatment for the road impact was developed for this playa and discussed below.

Placement and construction of county roads were identified as a large impact on playa wetlands and their watershed. One of the properties in this project, Woods playa, contained a 124.4 acre playa that was impacted by a low water crossing on a county road. A watershed draw that entered the playa began on an adjacent property, crossed a low water crossing on a County Road, and ended in the playa bottom. The County Road caused increased erosion on the downstream (playa) side of the road. This erosional feature was channelized at some point creating a straightened ditch that held surface water and deposited sediment in an alluvial fan in the playa. The ditch and sediment plume restricted the flow of water to the playa bottom and held surface water in the ditch for an increased period of time. Reineke Construction, in partnership with Zeedyk Ecological Consulting, were contracted to develop a demonstration restoration design and implement an innovative technique that would address the excess sediment in the playa and the restriction of surface water input to the playa, minimize the amount of surface water held in the ditch, while not impacting the current County Road low water crossing. The design utilized the excess sediment in the playa as fill for the channelized ditch, leveling the ground surface of the buffer around the playa. The ditch was split into two "wings" that leveled incrementally to the buffer surface level with a "media luna" made of rock at the end point of each wing. The "media luna" acts upon the water to slow velocity and spread the water over a larger surface area, allowing the water to flow over the buffer zone and enter the playa bottom as it would in an unaltered watershed. Ground surface levels and photos of the area were taken before, during, and after restoration implementation by the contractor. Permanent surface level and photo point monitoring points

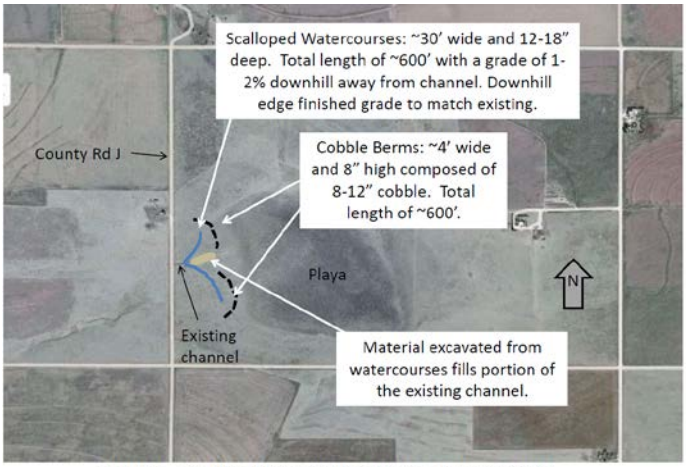
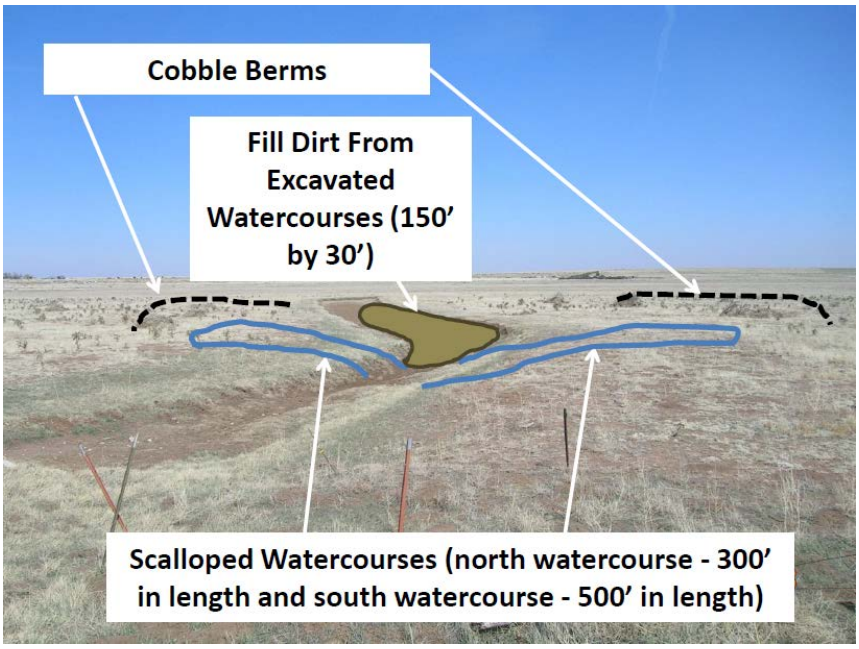


Figure 1. Overhead Image with Prescribed Treatments

were installed for future monitoring of the project area. As of June 30, 2013, there had not been a significant flow event in the project area.



Wood Playa – erosion control restoration design diagram – courtesy of Reineke Construction LLC

Wood Playa erosion control project - cobble berm in foreground with southern watercourse in background.

Increasing Playa Conservation in Eastern New Mexico

With funding from Playa Lakes Joint Venture and ConocoPhillips, The Nature Conservancy (TNC) organized four playa workshops taking place at landowner's playas in Curry, Quay, Roosevelt, and Lea counties in July 2013. The workshops were designed to increase landowner awareness of NRCS easement programs for playas and to emphasize the need for playa conservation. NRCS District Conservationists and State Resource Conservationist led presentations on NRCS easement programs to producers and NRCS staff. Local experts gave presentations on subjects including the decline of the Ogallala Aquifer, aquifer recharge from playas, playa wildlife, conservation easements, and easement tax incentives. The workshops were attended by 70 landowners and NRCS staff and discussions between presenters, NRCS staff, and landowners were constructive. Many of the attendees were not aware of the existence of these programs and many were quite unfamiliar with the fundamental aspects of conservation easements and land trusts.

Even though considerable playa education has taken place in the past, landowners continue to inform us that they are still learning about playa science and the benefits to native wildlife and the aquifer. Landowners have also let us know that the conservation benefits of playas continue to be a major factor in their decisions to enroll in conservation programs and that they are not strictly motivated by economic incentives. More playa workshops and benefits information provided to playa landowners will result in increased playa conservation using NRCS easement programs.

PLAYA ACTION PLAN STRATEGY

Currently there are many data gaps surrounding the playas of Curry County. It is estimated that at least 80% of the playas are currently mapped and inventoried by the National Wetland Inventory and the Playa Lakes Joint Venture. The availability of these geospatial data greatly assists with future restoration and protection endeavors. However, there is much information that needs to be gathered in order to move forward with restoration activities in Curry County.

Playa Condition Assessment

An assessment of the overall condition of playas in eastern New Mexico is the logical first step in planning conservation and restoration of playas in Curry County. Although recent research indicates that at least 90% of the playas in the Southern High Plains have already been negatively affected by human activities (Haukos and Smith 2003), the relative condition of eastern New Mexico playas remains poorly understood.

The overall condition of playas in eastern New Mexico is important information for use by area resource managers to understand funding needs of the area. Furthermore, individual condition of playas is critical in understanding which playas to focus conservation measures, which playas need restoration, and which playas may be too severely impacted for practical restoration methods to be effective. Also, Curry County is one of the best locations to study the effects of different agricultural land uses on playa condition. The eastern part of the county is dominated by cultivated agriculture while the western side is dominated by rangeland.

For these reasons, efforts such as the New Mexico Environment Department's New Mexico Rapid Assessment Method (NMRAM) should be fully supported by local and regional stakeholders. The NMRAM will likely be an excellent complement to the Playa Lakes Joint Venture's Playa Decision Support System, and will provide another useful tool with which to guide efficient playa conservation and restoration.

Threat Identification and Minimization

Rural Playas

As mentioned in earlier sections, sedimentation is probably the single largest threat to properly functioning playas on the Southern High Plains (Luo et al. 1997, Smith 2003). Excessive sedimentation is often the result of anthropomorphic causes such as poorly-designed county road construction and maintenance, sediment deposition from nearby farm fields, and increased runoff from urbanization.

The construction of roads using materials such as asphalt, caliche, chip-seal, and compacted soil all lead to decreased water infiltration and increased runoff. The increased runoff normally is channeled in ditches adjacent to the roadway and directed to playas. This creates point-sources for erosion leading to playas and increases the water flow the playas would normally receive. In playas near roads, this often results in the formation of erosional features that deposit huge sediment loads to the playa basin. This sedimentation would not occur with normal sheet flow on native rangeland. Many roads in Curry County were constructed near, and in many cases, directly through playas, severely impacting playa function. Playas should be avoided in the construction of future roads. For existing roads in close proximity to playas, efforts should be made to disperse stormwater gradually at multiple points in order to reduce erosional features created by excessive water flow.

Alternative road construction and drainage should be researched and explored in conjunction with the Curry County Roads department, and the New Mexico Department of Transportation. Funding may be available to develop a Best Management Practice (BMP) for use in road construction that will maintain sheet flow across the playa watershed without impacting roadways.

For rural playas surrounded by farmland, the threats of sedimentation and contamination from pesticides and fertilizers are often greatly increased due to the lack of vegetation cover at certain times in the cropping system. To protect cropland playas from excessive sedimentation and contamination, it is recommended that the playa be protected with a vegetated buffer. Generally, buffers of 10–60 m wide are required to reduce most sediments, while buffers of 10–90 m wide are generally required for reducing nutrients (Melcher and Skagen 2005).). Erosional features such as ditches and headcuts, and sedimentation features such as alluvial fans filling a playa basin, should be addressed by installing the appropriately designed erosion control structures in suitable sites, and sheet flow and sediment dispersal structures that prevent entry of sediment plumes into the playa basin. Such structures may provide only temporary protection, however, if the source of the sediment load is not addressed. The high registration in NRCS Equip programs in Curry County suggest that local landowners are willing to participate in a buffer zone management system. Creative strategies to continue to utilize NRCS funding (EQIP and

WRP) should be developed and disseminated to local landowners on a regular basis. New and proven erosion control techniques and sediment dispersal systems should be adopted by the NRCS so that landowners are eligible for funding to install these innovative and successful techniques.

Livestock grazing practices in pastures containing playa wetlands should be managed in a way that leaves a sufficient vegetated buffer around the playa bottom to filter sediment and other contaminants from reaching the playa. The use of upland watering facilities that discourage cattle from trailing through and over-grazing the playa will decrease the impacts of sedimentation from erosive downcutting through cattle trails and compaction of soils through trampling. NMED in conjunction with the NRCS has developed 10 year Conservation Plans for livestock management that offer improved vegetative buffer, exclusion of cattle from playas during migratory waterfowl use and when surface water is present, and overall better management of the playa watershed. More Best Management Practices (BMPs) for livestock pastures need to be developed and improved that provide conservation and restoration strategies for use on private lands.

Restoration practices to minimize or mitigate impacts from roads and livestock trails have been developed by the local NRCS, such as rock and brush weir structures. An innovative technique developed to mitigate a sediment plume and erosional feature due to road crossings was utilized on John Wood's playa. That technique's development, design, and implementation are included as an attachment to this plan. Techniques such as these should continue to be developed in conjunction with roadway planning and drainage improvements to produce cost-effective ways for private landowners and road planners to deal with these impacts. In addition, most impacts cross landowner property boundaries. So to fix an impairment on one property may not fix the problem at its source. Incentives should be developed by NRCS and other agencies and funding entities to entice landowners, counties, the NMDOT , conservationists, and others to be required to work together in order to be eligible for restoration programs and funding.

Urban Playas

Urban playas are often utilized as key components of stormwater management systems in cities within the Southern High Plains. The relative impermeability of city streets, driveways, and parking lots creates large of amounts of stormwater. This greatly increases runoff to playas, often turning them into permanent lakes. Some playas are excavated in order to increase capacity for stormwater catchment. Many urban playas even have concrete ditches and structures that direct stormwater to playas.

When considering infrastructure development and wetland protection, the first approach is to avoid direct or indirect impacts to the wetland. Many communities are developing infrastructure that tie-in stormwater systems and waste water treatment plants. The latest technology in waste water treatment can reclaim water that is suitable for public water supplies. In the drought-prone area of Curry County and the depletion of the Ogallala Aquifer, this option should be researched and considered. The development of infrastructure of this type can be quite expensive. However, with little other options for water resources in the area, it may become quite viable for future development and sustained agricultural practices. The New Mexico Environment

Department has several programs that can assist with research and funding including the Construction Programs Bureau, the Stormwater section of the Surface Water Quality Bureau, and the Drinking Water Bureau. (http://www.nmenv.state.nm.us/water.html).

The next option for infrastructure development is to minimize impacts to wetlands to the maximum possible extent. Without any effective vegetative buffers to filter contaminants, common urban pollutants such as heavy metals, hydrocarbons, pesticides, fertilizers, and automotive chemicals are delivered directly to the playa. As playas are the primary source of recharge for the Ogallala Aquifer, this could lead to contamination of the region's only water supply.

To reduce the possibility of contamination, it is highly recommended that vegetated swales be used to help filter contaminants out of stormwater before it is allowed to enter the playa. The use of vegetated swales and adequate vegetated buffer areas would likely reduce the impacts of urban pollutants, improve water quality, and protect the integrity of the Ogallala Aquifer. A well-designed wetland buffer would provide additional wildlife habitat, and improve the aesthetics of urban playas. It is recommended that the use of vegetated buffers, constructed wetlands or flow dispersal designs should be implemented into current stormwater catchments systems and utilized in the design of future projects. (http://water.epa.gov/scitech/wastetech/upload/2002_06_28_mtb_vegswale.pdf).

There are currently innovative techniques being developed across the country to contend with urban stormwater issues and aquifer depletion. The City of Clovis is in an opportune position to utilize this research and develop innovative techniques for stormwater management and aquifer recharge technologies.

State Managed Lands

Parcels of land owned and managed by the State Land Office are utilized for a variety of land uses. The BMPs in place for livestock grazing, hunting access, and oil and gas development need to be reviewed and considered in the prioritization of playa restoration and conservation activities.

While there are regulations in place determining the siting of waste facilities and pits in association with the oil and gas industry, one of the largest impacts to the playas in Lea County appears to be related to the siting and sheer number of pipelines interrupting the playa watershed and it's hydrology. In many oilfield areas, the release of excess H_2S is often situated within a playa watershed. This gas settles into the low lying playa areas and may have impacts on the native flora and fauna of the playa, as well as humans.

The Local Water Plan

The Eastern New Mexico Water Utility Authority (ENMWUA) consists of the City of Clovis, Elida, Grady, Melrose, Portales, Texico, and the counties of Curry and Roosevelt. The ENMWUA was developed to address the drinking water needs of these areas in to the future. One of the main goals of the future water plan consists of a pipeline from Ute Reservoir to these

areas in order to obtain 16,450 arce feet of surface water from the reservoir. The pipeline comes at an estimated cost of $550 million and is presently estimated to take 20 – 30 years to complete.

The intent of this pipeline is to supplement current water supplies. However, it is still assumed that the primary water supply for these end users will remain the ground water supply. The City of Clovis is currently working with local stakeholders to develop a Llano Estacado Water Conservation Initiative (LEWCI) to establish a Critical Water Conservation Area Northwest and West of Clovis, NM. This proposed area has over 16,000 acres currently under sprinkler irrigation with more than 100 playa lakes.

The proposal is currently being submitted for NRCS Regional Conservation Partnership funding. The proposal offers funding incentives to local landowners to conserve the remaining aquifer (defer irrigation) and restore playa lakes as a recharge source for the aquifer.

These two entities, ENMWUA and LEWCI, provide a great opportunity to re-engage stakeholder involvement in this Wetland Action Plan and to improve the direction and future opportunities for playa protection, conservation and restoration.

Restoration and Conservation

Playa condition assessment and identification of threats are important factors to help guide decision making on playa conservation and restoration. PLJV's decision support system may help inform resource managers as well as prioritize the importance of playas based on size and clusters for their importance as habitat for migrating waterfowl. It should be noted, however, that the habitat connectivity of playas based on use by waterfowl is unlikely to be relevant to the utilization by other wildlife such as native amphibians.

Another factor to consider is the current Lesser Prairie Chicken listing as Threatened under the Endangered Species Act. The Llano Estacado is considered important habitat for this bird species and is also under high pressure for energy development by the Oil and Gas industry and Wind Energy industry.

Ideally, all playas should be conserved to preserve their important natural functions and ecosystem services. However, especially in urban settings, this is not always possible. Many urban playas may have already been impacted so greatly, that restoration to natural condition is not economically feasible. Current use requirements such as the need for stormwater catchment will eliminate many urban playas from consideration as restoration projects. Some urban playas that are in relatively good condition may be excellent candidates for conservation and restoration if they have not been fully utilized for stormwater catchment and the threat of large-scale impacts is not imminent. Such playas may be good prospective sites for recreational opportunities. Selection criteria should include factors such as present condition, ecological importance, future threat outlook, cost of restoration, likelihood of successful restoration, educational potential, recreational importance, and specific use requirements.

Identification of Funding Sources

For most restoration or conservation projects, outside funding sources will need to be utilized. While some programs such as EQIP have provided a relatively stable funding source for rural playas, most programs and grants are constantly changing as far as funding and availability, and the list of possible funding sources in this document is far from complete. Urban playas will likely have very different conservation objectives and therefore very different funding opportunities than rural playas. Representatives of the funding agencies may be helpful in supplying the latest information on current grants and programs available to playa landowners and stakeholders. The Playa Lakes Joint Venture is an excellent resource for both learning about the latest playa science and possible funding opportunities. Non-profit conservation organizations such as The Nature Conservancy and Ducks Unlimited may also be able to offer funding advice for playa conservation. Attending Prairie Partnership Meetings and requesting updates on potential funding sources from agencies and conservation groups ensures that the word gets out on current funding opportunities and incentives.

Outreach and Education

Although funding is necessary for large-scale restoration and conservation of playas, landowner attitudes should not be underestimated in the role they play in the conservation of resources. Landowners with an interest in playa conservation often implement management practices that improve wildlife habitat and function of playas without any economic incentives. Playa education has been an efficient strategy for informing students and adults and even influencing public opinion.

Even though considerable effort has been expended in outreach and education on playas, there is still much work to be done. In comparison to other wetlands, playas are often overlooked, underappreciated, and poorly understood, even by playa landowners. Possibly because of their ephemeral nature, playas are often not noticed except when filled after rare, large rain events. The important part that playas play in supporting native wildlife and migrating waterfowl is just starting to be fully appreciated. The critical role of the playas in the recharge of the overburdened Ogallala Aquifer has just recently been recognized and is in need of future investigation.

Educational programs such as Ogallala Common's Playa Festivals have been highly successful and should continue to be funded. Funding for programs such as these remains problematic, although local industry may be willing to support targeted conservation education efforts at local public schools. Also, maintaining support for these programs through outreach to educators is essential as school systems always struggle with finding time to allocate to non-traditional learning opportunities.

The use of urban playas for recreational purposes is also an excellent opportunity for outreach and education. An excellent example is Clovis' Goodwin Playa Park. Since it opened in 2011, the trails around Goodwin Playa have been extremely popular with residents looking for an opportunity to walk in a natural setting at a convenient location in the center of the city. With trails centered around a playa lake and a black-tailed prairie dog colony, the location would be an

excellent opportunity to provide educational opportunities through the use of informative signs and perhaps a covered view area for birdwatchers and prairie dog enthusiasts.

Conservation education may be the key to long-tern significant playa conservation and restoration. The significant ecosystem services that are provided by playas as wildlife habitat and aquifer recharge are critical to life on the southern High Plains. The goal of playa education should be to increase awareness of the importance of playas in order to promote the protection of this critical natural resource.

POSSIBLE FUNDING SOURCES

U.S. Environmental Protection Agency (EPA)
• Five-Star Wetlands Restoration Grants

U.S. Fish and Wildlife Service
• Partners for Fish and Wildlife Program in New Mexico
• North American Wetlands Conservation Act (NAWCA)
• Private Stewardship Grant

Natural Resources Conservation Service (NRCS)
• Conservation Stewardship Program
• Grassland Reserve Program
• Wildlife Habitat Incentives Program
• Environmental Quality Incentives Program
• Conservation Reserve Program
• Wetlands Reserve Program
• Farm and Ranchland Protection Program

New Mexico Department of Game and Fish (NMDGF)
• The Landowner Incentive Program
• Private Land Entry and Sportsmen Enjoyment Program
• Habitat Stamp Program
• Share with Wildlife Program

U.S. Department of Transportation (USDOT)
Federal Highway Administration (FHWA)
• Transportation Enhancement Funds
• Federal-Aid Eligibility of Wetland and Natural Habitat Mitigation

New Mexico Environment Department (NMED)
Surface Water Quality Bureau (SWQB)
• Project funding supported by awards to the SWQB Wetlands Program through CWA Section 104(b)(3).

Playa Lakes Joint Venture
• State Capacity Grant
• Conoco Phillips Grants

Wildlife Conservation Society (Foundation)
• Wildlife Action Opportunities Fund

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